Development of an interactive multimedia research information system for the archival of the music and culture of the Sliabh Luachra area

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DEVELOPMENT OF AN INTERACTIVE MULTIMEDIA RESEARCH INFORMATION SYSTEM FOR THE ARCHIVAL OF THE MUSIC AND CULTURE OF THE SLIABH LUACHRA AREA

MARTINA O'NEILL
Development of an Interactive Multimedia Research Information System for the Archival of the Music and Culture of the Sliabh Luachra Area

A thesis presented for the M.A. (I.S.M.) Degree of the National Council for Education Awards

by


Supervisor: Ms. Brigid Crowley

Submitted to the National Council for Educational Awards, July 2000
Development of an Interactive Multimedia Research Information System for storing the Music and History of the Sliabh Luachra Area

by

Martina O’Neill

ABSTRACT

We are living in a world where communication is introducing much multiculturalism into society. Irish music is being mixed with music from all different cultures creating a worldwide acceptable type of ‘Irish Music’. As a result we are losing our true culture which is rooted in the Irish music and dance.

This primary focus of this project was to set up an archival system to store the music of the Sliabh Luachra area. The music of the Sliabh Luachra area is a rich and rare heritage and was influenced greatly by the music of Pádraig O’Keeffe, a renowned fiddle master from that area. O’Keeffe’s music and life is looked at, and his music tablatures are examined and converted to standard notation. The projects follows on to examine the different methods used to store images, text, video, and sound, all which are elements of multimedia. MIDI (Musicial Instrument Digital Interface) is examined and assessed on its ability to create sound samples of the music of Sliabh Luachra. Finally, Web development software is used as the User Interface for the archive due to the greater move by society to information dissemination over the Web environment.
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All the staff of the Scartaglen Heritage Centre

Mom and Dad whose love and support I cherish

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Eddie whose patience and encouragement is admirable

To my friends Deirdre, Aine, Sheila, Marguerite, and Ciara, whose friendship I treasure

And to all my musical friends who provided me with information and great music throughout the last few years
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CHAPTER ONE
1.1 INTRODUCTION

This project involved the development of an Interactive Multimedia Research Information System for the music and culture of Sliabh Luachra. Although broadly defined, it shows how many different disciplines interact to form a composite discipline. For example, many aspects such as database development, multimedia technology, market research, music and sound technology, web page development and Irish traditional music are all encompassed in one project.

This chapter describes the background of the author, the origins of the project and its goals. It also outlines the advantages and disadvantages of the system for archiving the proposed outlined.
1.2 BACKGROUND

Being a musician and dancer, a deep love of the Irish culture has directed me in many paths throughout life so far. While studying at college I constantly found new ways to integrate this fondness of the true Irish tradition with my Business and Information Technology life. It was a mixture of this involvement in both technology, business and music that lead me to this research proposal, which as mentioned above shows how no discipline is separate from another.

Many believe that because of today’s technological environment, we are losing our true culture. People no longer want to stay in rural areas with no televisions, computers, etc. Because of the continuous broadcasting of television and radio programmes from different countries, it is leading to monoculturalism. As a result, we are perhaps losing our true, rural culture. Despite this, I believe that modern technology is a means we can use to preserve our heritage.

For this reason, a multimedia archive containing the music of Sliabh Luachra has been developed. Although confined to one area for the purposes of this project, the archive template is adaptable to any area wanting to preserve its music and culture.
1.3 GOALS

The objectives of this project are as follows:

- To look at the use of multimedia technology as a means of archiving the music and history of Sliabh Luachra, Co. Kerry.

- To translate the music tablatures of Pádraig O’Keeffe to standard music notation using suitable software.

- To develop a Multimedia Information System, with a Graphical User Interface developed using a Web browser, for use by members of the public who are both computer literate and not computer literate.

1.4 CONTENTS OF THE ARCHIVE

This archive deals with Traditional Irish Music, and has been confined to the music of the Sliabh Luachra area, an area situated between the Cork, Kerry, and Limerick borders. (See Appendix 1 for map of the area.) Although the archive contains a great deal of information about the Sliabh Luachra musicians and singers, its main focus is on the music of Pádraig O’Keeffe, a renowned fiddle master of this area. It contains samples of O’Keeffe’s tablatures and also shows these tablatures translated into standard notation. Video clips of two musicians are included as examples of how video can be incorporated into the archive. Photographs of many musicians are also included. This archive is a valuable part of the historic culture of the Sliabh Luachra area.
1.5 PROJECT HISTORY

This project came about as a result of the development of a Heritage Centre in Scartaglen, Co. Kerry. A lot of information on the history and music of Sliabh Luachra had been collected but the committee of the Heritage Centre identified the need for a computerised system that could store a copy of all this information electronically.

The main focus was on the music of Pádraig O'Keeffe, a fiddle player from this area. O'Keeffe's playing technique was as influential to musicians of Sliabh Luachra as Michael Coleman's (fiddle player from Sligo) was to the people of Sligo. O'Keeffe wrote his music in his own individualistic method – in tablature form. Much of this tablature music has been collected, but it is of no use to musicians who do not read this form of music.

It was decided that the Heritage Centre needed an Interactive Multimedia Information System that would act as a form of archive for all the material. If people needed information, it would be available in computerised form and thus the original versions of manuscripts, etc, would be stored for preservation. Thus, the task of this research was to translate these original manuscripts to standard notation. Ten examples are given in the archive.

The music tablatures of Pádraig O'Keeffe were converted to standard notation using special software available. This new notation was stored as individual files and later imported into a database. Some of O'Keeffe's tablatures can now be seen alongside the standard notation read by many musicians. (See Appendix 2)
Chapter 1 - Introduction

1.6 IMPORTANCE OF THIS PROJECT TO SCARTAGLEN AND SLIABH LUACHRA

Scartaglen is located in the heart of the Sliabh Luachra area that has a rich traditional music heritage and was and still is the home of many of Ireland's famous and legendary musicians, singers, story tellers and poets. Every August Bank Holiday weekend a Féile Cheoil is held in Scartaglen. Hundreds of musicians from all over the country visit and play music with the local legends such as Maurice O'Keeffe, Johnny O'Leary, Mikie Duggan, Pádraig Moynihan, and Denis McMahon. Music workshops are held at this event and dancing competitions and music sessions also take place. The Féile Cheoil began in 1967 and has taken place every year since then. Sliabh Luachra is also home to the renowned poet Seán Rua Ó Suilleabháin and Aogán Ó Rathaille.

In the centre of Scartaglen Village there is a monument in memory of the famous fiddle master Pádraig O'Keeffe who died with a thousand memories and left a rich culture of music. Across from this monument a Heritage Centre has been built. (See Appendix 3)

Thus, from the strong history of Scartaglen and Sliabh Luachra, this project will be of benefit to both the local community and to the public who want easy access to information on the area.

1.7 COLLECTION OF INFORMATION

Much of the information in the archive has been collected by members of the Scartaglen Heritage Centre who went from house to house gathering materials and carrying out
interviews with the people of the Sliabh Luachra area. Other data was obtained from newspapers, books and from personal accounts of visitors to Sliabh Luachra.

1.8 FUNCTIONS OF THE ARCHIVE

The Archive has four functions:

1. **Collection:** Acquiring published and unpublished material and information about the culture and music of Sliabh Luachra and Pádraig O’Keeffe.

2. **Preserving:** Recording the information in a database along with short video clips and photographs. The music tablatures of Pádraig O’Keeffe are also included with the translations to standard notation.

3. **Organisation:** Organising the material in a database and referencing it in a manner that is easily attainable by members of the general public.

4. **Dissemination:** Making the information available to members of the general public, students and researchers carrying out projects on the area, other musicians and historians. This will be done through the new Heritage Centre in Scartaglen, Co. Kerry.

1.9 PREVIOUS ARCHIVAL METHODS

Before the development of this archive the material was simply kept in peoples’ houses, in attics, old sheds, under mattresses, etc. Thus, no formal method of archiving this material had been developed in the Sliabh Luachra area.
1.10 WHY USE AN INTERACTIVE MULTIMEDIA INFORMATION SYSTEM?

An Interactive Multimedia Information System has many benefits to a Heritage Centre and its staff.

1. An Information System is a means of information storage. Thus, all originals such as handwritten letters, manuscripts, stories can be stored away and not damaged as the material can be seen on the computerised database.

2. Multimedia software presents information with text, photos, illustrations, narration, music, animation, and film clips which thus ‘stirs the imagination’. [Capron 1998] With the material being presented in a glossy, attractive manner it attracts more people to use it. As the system is developed for use even by computer illiterate people it should attract many to use it and enjoy the amount of information stored on the system.

3. Old music, such as the tablatures of Padraig O’Keeffe, were notated using FINALE, a music software program. This enables those interested to see both the old version of the music and the regular music notation on one computer screen.

4. MIDI, Musical Instrument Digital Interface, allows us to record music and have it played back so that people can hear the music as well as see it.

5. Results of a search for information in the database are immediate. People searching for archive material do not have to sift through reams of papers and boxes to get a hold of information they need.
6. A counter to check the number of people who have searched the Information System enables the Heritage Centre to gather statistics on the number of people who looked for, or were interested in the history of Sliabh Luachra.

1.11 CHAPTER CONTENTS

This thesis looks at the different stages and methods used in developing the archive.

Chapter Two looks at the history of Irish Traditional music and why the music of Sliabh Luachra is so rich in culture. This chapter also looks at the music tablatures of Pádraig O’Keeffe and why O’Keeffe was so important to Sliabh Luachra.

Chapter Three focuses on the multimedia aspect of the archive. Different multimedia types are discussed including graphics, video, text, and sound. Finally, it looks at the World Wide Web, how to develop a graphical user interface for the web and TCP/IP (Transmission Control Protocol/Internet Protocol), the language governing communication between computers on the internet.

Databases are the primary tool used for information storage and retrieval. Chapter Four addresses the design and development issues encountered in developing the Sliabh Luachra archive.

Chapter Five introduces sound and how we record and digitise sound. The focus of this chapter is on MIDI (Musical Instrument Digital Interface) which is a method of representing musical performance information as electronic data. The chapter proceeds to look at what
MIDI is and why MIDI was chosen to produce sound samples of the music of Sliabh Luachra.

Finally, Chapter Six looks at the research that was carried out before developing the archive in order to determine what information was available to fill the archive. Following this the chapter focuses on the primary research carried out to establish what information the public would want to see in the archive.

Chapter Seven concludes the project and looks at some future recommendations for further developing the system.
CHAPTER TWO
CHAPTER TWO

IRISH TRADITIONAL MUSIC

"There is one compelling reason why we should know our own music: it is our own"

Breathnach, Brendán 1993

2.1 INTRODUCTION

This chapter gives an introduction to Irish music and its history. It delineates the history of the music of Sliabh Luachra, where it originated, and how Pádraig O’Keeffe contributed to the music of the area.

2.2 THE ORIGINS OF IRISH MUSIC

Irish music goes back to ‘ancient’ times where the music was mentioned in an Irish mythological account of the origins of the three categories of Irish music, the ‘suantrai’ or lullabies, the
'geantraí' or joyful airs, and the 'goltrai' or laments. During this time the harp had the pride of place among musical instruments, with the harper being the most cherished of musicians. The harp became a symbolic symbol for Ireland as can be seen from the Irish coinage.

Originally Irish music was very much an accompaniment to Irish dance with the bagpipe being the most popular instrument. Bagpipers and harpers were the principal musicians for dance in the seventeenth century but when they were prevented playing by legislation other musicians provided the beat for the dance. Very often these musician had some physical disability and music offered them a regular income. The most famous of these was the blind harper, Carolan who is best known for Carolan's Concerto. In 1601 pipers had their instruments destroyed by the English so they improvised by making whistles from corn cobs (the woody centre in the stalk of corn). It was not until about 1700 that the modern uillean pipes were invented. These had a much milder tone that the original war pipes.

The eighteenth century brought a period where harpers wandered the roads of Ireland playing only when they felt their music would not alert the English authorities. They kept their fingernails very long for fear of recognition by these authorities. The Penal Laws introduced more freedom and harpers were invited to play in the Great Halls of princes and lords. Very often one of these lords would commission the harper to write a tune in honour of his family.

---

1 The uilleann pipes are an indoor instrument and are played sitting down unlike the Scottish pipes. Native to Ireland, uilleann pipes date back almost 300 years to the beginning of the 18th century and had probably some common ancestry with Scots lowland pipes. Uilleann pipes are no louder than a fiddle or accordion and sometimes much quieter, depending on the pitch, the style of the player (how the pipes are adjusted), and the particular instrument.

2 Originally the pipes were known as the musical instrument of war. Their shrill and penetrating notes worked well in the roar and din of battle. Pipes have been heard at distances of over six miles, and under favorable conditions at ten miles. The music of the war pipes was also used to cheer on the troops at war. [Kinnie 1998]
Examples of these tunes played today are Lord Inchiquin and Lady Eleanor Brabazon. In later years the harper teamed up with dance masters and played for dancers. [Flynn 2000]

From the end of the eighteenth century dancing at wakes was a familiar sight where mourners followed each other in a ring around the coffin to the sound of the bagpipe. If an instrument was unavailable a fiddle provided the music.

Music today is very much influenced by this music of the seventeenth and eighteenth centuries which consisted mostly of dance music, airs, and songs in both Irish and English. The majority of tunes in a player’s repertoire now consists of a mixture of jigs, reels, hornpipes, polkas, slides and mazurkas. How frequently each is played depends on their particular background, regional style, learning experience or taste. [O’Connor 1991] As mentioned above, music was traditionally only played for dancers but it is now also played for listening purposes.

‘Over the period 1900 to 1950 most of the important developments in the field of Irish music took place in the USA.’ During this period four million people left Ireland for America and each ship that left carried a cargo of music with it. This Irish music planted itself in America and changed itself in a way that affected the development of the music in its new country. In the 1920’s the gramophone was invented and the American recording companies in America made hundreds of recordings of Irish traditional musicians. These were released and thousands of them made their way across the Atlantic.
The arrival of the gramophone in Ireland changed music considerably. When an Irish family received a gramophone from America, it meant that they had not been forgotten by those who had left. As a result, even those who were uninterested in Irish music began to listen to it and were proud that America regarded our music as being good enough to record.

In the twenties Irish radio had begun broadcasting which lead to people learning these new tunes from the radio that they would not have heard in their local communities. The American recording of Irish music ended in the 1930s. The next significant development in Irish music came from Seán Ó Riada. Ó Riada was a composer from Cork trained in the art of European music but emmersed himself in the oral tradition of Irish music. He invented new ways to play Irish music in his orchestral settings, film programme music, and choral singing.

The status of Irish music in the 1950s was low where it was confined mainly to the rural areas and because of this Ó’Riada was afraid that the tradition was disappearing. As a result he formed a group of musicians – Ceoltóirí Chualann – whose mission was to try and make the music popular once again by encouraging musicians to play together in groups. This idea of group playing was new. Until this time music was predominantly played by individuals for solo performances.

The advent of the Fleadh Cheoil (a music festival/competition) in the 1960s unlocked doors to allow the older rural-based traditions access to the streets and hall of the newly emerging urban Ireland. The country’s discovery of its own music went hand-in-hand with a period of economic growth and a consequent attitude of self-confidence.
In 1962, Ó Riada presented a series of radio programmes called ‘Our Musical Heritage’ and he gave concerts with Ceoltóirí Chualann which were recorded. O’Riada went on to write music for a film called Mise Eire. He scored music for an orchestra based on the song airs of Ireland. The film and music were a great success and the status of Irish music raised amongst a section of society which had never taken any interest in it before. For this reason many bands today including the well known band De Danann are indebted to Seán Ó Riada. Ciarán MacMathúna once said about him that ‘He worked at traditional music at all levels and was able to attract an audience for all that kind of music right through the whole perspective of Irish music.’

[O’Connor 1991: 101]

The next significant influence in Irish music in the 1960’s eminated from a group from Tipperary, the Clancy brothers and Tommy Makem. They travelled across America and came back to Ireland and brought folk songs back into the Irish public. It was Ciarán MacMathúna who encouraged the Clancys to come back to Ireland and do a series of concerts. They were very successful and from these Irish music began to find its way into urban society.

MacMathúna pointed out that ‘a very much wider audience than Irish music ever had before, went back to hear the real tradition; ... they were led back ... to the source of these songs ... by the Clancy Brothers and it also brought them back to instrumental music.’[O’Connor, 1991: 113]
In the 1970's a group of Irish touring bands emerged such as Clannad, The Bothy Band, De Danann, The Dubliners and The Chieftains emerged from the influence of Ó Riada. All of these bands have mixed different influences into Irish music.

The 1970s also brought a growth of acoustic-pop and traditional music. This resulted in a blend of music. The music that was once Irish Music, represented by traditional musicians playing authentic style on traditional instrument, was now becoming popular music, represented by musicians from more popular forms of music playing stringed fretted instruments in accompaniment to Irish Music.

Today, traditional music is well promoted and it is influenced by numerous Irish traditional music groups worldwide. These have mixed different elements of their own traditional music with music. As a result our true traditional music is changing from the influences of modern society and modern music. Our music is part of the culture of each community and we must make a move to preserve this music and protect it from destruction from modern influences for future generations to hear.

Thomas Davis once quoted that:

'Music is the first faculty of the Irish, and scarcely anything has such power for good over them. The use of this faculty and this power publicly and constantly, to keep up their spirits, refine their tastes, warm their courage, increase their union, and renew their zeal, is the duty of every patriot.'

[O’Neill, 1986: 3]
Traditional Irish music is the music that is passed on from one generation to the next. For this reason, a few short minutes filled with music may be the result of many long hours of practice, years of listening and perhaps generations of involvement in the tradition. Although one may not know the exact history or tradition of the tunes; we are able to describe them as being either traditional or not due to the distinct features of traditional music. Our music, like Irish dancing is characteristic of the areas in which it is played, for example, the music of Donegal is different to the music of Clare, which is different in turn to the music of Kerry/Cork where the playing of polkas and slides is dominant, because of the polka set tradition.

2.2.1 The Oral Tradition

Until 1792 the music of the harpers was unwritten when Edward Bunting made the first attempt to preserve their tunes for prosperity at the Great Harp Festival of Belfast. These tunes were published in 1840 as ‘The Ancient Music of Ireland’. Music was learned and played by ear and this is the way it was passed on from one generation to the next.

[Flynn 2000]

Ireland is unique in retaining a vigorous orally transmitted tradition of music. This music gains character when it has been reshaped and recreated by a community. Traditional musicians are not bothered by the idea that there can only be one correct version of a tune. They don’t always believe what the book says, which results in a tune being reshaped in playing to allow the individual style of the musician to develop. A traditional tune is continuously subject to change due to the individual preferences of each musician.
In our oral tradition tunes are not written down but are actually composed on an instrument and transmitted orally. Sometimes if the tune is composed on an instrument, the tune will carry some of the character of the instrument itself. For this reason the composer will automatically favour certain movements which make the tune easier to play on that instrument. [Ó Canainn 1993: 1-2]

Although jigs, reels, and hornpipes are being composed by Irish musicians in different parts of the world, they are not traditional until they are accepted and played by traditional players as part of their repertoire. [Breathnach 1993: 119 - 123]

Traditional music can be learned properly only by ear, which is the way a child learns his/her first language. It is advised that a teacher who is not a traditional player should not attempt to teach traditional music by playing the music from notation as it may result in the child never learning to play in a traditional style. Traditional playing has the personal feeling of the musician in the tune. This is one of the advantages of Irish music where the musician has the freedom to refashion the basic tune putting his/her own individuality on it. Thus, in a sense the performer is part composer as well. This is very true of the music of Pádraig O’Keeffe, a fiddle player from Sliabh Luachra who wrote his tunes in tablature form and included his own bowing symbols on the tunes so that others could use these bowings in order to imitate O’Keeffe’s own style.

If the music teacher is not a traditional player, records, tapes and CD’s should be used, but the material should be of an authentic manner. Manuscripts should only be used as an aid to
memory or be used to identify a note where difficult for the ear to recognise. Traditional musicians rarely tolerate those who play a tune directly from manuscript. Although books of printed manuscripts of tunes have been published, these are generally regarded as being a mere aid to learning tunes, since style ultimately can only be developed by listening to other musicians. Notated tunes only provide an outline. Traditional musicians add variations to the tunes or change notes to suit their style of playing.

Learning traditional music is like learning another language. ‘The music is handed down from one generation to the next, or passed on from one performer to another, more by example than by formal teaching.’ [Carson 1986] The new traditional musician normally acquires tunes and style through imitation of more experienced musicians.

2.2.2 Dance Tune Titles

Unlike classical music, the titles used for Irish dance tunes have no relevance to the tune as such. They are mainly used as a form of identification, for example, Gravel Walk, The Mason’s Apron.

In general, the titles of Irish dance tunes give no hint of the economic and social conditions of the times in which they were composed. One will notice however that Jenny, Kitty and Paddy seem to be the favourite Christian names used. Examples of dance tunes with these names incorporated are: Kitty’s Wishes (reel), Paddy Ryan’s Dream (reel), Paddy Murphy’s Wife (reel), Paddy in London (jig), Jenny’s Wedding (reel), Kitty’s Wedding (hornpipe). [O’Neill’s 1986: 6 – 12] Also, the Galway Reel may have come from Galway or the Dublin Reel may have come
from Dublin or be common in Dublin, but on the other hand the *Fairy Reel* has nothing to do with Fairies. A well known tune played by DeDanann is the *Doberman's Wallet*. As we know a Doberman is a dog so it makes us wonder what a Doberman would be doing with a wallet?³

On the other hand, the original name of the tune may have been lost and a personal title may have been put on the it. Alternatively, a tune may be called after the person whom one got the tune from. An example of this is a three part polka which is played by Dan Herlihy, a well known accordeon player from Ballydesmond, Sliabh Luachra. The polka is played by many musicians. Andy O’Sullivan from Kenmare plays the tune regularly and refers to this polka as Dan Herlihy’s polka, even though Dan does not claim it as his own! The reason for this is that he got it from Dan.

Hundreds of names of our dance tunes have been lost over the years. Other tunes then may have several names like the Cork Hornpipe also known as Harvest Home. In addition, two tunes with the same name cannot guarantee that they are the same tune as many tunes may have the same name! [Breathnach 1993: 63, 64] Today, many musicians do not have names for the tunes they play, but in Sliabh Luachra there is a story behind every tune. Nicky McAuliffe, a musician from Castleisland in the Sliabh Luachra area has a great interest in the names of tunes and has collected several names for different tunes. [Personal correspondence from Nicky McAuliffe]

³ Information provided by Andy O’Sullivan, a flute/mouth organ/whistle player from Kenmare, Co. Kerry who is well known for playing the Sliabh Luachra style of music.
2.2.3 The Decline in Genuine Traditional Players

'Today’s Irish traditional music recognises no national boundary.'

[Ó Canainn 1993: 1, 2]

Genuine traditional musicians are declining today and young people are attracted by choice to
the music made popular by public performers like Sharon Shannon, Altan, Dervish, Music from
Riverdance, Lord of the Dance, etc. For this reason it leads to a neglect of their local music.
Also, the availability of radio, tape-recorders and CD’s has meant that a traditional player’s
repertoire is no longer his own. This is resulting in a particular style no longer being confined to
its own region. As Matt Cranitch, a fiddle player from Cork stated:

‘Styles now tend to be individual or personal, rather than regional as
they were in the past. You hear so much that your own way of playing
may be a mixture – not any one style.’ [Ó Canainn 1978: 131]

Thus, with so many people worldwide from different backgrounds playing Irish Music it is
becoming very important to try to preserve tradition of our regions.
2.3 SLIABH LUACHRA

This is very relevant to the area of Sliabh Luachra situated on the Cork/Kerry/Limerick border where few genuine Sliabh Luachra musicians remain. Among those who still play the true Sliabh Luachra music are Mikie Duggan, Maurice O’Keeffe, Johnny O’Leary, Dan Herlihy, Nicky McAuliffe and Emma O’Leary. Many of these people learned their music from, or played with and were influenced by the music of Pádraig O’Keeffe, a renowned fiddle player from the Sliabh Luachra area.

Sliabh Luachra is not a huge urban city on the Cork/Kerry/Limerick border. It is very different from this. Siobhán Long, in an article for Hot Press Magazine (1999) mentioned the area of Sliabh Luachra as ‘... the place deftly avoids dual carraige ways, motorways and bypasses ... the land where thoughts turn to fiddles and football far more readily than they do scurrilous tribunals and pocket-lining bureaucrats.’

Sliabh Luachra is recognised Nationally and Internationally as ‘the bedrock of Traditional Irish Music, Song, Dance, Poetry and Culture.’ [I.R.D. Duhallow] Hundreds of years ago it was sparsely populated and consisted only of bogs, marshes and woodlands. After the plantation of Munster in 1583 and the battle of Kinsale in 1601 many poverty stricken people moved into the area. It was remote and barren and thus these people knew that the authorities were unlikely to bother them. Despite the hardship music, poetry and dance survived. The children were literate and had accomplished music teachers. The music possessed a ‘draíocht’ and ‘a feeling that it
came from the soul of the people’. [I.R.D. Duhallow] This music still loves today and has a distinctive style, which is difficult to explain in words but easy to distinguish in sound.

The result of the continuous broadcasting of music from radio and other media from the 1920’s onwards resulted in a change in the nature of the music. The music was faster and contained a ‘mixture of the genuine and the spurious’. [I.R.D. Duhallow 1999: 32] The music became a type of cosmopolitan music which resulted almost in the exclusion of the older regional styles. The younger musicians who possessed the genuine tradition were now doubtful of its value and it was now possible that the old authentic music of Ireland with its deep feeling and dríocht could be lost in a short time. Despite the decline in traditional music and the strong influences the media had on Irish music the tradition continued to thrive in Sliabh Luachra.

As mentioned above the music of Sliabh Luachra has a distinctive style. It is renowned for its polkas and slides and for the vigour and infectious good humour with which the music is played. Many people have spoken about the music. Breandán Begley, a musician from Dingle, believes that the music reflects the land from which it comes. The Sliabh Luachra music has the same kind of wildness and passion which is reflected in the landscape. This is different to the ornamented and genteel music of Tipperary where the landscape is gentler. Thus, where one lives has a great influence over the type of music played. [Long 1999] Terry Moylan, a step dance teacher, believes that the dancing in Sliabh Luacha matches the way in which they play the polkas and slides. He believes that they can make these polkas and slides look as complex as reels and hornpipes.

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From the decline in the number of people playing the true Sliabh Luachra music came the need to set up a system to preserve the music of Sliabh Luachra, with the focus being on the music of Pádraig O’Keeffe. The continuity of O’Keeffe’s music depends on those who play it and pass it on to others. For this reason the music style needs to be preserved in order for people to hear it, play it, and pass on the tradition to others.

Sliabh Luachra, located on the Cork/Kerry border, is a district famed for its musicians and dancers and, formerly, for its poets and learned men.

The origin of some of the music of Sliabh Luachra dates back to the mid-eighteenth century to the time of Eoghan Rua Ó Suilleabháin who was born in Meentogues in the heart of Sliabh Luachra. Many of his great poems were set to music and are, today regarded as some of the best ‘Sean Nós’ songs and slow airs. Some of these great songs would be in ‘Aonar Seal’, ‘An Ciarraíoch Mallaithe’, ‘An Spealadóir’, ‘Ag Taisteál na Blarnán’, etc. Meentogues was a place of poor land, of struggling people. Ó Suilleabháin came from a place where poetry was still accounted as riches and as a means against misfortune. For this reason, he quickly learned to read the Gaelic stories and poems with which he was already familiar from home. These stories stayed with him throughout life. At the age of eighteen he opened his own school, but it did not last long. Following this he became a spailpín, a wandering farm labourer and also work as a schoolmaster from time to time. He was known to be full of wit and often sang his own songs while at work. This is portrayed in his poetry. He was dead for almost a century and a half when his poems were collected by Father Dinneen for the first time and published in a book. [Corkery 1979]
Aogán Ó Rathaille, another renowned Irish poet, also lived in this part of Ireland. Ó Rathaille was born in the Sliabh Luachra area in about the year 1690. He moved from here nearer to Cork city during his lifetime, but died in great poverty and desolation of spirit in 1726, not far from his birthplace. He is buried in Muckross Abbey. [Corkery, 1979: 155-183]

### 2.3.1 The Travelling Fiddle Masters

From the beginning of the nineteenth century onwards travelling fiddlers went from house to house teaching music. ‘Taidhgín an Asail’ was one who spent his life travelling the countryside on a donkey. One of his most famous pupils was Tom Billy Murphy (1879 – 1944) of Glencollins Upper, Ballydesmond. Tom was blind and partially disabled. He took up teaching the fiddle and he also travelled around Sliabh Luachra on a donkey. Pádraig O’Keeffe is one of Tom ‘Billy’ Murphy’s most written about musicians.

Sliabh Luachra music focuses predominantly on the playing of polkas and slides and the fiddle style is rhythmic and direct. This energy and rhythm can be seen in the playing of Johnny O’Leary, an accordion player whose music is still played weekly in Knocknagree, Sliabh Luachra. For fiddle playing the full length of the bow tends to be used. Many notes are played in one stroke of the bow in preference to one note per one bow. Ornamentation with the left hand is not as frequent as in some areas but the use of occasional grace-notes imparts the general Sliabh Luachra quality. The players generally focus on playing the tune.

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4 Information given to me by Nicky McAuliffe – a well known fiddle player in the Sliabh Luachra Area.
2.3.2 Pádraig O’Keeffe

‘The Last of the Travelling Fiddle Masters’

Pádraig O’Keeffe was one of the most important fiddle players of this century, one of the four great fiddle masters and perhaps the last of his kind. The others were Din Tarrant, Corney Drew and Tom ‘Billy’ Murphy. ‘His influence can be heard everywhere today in the tunes and the lovely rolling and flowing style of music making in the area of Sliabh Luachra on the borders of Cork and Kerry.’ [Browne: 1] See Figure 2.1.

Figure 2.1: Pádraig O’Keeffe – The Last of the Travelling Fiddle Masters (left)

O’Keeffe spent many years walking from house to house teaching his music and writing out tunes for his pupils which they would learn before his next visit. Unfortunately, his music wasn’t recorded until his later years and although he didn’t get to America to record his music
(like Michael Coleman), people believed that he was happy at home because he was an important person there. He read about the U.S. but he came to the conclusion that 'it wasn't a great place.' As a result O’Keeffe’s first recording came when he was 60 years old (the late ‘40s) by Séamus Ennis from Radio Éireann. From then on and throughout the 50s Radio Éireann made recordings of O’Keeffe’s music.

O’Keeffe was born in Gleanntán, Cordal, Castleisland on 8 October, 1887. As a young child he heard and was influenced by the music of his Uncle Cal Callaghan. His music came from his mother’s side of whom she and her brothers were all musical. He was taught by Tom ‘Billy’ Murphy (1979 – 1943) a well known travelling fiddle master of the Sliabh Luachra area who travelled from place to place teaching music. O’Keeffe is said to have got his old Sliabh Luachra fiddle playing from Tom ‘Billy’. He also studied music theory while at college in Dublin.

National school teaching was his trade and he took over as principal in his father’s school in Gleanntán in 1915. But, it was the music of his local area that captured his imagination. His teaching time ended in 1920 when he lost interest and resigned in anticipation of dismissal. The story told of this was that one of his students went to get him from the pub on the morning the school inspector was due. But, O’Keeffe had no interest in going back to the rigid ways of the school and told the pupil that he was sure that the inspector would ‘find everything in order’. From then on he travelled the Sliabh Luachra area by foot writing tunes and teaching young people to play music. His fee was five tunes for half-a-crown and his aim was to earn enough money to support the evening’s relaxation. It is said that he could cover as much as 30 miles a day.
O'Keeffe 'wasn't too fond of playing for dancers ... He preferred 'listening' music as this gave him a chance to show the beauty and the depth of the tune.' [Templeton] When playing for dancers he was sometimes known to break a string in order to get away if he had enough! He encouraged his pupils to play slowly. He had his own system for bowing which consisted of long bows and he had a wide range of decorative techniques for the left hand. [Ward 1976: 12–23] O'Keeffe taught many well known musicians such as the distinguished Denis Murphy, who went and lived in New York for many years, and his sister Julia Clifford who emigrated to London, Cuz Teahan, Paddy and Johnny Cronin, Mike Duggan (fiddle player), Johnny O'Leary (accordion player) – see Appendix 4 - Terry Cuz Teehan, Jerry McCarthy and Johnny Clifford. Many say that O'Keeffe's skill with the bow came from experience, practice and a loving talent that came from the heart. Ciarán MacMathúna believed that when O'Keeffe played a slow air for him it reached into the soul and he believes that his music has survived, and he is assured of a place in the history of traditional music. [Ryan 1999] He was a modern Eoin Rua Ó Suilleabháin or Ógán Ó Rathaille.

O'Keeffe lived to be 75 years until he died in Tralee Hospital in February 1963. He is buried in Kimurry, Castleisland, Co. Kerry. Peter Browne, an RTE producer and folklorist refers to a story about O'Keeffe's attitude to death. O'Keeffe's attitude was that when he died he would go to Fiddlers Green'. This was neither heaven or hell but was eight miles below hell where 'you'd need all steel strings on the fiddle as any other string wouldn't be able to stand up to the pressure of he head'. [Long 1999]
2.3.3.1 O’KEEFFE’S MUSIC

People say that O’Keeffe’s music was lonesome reflecting that at times he was a lonely man. He liked to play his tunes slowly with much variation added. His bowing had a special style and as described by Seamus Ennis: ‘It was a light, agile flowing style with a wonderful pulsating vigour in the dance rhythms with a tendency to gay, wild abandon in the slides and polkas. He bowed a lot or slurred a lot as taste dictate.’ [Browne] O’Keeffe claimed he had the bowing style of the old Sliabh Luachra fiddle players Tom Bill and Callaghan and others.

O’Keeffe had a large repertoire of tunes. He learned tunes from O’Neill’s collection, from the radio and older musicians. Johnny O’Leary (accordion player) has said there was many occasions during sessions when O’Keeffe often came up with a whole night of tunes previously unheard of! Slow Airs played a very special part of his music and he had the ability to get to the heart of the tune.

2.3.3.2 O’KEEFFE’S CONTRIBUTION TO THE CULTURE OF SLIABH LUACHRA

‘Sin é an file go fann, nuair a thiteann an peann as a lāimh’

‘Weak indeed is the poet when the pen falls from his hand’

These were the words whispered by Eoghan Rua Ó Súilleabháin on his deathbed in 1784. This marked the end of a golden era of literature in Sliabh luachra, an era in which Sliabh Luachra was known as the literary capital of Ireland. [McAuliffe]
One hundred and three years after the death of Eoghan Rua, Pádraig O’Keeffe was born. He, like Eoghan Rua, worked as a teacher for some years. His love of the fiddle drew him to travel the country-side teaching music with his bowing style being the distinctive feature of his technique.

O’Keeffe’s death in 1963 also marked the end of a tradition in Sliabh Luachra for many years – the travelling fiddle master.

Both Eoghan Rua Ó Súilleabhráin and Pádraig O’Keeffe have left an ‘indelible mark on the face of Irish culture for prosperity’. Seán O’Riada described Eoghan Rua as ‘the Mozart of Gaelic Ireland’. Nicki McAuliffe believes that one could say that Pádraig O’Keeffe was the Eoghan Rua of the 20th century.

2.3.3.3 O’KEEFFE’S TABLATURE

Although O’Keeffe could write music in normal staff notation he preferred to write the tunes in his own code – this ‘code’ is known as a tablature. He invented a system of writing tunes for his pupils which was a simple and effective way to teach music. He wrote the music on the back of old cigarette boxes, calendars, match boxes, and anything he could find and would write them without picking up any instrument.

The tablature consisted of four lines (denoting the four strings of the fiddle) and three spaces between the lines. The spaces between the lines were the strings of the fiddle with the top space
being the ‘E’ string. ‘0’ on this space meant ‘open string’, ‘1’ meant that one applies the ‘first finger’, ‘2’ meant one to apply the second finger and so on. The smaller numbers were used for grace notes. Thus, the notes to be played were indicated by the numbers of the fingers (1, 2, 3, 4) on the fingerboard.

A tick above the note meant a person to play an up bow and no tick above the note(s) to play a down bow. A curved line over several notes meant that all notes are bowed in the same direction and an ‘R’ meant ‘repeat’. [Ward 1976: 12-23]

There is no attempt to show the rhythmic emphasis of the tune or to differentiate between C or C sharp or f and F sharp in the tunes. Thus, we are not told at the beginning of the tune what key the particular piece of music is in. For this reason, O’Keeffe’s demonstration of the tune to the pupil was important in learning it.

Many of O’Keeffe’s manuscripts which have survived are signed and dated by himself. He had numerous tunes and we will never know exactly how many he knew. Looking at the dates on the tunes showed that O’Keeffe continuously learned ones that were played on the radio and available on record at the time. He had a sharp ear for picking up tunes.

The following is an example of the tablature code of Pádraig O’Keeffe. As can be seen it is dated the 24 June, 1944. (See Appendix 2 for more tablatures)

5 Quote by Nicki McAuliffe from Castleisland, Co. Kerry about Pádraig O’Keeffe in Fleadh Ceoil na hÉireann p 26
2.3.3.4 MEMOIRE OF O'KEEFFE'S PUPILS

Those who knew or played music with O'Keeffe had nothing but good things to say about him. Some comments were as follows:

In an article in Treoir magazine in 1969 Seamus Ennis gave a memoir about O'Keeffe from a meeting with him in 1946. He believed that O'Keeffe had 'great wit and a strong hearty voice.' O'Keeffe's way with a pint was on the first draught to empty it down to his thumb 'below the

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6 Tablature provided by the Sliabh Luachra Cultural and Heritage Centre, Scartaglen, Co. Kerry.
Johnny O’Leary, an accordion player from Maulykeavane, Sliabh Luachra was a student of Pádraig O’Keeffe’s. Johnny has many memories of O’Keeffe. ‘He was full of wit. He used to call the fiddle the Misses and he was able to play it. Pádraig was one of the best in the world. That’s my honest opinion.’ Johnny went on to tell of the time O’Keeffe wrote out a tune for Willie Clancy without trying it on an instrument and when he gave it to him Willie played it perfectly on the tin whistle. He also told the story of how O’Keeffe would know a budding musician a mile away even though he met a lot of bad ones too. ‘A fine thing to teach a bonham to pray ...’ he used to say.’ Johnny believes that O’Keeffe’s musicianship was in the same league as that of Michael Coleman.  

Maurice O’Keeffe is another renowned musician from Sliabh Luachra whose music, along with Johnny O’Leary’s is still heard frequently in the area. Maurice remembers O’Keeffe, the way he used to write tunes on the back of match boxes and get a ruler to draw the lines where he wrote in the numbers. ‘Poor ol’ Pádraig, he was a gentleman,’ claims Maurice.

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7 This information is taken from an interview by staff from the Scartaglen Heritage Centre with Johnny O’Leary in 1998.
8 Taken from an interview with Maurice by staff from the Scartaglen Heritage Centre.
2.3.3.5 RECORDINGS

The first recording of O’Keeffe was in 1947 when he was nearing his 60th birthday.
Seán Ó Cróinín of Macroom did this recording. He later introduced O’Keeffe to Seamus Ennis who recorded O’Keeffe’s music later that same year for the Folklore Commission. He did further recordings for Radio Éireann in 1948 and 1949 and for the BBC in 1952. [Browne]

2.3.3.6 THE O’KEEFFE O’KEEFFE ANNUAL MEMORIAL WEEKEND

Because of the rich legacy O’Keeffe left in the area, a memorial weekend is held each year during the October Bank-holiday weekend. Musicians come from all over Ireland to play and listen to the Sliabh Luachra music with the hope of learning a new tune. Many of Padraig’s students are still playing and passing on his tradition through informal music sessions and workshops during the festival.

The 1999 festival was very successful. ‘One of the winning factors of the festival is that the committee is interested in the music.’ [O’Mahony 1999] Several of the committee for the festival are musician and as a result of the success of the festival many prominent and established musicians visit and play in the sessions during the festival. In 1999 these included Matt Crannitch and Tommy Sullivan of Sliabh Notes, Cathal Hayden, Frankie Gavin from DeDanann and Dessie O’Halloran from Innisbofin as well as Josaphine Marsh, accordéon player.
In an interview for the Kerryman newspaper Aineen Roantree of Kenmare said that she believed the festival is so successful because ‘from a musician’s point of view, it’s the one place which has so many musicians and gives them time to play and come together. Other places expect them to be on stage all the time’.

2.4 NOTATING IRISH MUSIC

In most traditions there is little need to notate music as long as the aural tradition lives on, but as soon as one leaves the area of this tradition the need for and the use of notation increases. Each community has a sense of style and rules for playing their music that reduces the complexity of the notation itself. The style of the music would encompass phrasing, ornamentation, speed, variation, intonation as well as the types of tunes such as a Reel, Jig, Hornpipe, etc.

Musicians generally know that a hornpipe is a hornpipe and a jig is a jig and often in Irish music, the notation only includes a series of pitches, with different symbols to mark notes that should have a longer duration. A musician familiar with the style of an area can then perform the music using the knowledge of the concepts in the notation. It is the style of the community in which the music comes from that shapes the performance of the notes that could be annotated in several different ways.

The market and distribution of music has also affected the use of the notation. When the music goes outside the community it is often used for performance on other instruments. For example Bunting’s transcriptions of the Harp festivals in the 18th century must have been affected by
Bunting himself who was an organist and most musicians think of music in terms of their own primary instrument. This is very true of the rich notation of Pádraig O'Keeffe’s tablature which demonstrates that different ways of notating music within a community can provide a more effective transmission of performance. O'Keeffe’s notation was simplistic for the musician to learn in order to play a tune. His notation show the musician how to perform the tune where he used numbers a lines. The lines symbolised the strings of the fiddle and the location of the numbers showed which finger would be place on which string. He also used symbols to show the direction in which the bow show go and used slur lines over groups of notes to show how many notes should be played per bow. But, although the music was written primarily for violin and sometimes accordion, O’Keeffe’s music is played on all instruments today. [Fernstrom 1996: 343 – 353]

The problem with the use of notation is that there is ‘a big difference between the art of performance and the technique of playing the correct notes’. [Fernstrom 1993] The musician or learner must hear the music of the community in order to hear and learn the distinct style of the music. Today’s technology is capable of recording this style of music for people to hear how the music is performed. This is the focus of my research. It is the beginning of a significant database containing both the music, the translations of the original music tablatures of Pádraig O’Keeffe into regular notation and recording the history behind the music of the Sliabh Luachra community and those people who lived and played the music.
2.5 CONCLUSION

In summary it is clear that our heritage of Irish music is very important to us. The music of Sliabh Luachra is a part of Ireland rich in heritage and it is important to preserve this music and folklore for future generations. As Sliabh Luacra is not a tourist area and is, as I feel, not well known among those outside the music industry, the development of a web site will act as a method of alerting people to the culture and historical wealth of the area.
CHAPTER THREE
CHAPTER THREE

MULTIMEDIA AND THE WEB

3.1 INTRODUCTION

This chapter introduces the concept of Multimedia. Different types of multimedia are discussed and the integration of multimedia with the Web is examined.

Having considered the fact that the true Irish traditional music is disappearing because of the effects of modern society and technology, it was decided to develop an archive based on the principle of a multimedia kiosk, where people would use the system to get information about the history and people of a particular region. The region focused on is Sliabh Luachra area.

Multimedia kiosks are ‘automated information, data entry, and transaction centres’. [Villamil-Casanova, Molina 1996: 25] Interactive (See Section 3.2) multimedia kiosks enable users to locate quickly relevant information. This is accomplished using the interface in front of them
with a keyboard, a touch screen or mouse. They are now available in many places such as colleges, government services, retail stores, tourist centres, cultural and heritage centres, etc. In some situations the need for additional staff in, for example, a heritage centre, is eliminated because the kiosk provides all the information needed. For example, all information previously stored in files no longer has to be located by staff. The kiosk now contains an electronic form of all this information. For this reason salary and employment expenses can be reduced.

3.2 MULTIMEDIA

The term multimedia is relatively new in the English vocabulary even though it has been around for a long time but in different formats.

Multimedia refers to the ‘integration of multiple media – such as visual imagery, text, video, sound, and animation – which together can multiply the impact of the message.’ [Villamil-Casanova, Molina 1996: 8] A basic multimedia presentation may include a slide presentation with background music. More advanced levels of multimedia may include video clips, animation sequences, digitised still images captured from a video camera or scanner and sound.

Interactive multimedia refers to the user’s ability to control these components and interact with them as needed. [Villamil-Casanova, Molina 1996: 8] Multimedia allows the user or the researcher to get information without human interaction and it makes searching for information more entertaining and exciting. When a user interacts with a computer system very often they want to decide which path they want to take in seeking the information. For example, the
archive system developed allows the user to search for information on the area a musician comes from rather than information on the actual musician. This interaction is expressed under the term ‘interactive multimedia’. It now means that the audience controls the sequence, the pace and what to look at and what to ignore.

Villamil-Casanova and Molina identify four basic navigational structures that are used by multimedia designers:

- **Linear**: The user navigates through the system sequentially.
- **Hierarchical**: The user navigates through a branching structure identified by the system content logic flow.
- **Nonlinear**: The user navigates through the system content without a determined path.
- **Composite**: The learner navigates through the system freely, but at certain points the user is forced to follow a certain sequence which may or may not be of linear focus.

[Villamil-Casanova, Molina 1996: 14]

3.3 MULTIMEDIA DEVELOPMENT

The first form of multimedia appeared in the form of newspapers where text and images were used for communication. Following this came the radio which communicated through the use of audio. After the radio came television and this combined text, audio and images to convey a message. These multimedia productions were linear in nature. From all of these came the evolution of a non-linear, interactive, computer-based multimedia that allowed the user/viewer to
become part of the presentation. They could now interact with the computer instead of being merely a passive observer. Multimedia now plays a large part in the World Wide Web, where many web sites now contain some form of graphics, animations, audio or video. Linking to different sections of multimedia on the web is achieved by hypermedia links. (See Figure 3.1)

**Figure 3.1: Web Page with Hypermedia Links**

Multimedia’s greatest asset is that it reaches the mind and the heart of people via the senses. It focuses primarily on the sense of sight and sound and when used in interactive information kiosks it also includes a degree of touch. When we watch a video or a movie, we see about 24 to 30 megabytes of visual information per second. [Lindstrom 1994] Thus, sights and sounds
combine to reach more areas of the brain and trigger a deeper, more thoughtful response. For this reason, the web pages used as the graphical user interface in this archive are based primarily on images so as to attract the viewer/researcher to use the archive and to enter the database.

Multimedia also caters for different learning styles. Many studies have concluded that most people retain about 20% of what they hear; 40% of what they see and hear; and 75% of what they hear, see and do. [Villamil-Casanova, Molina 1996: 8]

3.4 MULTIMEDIA TYPES

Multimedia can be divided into four main types: text, graphics, audio and video. This section looks at these and discusses their use in the Information System developed.

3.4.1 Images and Graphics

'A picture is worth a thousand words.'

This is an ancient Chinese saying implying that people learn and retain more information from viewing pictures than any other form of information. Graphics are a key building block for multimedia applications. Integrating graphics into multimedia presentations means including photos, backgrounds, charts, drawings, buttons and three-dimensional pictures. These will be discussed later.
The development of technologies such as scanners, video capture boards, digital still cameras and slide scanners allow the production of photos, slides, colours, clipart, textures and graphics of all kinds. In addition, once an image is digitised it can be edited.

3.4.1.1 COLOUR DISPLAYS

Current colour monitors for desktop microcomputers are based on cathode ray tubes (CRT’s). As CRT’s display light, CRT displays use the red-green-blue (RGB) additive colour model. The RGB model is ‘additive’ because a combination of the three pure colours adds up to white light.

The Mac’s operating system (also Windows) organises the display screen into a grid or x, y coordinates. Each box on the grid is called a pixel. A pixel is an abbreviation of ‘picture element’ and is used to describe the building blocks that make up an image.

3.4.1.2 PIXELS AND COLOUR

To control screen colour the operating system dedicates memory ranging from 8-bit to 24 bit. The resolution of a monitor is measured in pixels-per-inch (ppi) or dots-per-inch (dpi). Monitor resolution is 72 dpi.

Memory used for screen display is referred to as ‘video RAM’ or VRAM’. With a black and white computer a single bit of memory is assigned to each pixel. As each memory bit is either
positive or negative (0 or 1), a one-bit display system can only manage two colours (black or white) for each pixel on the screen. *Black and white images* are 1-bit data types.

*Grayscale images* are usually designated as 8-bit data types. They can contain black, white and as many as 254 different shades of grey and produce good to high quality prints depending on the printer resolution. This type of monitor display is called an ‘8-bit’ or ‘256-colour’ display.

*Indexed colour images* can be either 4-bit or 8-bit data types. The 4-bit data types is good for maps or drawings but is not recommended for photographs as the colours will be less than life-like.

*True-colour images* or 24-bit colour displays can include as many as 1.7 million colours. Near photographic colour can be reached on the computer screen. In this instance each pixel is allocated 24 bits of memory – eight for the red, green and blue components. This choice is give in Photoshop (software) where a ‘picker’ allows the user to mix the red, green and blue components to get a particular colour. [Lynch, Horton 1997]

### 3.4.1.3 RESOLUTION

This refers to the number of pixels per inch on a monitor or printer. The resolution determines the sharpness or clarity of an image. High resolution monitors, printers and images provide more detail and a finer appearance than those of low resolution. The cost of a high-resolution image is more memory, more disk space and more time to display or print the image. The resolution of a
monitor is described in dots-per-inch (dpi), or pixels-per-inch (ppi). See Figure 3.2 for close-up of screen pixels.

**Figure 3.2:** Bit-mapped Graphic Images illustrating the concept of Pixels

The higher the image resolution, the more disk space required, the greater the display time and the longer the printing time. When scanning images for a on-screen multimedia presentation, as with the archive developed, pictures are scanned at a maximum of 72 dots per inch (dpi) and this is the resolution that is available for screen images.
Before exporting, the resolution is further lowered to 72 dpi so to keep the multimedia application at its minimum size. In doing this, it is important not to lower the image resolution and to later increase it as decreasing resolution deletes some original colour information. Increasing the resolution again results in an image that is not as sharp as the original.

Screen resolution for web graphics is different than for print graphics. The higher the resolution the sharper the image and the greater the amount of detail that can be displayed. Unfortunately this detail is limited to what a computer monitor can display. [Smith 1999]

3.4.1.4 GRAPHIC COMPRESSION SCHEMES

Compression\textsuperscript{9} is the process of reducing file sizes to a manageable level so that they can be used in different applications. There are many graphic compression formats available. The following are some of the more popular formats:

3.4.1.4.1 JPEG

JPEG is a standardised image compression mechanism. It stands for Joint Photographic Experts Group. [MIS 1997] It is used for compressing either full-colour or gray-scale images of natural, real-world scenes. It is best used for photographs and artwork and not as useful for lettering or line drawing. The reason for this is that the decompressed image is not exactly the same as the image one begins with. JPEG exploits known limitations of the human eye where small colour

\textsuperscript{9} Compressed files are files which have been made smaller so that they take up less computer storage space. These files are also transferred through the Internet more quickly than the original, uncompressed files.
changes are noticed less accurately than changes in brightness. For this reason JPEG is used to compress images that are looked at by the human eye.

JPEG uses a mathematical technique called discrete cosine transformation to produce a sliding scale of graphics compression. The more a picture is compressed using JPEG the more its quality decreases. A graphic can be squeezed down to as much as 100 times smaller than the original file. The reason for this, is that JPEG discards unnecessary data as it compresses the image. This is known as ‘lossy’ image technique.

Advantages of JPEGs

1. JPEG allows the user to trade file size against image quality. Quality may be lost but file size will be considerably reduced. Making files smaller is important for transmitting files across networks and for faster download speeds over the internet. A two-megabyte full colour file compressed to about 100 kilobytes makes a great difference in disk space and transmission time.

2. JPEGs support full-colour images (24-bit images). As a result they give excellent results in most photographic images and naturalistic artwork.
Limitations of JPEGs

1. Once an image is compressed with JPEG data is lost and cannot be recovered. For this reason it is important to save an uncompressed original file of the image in question.

2. JPEG images normally take longer to decode and view than GIF but decoders can trade off decoding speed against image quality using fast approximations to the required calculation. In this way speed can be increased resulting in this feature being invaluable when creating Web sites involving many JPEG images.

3. Transparency is not possible with JPEG images because the compression makes small changes to the image data.

3.4.1.4.2 GIF FILE FORMAT

Graphic Interchange Format is another popular means to transmit images across data networks. This file format uses a form of file compression that displays fewer unique colours in the graphic without distorting the image or causing a loss of data. It is useful for compressing images with large fields of homogeneous colour. [Lynch, Horton 1997] A GIF graphic downloads one line of pixels at a time and Web Browsers such as Netscape display each line of the image as it gradually builds on the screen. GIFs are limited to a maximum of 256 colours in an image consisting of red, green and blue. The current standard is GIF89a.
Advantages of GIF Files

1. GIF files can be indexed to colour maps meaning that they can display 256 colours consistently.

2. All graphic Web viewers support the GIF format.

3. There is at most 8 bits/pixels meaning that GIF files can be very small. This is because fewer colours are used meaning that the file size is smaller. This then allows the image to load faster on the web.

4. GIF images can be saved with transparent areas. The transparent GIF [Bernstein 1997], has a certain bit set on one of its colour map entries, so that a Web browser’s background will show through the image’s background. This allows an image to blend in naturally to the browser’s background rather than appearing like it is a rectangular or square stand-alone entity on the Web page. Thus it is useful for getting rid of background in graphics or allowing other image layers to show through.

5. GIFs also support animation.

3.4.1.4.3 PNG

PNG is a file format invented specifically for online graphics. It stands for Portable Network Graphics. For the Web, PNG has three main advantages over GIF:

1. Alpha channels allows one to create effects like drop-shadows and anti-aliasing against any background
2. Gamma correction. This allows an image to display properly on different platforms without losing brightness or contrast during translation.


PNG also compresses better than GIF in most cases, but the difference is usually only around 5% to 25%. PNG uses lossless compression meaning that no quality is lost in compression. It is compressed with any of a number of precompression filters and is then decompressed when viewed. Thus, PNG retains every original detail and pixel. [Weinman 1997] PNG can be stored at different bit depths using different storage methods. It is unlike GIF or JPEG as GIF can be stored only in 8-bit or lower depths, JPEGs are stored in 24-bit and now lower, but PNG can be stored in 8, 24 or 32 bits. As it also supports up to 48-bit truecolor or 16-bit grayscale-saving, restoring and re-saving an image will not degrade its quality, unlike standard JPEG. [Roelofs 1999]

PNG is useful for use on the Web as Internet Explorer and Netscape now support PNG images.

3.4.1.4.4 Vector Graphics

GIF, JPEG and PNG are examples of bit-mapped graphics that consist of images represented as a sequence of coloured pixels that require storing every single pixel of an image. Despite excellent compression abilities to reduce file sizes, they require much more space than vector graphics. Scalable Vector Graphics (SVG) are ‘mathematical descriptions of graphical elements that enable a viewer (such as a browser) to display lines, curves, and text at optimal resolution,'
whether viewing or printing'. [Rein 1998] This advantage of the image looking the same whether on screen or when it is printed is a large advantage over bitmapped graphics. Bitmapped images may differ between the screen view and the printed view. The term Scalable Vector Graphics is used to emphasize that graphics generated by vector graphics for the Web will render properly even if they are re-sized when displayed on different screens, or for the purpose of printing on paper. [Lilley 1999]

There are many advantages of scalable graphics:

1. As mentioned above these graphics look the same whether on screen or printed.

2. In some instances, vector graphics images will be smaller than the bit-mapped equivalent after compression. Smaller files lead to faster download times.

3. One can apply different styles. Bitmapped images are static, but with vector graphics one can apply different styles. For example, in text diagrams a particular font or colour can be chosen.

4. They support complex animations.

5. Better for devices with low bandwidth\(^{10}\) and limited memory.

\(^{10}\) Bandwidth is the term used to measure the amount of data being transferred from your web space. This does not directly relate to the number of 'Hits' a web site receives. [Gillespie 1999]
3.4.1.5 WORKING WITH IMAGES AND GRAPHICS

There are many different programs available for image-editing including Adobe Photoshop, Corel Photopaint, etc. Adobe Photoshop was used for some images in developing the archive.

In editing images the first step is to crop the areas of the photograph that are not wanted. This is done using a Cropping tool in the toolbox of Adobe Photoshop. The pointer is dragged over the area to be cropped. The mouse pointer appears as a scissors shape at this stage. Once the crop area is selected the pointer is moved inside the crop box and clicked. The area outside the crop box is deleted.

Following this the output level, brightness and contrast of the picture can be manipulated. During scanning some resolution and contrast was lost. This can be adjusted in Photoshop where the Adjust Level dialog box gives the option to correct the output levels of red, green and blue channels (RGB).

3.4.1.5.1 BACKGROUNDS

The background is one of the most important graphic elements of a multimedia application. The background establishes the tone and theme of the system developed. It influences the look, balance, and location of all other elements on the screen and it fills empty spaces on the screen so that other elements are not floating objects. The choice of background depends on:
• The storage capacity of the medium to be used for distributing the information

• The colour-display capacity of the monitor used for playback of the application or system developed

• The amount of text to be placed over the background. The background should be composed together with the other elements that will appear on top of it to make sure that all objects are distinct and to adjust colours or contrast where necessary.

• The theme of the application. [Casanova, Molina, 1996: 31] The background must have a sense of the goal or theme of the application. They may include solid colours, logos, photographs or images.

The background used on the Sliabh Luachra Archive Web pages is a plain white background with a green section at the lower left hand corner. This background was developed in Photoshop. See Figure 3.3.

A plain grey colour was used as the background on the database files for visitors. This colour was used as it is not a severe colour for people to look at. The navigation buttons are yellow so they are easily identifiable on the screen.

A pale pink was used for the administrator background to distinguish the administrator views from the visitor views.
3.4.1.5.2 **GRAPHS**

Charts are frequently used in business presentations where they are used to show facts and figures. They are developed using spreadsheets and statistical programs. There are numerous different forms of charts including pie charts, bar charts, line charts and area charts. Charts were not used in the archive developed as statistical information is not represented in it.

3.4.1.5.3 **BUTTONS**

Navigational aids or buttons are used throughout the archive. The button usually consists of a graphic or text to which a script is assigned. A script is lines of code written in the programming
language of the authoring program or application used. Buttons with scripts assigned to them are used frequently in the database developed in FileMaker Pro where the data for the Archive System is stored. FileMaker is based on a scripting code. The following is an example of a script used for the navigation button called ‘Search for Musician by Name’. Thus, when a person wants to search for a particular musician this script is put into action. See Appendix 5.

Figure 3.4 illustrates the navigation buttons used in the Sliabh Luachra Archive database. The database was developed using FileMaker Pro.

Figure 3.4: Navigation Buttons used in the Database

The buttons developed for navigation will not work unless a script is assigned to them. When developing buttons it is important that:

- They are clear and unambiguous.
- They should attract people to use them as they are the controls that provide the opportunity to amuse, intrigue and entertain the user.
• They reveal its purpose at first glance to the user.
• The control needs to match the style and composition of the screen.
• When the same controls are used frequently, users need to find them in the same place every time.

3.4.1.5.4 TEXT

Text is one of the fundamental building blocks of multimedia applications. It can be displayed in different forms, for example, on buttons, as titles, bullets paragraphs and scrolling text. The amount of text, font sizes, font selection and colour are important design choices and these are influenced much by the program's intended use. Typography within electronic documents depends on the typefaces in the operating system of the computer. For example, if one chooses a typeface not standard with most operating systems the typeface must be supplied with the electronic document. The user will then have to install the font onto their operating system before viewing the electronic document. If this is not done, another font may be substituted but the effect may result in disaster.

Typographic design means choosing the right typeface and getting the size, spacing, colour and format exactly right. Good typography depends on the visual contrast between one font and another. Strong contrasts between fonts attract the viewers eye. It is unwise to put all text in block capitals, as it seems that you are shouting at the viewer and all bold text means that nothing stands out. Italicised text can be difficult to read on computer screens. Underlined text may give the viewer the idea that it is hyperlinked text. Alternatively, text crammed into a page
will cause the viewer’s brain to reject the text on the page. Optimum line lengths for text blocks
should be proportional to the size of the type font in use. The width of a web page can be limited
through the use of tables. These allow the placement of elements is a grid-like pattern. For
example, column widths of 40 to 60 characters provide optimal line lengths for legibility.
[Lynch 1994]

When we read we primarily view the overall shape of the words. We do not stop and view each
letter and then assemble them to form a word. Text in all-uppercase is also much more difficult
to read because words formed with capital letters are simply rectangles that offer few distinctive
shapes to attract the viewer’s eye. For example:

Capital Letter       CAPITAL LETTERS
Uppercase           UPPERCASE

In general we scan the tops of words when reading. It is much easier to read the text when a
capital letter is used for the first letter in the first word of a sentence. This font style is called
‘downstyle’. For example, in the following text, it is much easier to read the first line where the
tops of the characters can be seen. It is much harder to read the text below it where the tops of
characters cannot be seen. [Lynch 1997]

We scan the tops of words when reading.
we scan the tops of words when reading.
The facilitation of large blocks of text into a multimedia application for individual users is carried out using the features available in the authoring program used. Scrolling text boxes are useful for large amounts of text. It is also advisable to avoid mixing different font sizes, styles and attributes, as it is visually confusing. Blinking text can also be a considerable cause of annoyance when reading a web page.

### 3.4.1.5.5 ANIMATION

These are moving images. An animated GIF is created by storing the sequence of images used to produce animation in one file. A web browser that supports these GIFs is designed to present the images in the file one after the other to produce the animation. These are powerful communicators and distributors of information, especially when illustrating a concept that involves movement, e.g. when showing the proper way to move a bow across violin strings. Animation files require a lot of storage space. Examples of animation programs are Adobe Premier and Macromedia Flash.

### 3.4.1.5.6 INTERACTIVE LINKS

These are an integral part of multimedia. Where interactivity is present the user can point with a mouse and click on certain screen objects such as a button or highlighted text which causes the program to respond in a certain way, for example it may bring them from a screen showing information about a musician to another screen showing the instrument that musician plays.
3.4.1.6 ADDING IMAGES TO THE WEB

Once an image is stored and ready for use on the web, the HTML <IMG> tag can be used to place the image on the page. Although this <IMG> tag can be used alone it is important to use it with an SRC attribute. The SRC specifies the URL (Uniform Resource Locator) of the file where the image is stored.

Other attributes, which can be used, are:

- HEIGHT and WIDTH: Identifying the height and width of the image helps speed up the page layout process and allows users to see pages faster. Using this the browser loads the entire page first and then places the image on the page. This allows the user to view the page while the image is downloading. Without these specifications the browser would begin to download the page and when it comes to the image it will compute its size, place it on the page and then continue downloading the rest of the page. This is a time consuming process.

- An ALT (alternative) attribute can also be placed in the HTML code. This is used where a user does not have a graphical browser. Text can be provided as an alternative to the image that cannot be viewed.

Thus the <IMG> tag may look as follows:

```
<IMG SRC="URL_OF_IMAGE_FILE" WIDTH=width_in_pixels
HEIGHT=height_in_pixels ALT="ALTERNATIVE_TEXT_DESCRIPTION">
```

[Ladd, O’Donnell 1996]
3.4.2 Sound

Adding music to the start and end of a multimedia presentation helps set the mood of a multimedia presentation, for example, it helps the person to get a feel for the area they are researching. Adding music also helps to reinforce a message; for example, if a musician is selling a music CD playing extracts from the CD may help to reinforce the sale. Sound may also be used to add sound effects to a system. For example, a music note may play every time a person clicks a button or a hyperlink. Finally, narration can be used as a background instead of having someone present to tell you about the contents of a particular system. [Villamil-Casanova, Molina 1996: 108]

Music is added to the Archive Home Page so that it plays automatically when the page is launched. This helps the viewer to get the feel for the archive they are about to search. This music can be stopped and started at any time using the [Start/Stop Music] button on the Navigation frame.

11 This section is covered in detail in chapter 5
3.4.2.3 FILE FORMATS

The following are some file formats for sound that can be used in multimedia productions:

- MIDI – Musician Instrument Digital Interface
  This is the standard file format for music files generated by digital musical instruments and devices. See chapter 5.

- AIFF – Audio Interchange File Format
  The AIFF format is used on the Apple Macintosh for storing digital audio. It supports looping where a piece of audio can be replayed several times.

- RIFF – Resource Interchange File Format
  RIFF can contain different types of data including digital audio (WAV) and MIDI. This is a file format used by Microsoft.

- WAV – Wave
  A subset of the RIFF specification of Microsoft, it is used for digital audio storage.

- AU – Sun Audio
  This is a 16-bit compressed digital audio file used by Sun Microsystems’ workstations.
3.4.3 Video

Digitised video is one of the most recent additions to multimedia technology. Since film, video and television are everywhere it is very difficult to make video on the web exciting. Due to the fact that an application for the web was developed, adjustments for the video clips taken had to be made. An important factor in doing this was to use tight close-ups whenever possible because video on the web is viewed in a small box. Six people sitting in a room playing music would resemble tiny, moving insects. Close-ups of the musician in question revealed much more information.

Video is a sequence of individual images, called frames, which are displayed on a screen. Projecting several frames per second gives the illusion of motion because our brains cannot register the individual images. Video has a frame rate of 24 to 30 frames per second (fps) projecting a smooth and continuous motion. [Villamil-Casanova, Molina 1996] Along with these frames audio tracks are usually used to provide sound.

3.4.3.1 GENERATING VIDEO FOR USE ON A COMPUTER

There are many different ways to get video clips onto a computer including:

1. Creation of video clips using a video camera. A special video card is fitted on the computer to allow the system to display and record video signals. The images are digitised off the
video feed into the computer. These images are then stored in a video file format and can be edited in a video editor such as Adobe Premiere.

2. Using a digital camera. These are different from standard cameras as they automatically convert the visual image into a digital image. These cameras can scan still and moving images without additional hardware.

3. Create a video clip through a computer. Many recent Macintosh computers come with audio/video capabilities built into the machine. The pre-installed software allows the creation of video clips from the computer itself. [Jung 1996]

3.4.3.2 RECORDING AND ENCODING ANALOG VIDEO

Light-sensitive devices called charge-coupled devices (CCDs) are contained in video cameras. These capture (digitise) individual images as optical images and convert (encode) them into electrical signals. From once this analogue video has been encoded it can be recorded on magnetic media, such as analog videotape. Colour and brightness details of an image are captured by the electrical signals of the video camera. [Villamil-Casanova, Molina 1996]

3.4.3.3 HOW VIDEO CAMERAS INTERPRET COLOUR

Similar to working with images, video cameras interpret colour as a combination of the three primary colours red, green and blue. High-end cameras process signals for each RGB
component where they process the colour and brightness separately. Most commonly though, both are processed in one signal.

3.4.3.4 ANALOG VIDEO

Analog video requires a camera, a recording deck and a playback deck. When recording the video camera focuses light through a lens at timed intervals. The light is detected by charge-coupled devices (CCDs) which are \( \frac{1}{2} \)-inch microchips arrayed with 380,000 photo-sensitive diodes. The diodes generate an electric charge based on the light intensity that strikes. These charges are scanned and then converted to electronic signals. These signals are then sent to the recorder. Magnetic patterns are created on the videotape as the signals pass by magnetic heads in the recorder. The video signal is then read from the videotape by a magnetic playback head that then sends the signal to the monitor for viewing. Videotape can be edited by recording a section from one tape onto another.

From the introduction of videotape in 1956, the use of 'moving pictures' in entertainment became popular as it allowed images to be stored, edited and played back much faster than film.

3.4.3.5 DIGITAL VIDEO

Digital video evolved from a combination of computer technology and analog recording. As with digital sound, digital video is stored using binary code. The difference between static images and video images is that video is time based. Each image is played back at a constant
speed to achieve the illusion of motion. When sound accompanies a digital clip it must also be
digitised and stored. It is important that this is done in such a way that both the digital clip and
sound are synchronized as the information is fed from storage to the video and audio processor
and from these to the monitor and speakers.

Video which is converted to digital form is easier to work with as its clips can be edited and
moved around. Transitions and effects can be added when moving from one subject to another,
or from one screen to another. Titles and graphics can also be added and audio can be changed,
deleted or updated as necessary.

**Advantages of Digital Video**

1. **Enhanced interactivity**

   Since videotape is linear in nature, it allows for little interactivity. Digital video is different
   in that when a digital video production is run on a powerful PC with a fast hard drive, it can
   be delivered almost instantly, thus avoiding long waiting times.

2. **Cost Savings**

   The cost of digital video system equipment is falling rapidly, in particular where broadcast-
   quality production is not a necessity. With an inexpensive capture board, a camcorder and
   software one can capture, compress and playback video clips. These can then be
   incorporated into other applications.
3. **Storage Flexibility**

Digital video can be captured and stored for the intended screen size in which it will be presented. This saves much storage space in contrast to analog video. With analog video the clip can only be stored at the screen size in which it is captured. Thus each clip requires the full signal information for a full screen regardless of whether it is for use on a full screen or a small screen. Digital video, which will fill a quarter of a screen, only requires an image to be captured and stored as this.

4. **Editing Facility**

Because digital video information is stored using numeric values, it can be edited without quality loss. The only time quality is lost is during compression and decompression when information may be lost. Using analog video it is difficult to avoid quality loss. After duplicating and editing the clip quality is lost due to unwanted noise from tapes and recording heads. For this reason most editing is done on copies of the information where selected clips are copied and recorded to a master from the source tapes.

5. **Flexibility**

Digital video is very flexible in that it allows the user to make changes very quickly. Changes can be made and while allowing the original clips to be kept also.

[Lindstrom 1994: 327-330]
3.4.3.6 VIDEO FORMATS

One of the biggest challenges with multimedia files is keeping file sizes to a minimum. The file format chosen will have an impact on this. There are numerous video file formats to be chosen from. The following section looks at some of these.

3.4.3.6.1 MPEG

Moving Picture Experts Group (MPEG) was formed by the joint direction of the International Standards Organisation (ISO) and the International Electro-Technical Commission (IEC). The group works on standards for the coding of moving pictures and associated audio. This standard is a very efficient way for storing video clips, as most MPEG files are usually 3 – 10% smaller than files in other formats. [Jung 1997]

MPEG approaches the growing need for multimedia standards and three phases of MPEG have been defined to date:

MPEG-1 – Focuses on the Coding of Moving Pictures and Associated Audio for Digital Storage Media operating at up to about 1 Mbit/s. It deals with the synchronization of video and audio, and video and audio compression.

MPEG-2 – This is used for higher data rate interlaced video applications operating in the 3 – 15 Mbps range. [King 1995] It is broadly aimed at the broadcasting community. This standard has been used by the television industry.
MPEG-4 - This standard is aimed audiovisual coding schemes for low bit rate wireless communications. It uses object-based audiovisual coding and is expanded to target applications such as audiovisual data (TV, film), interactivity (computer), and wireless (telecommunications). [King 1995] Thus, it is very much aimed at the multimedia environment.

MPEG makes use of the capabilities of the human eye. It determines which colours the eye cannot see in a particular frame and the colours that cannot be seen are removed from the palette. The main disadvantage of MPEG is that it is extremely math intensive and for this reason it takes a lot of time to create an MPEG clip.

3.4.3.6.2 QUICKTIME

QuickTime digital video format was developed by Apple and is predominantly used for the Mac environment. QuickTime is a standardised file format for production and playback that allows video and audio to be captured and combined in a file on one machine and played back together on any other machine running QuickTime. [Lindstrom 1994: 332] Although not as efficient as MPEG, it offers reasonable file size and video playback ability. [Jung 1996] QuickTime files can only be created on a Macintosh computer but can be played back on any PC that has Apple’s QuickTime for Windows.

QuickTime uses a file compression format known as M-JPEG that compresses video clips into small file sizes.
3.4.3.6.3 AVI

The AVI (Audio-Video Interleaved) video file format, defined by Microsoft, is the most common format for audio/video data on the PC and can be played on Windows, Unix and Machintosh platforms. [McGowan: 1998] Windows 95 has a built-in AVI player in the form of a Media Player. Microsoft’s Web browser and Internet Explorer can view AVI files. The audio tracks in AVI files are waveform (WAV) audio data used by the WAVE system. Video for Windows, a helper application that handles AVI, extracts the WAV data and pipes it to the WAVE system. It handles the video track itself, through it’s MediaPlayer application. The data in AVI is ordered in time sequentially as it appears in the file. The player application displays the video frames at the frame rate indicated in the file header and the audio at the audio sample rate indicated. AVI files can be converted to the QuickTime file format.

Both QuickTime and AVI support different types of compression and they also combine audio and video. Since audio and video are combined together in one file, they appear to be in synchronisation when played back.

3.4.3.7 PRODUCING VIDEO FOR MULTIMEDIA

Lindstrom (1994) suggests four stages in producing video for multimedia productions. These include:
1. **Analog video acquisition.** This involves selecting the equipment needed and shooting the video.

2. **Digital capture, processing, and storing.** This includes digitizing the analog video and selecting the hardware and software for compressing and decompressing.

3. **Editing, adding effects, and titling.** Selection of editing software is carried out.

4. **Delivery and display.** Display devices are decided on.

**Analog Video Acquisition**

With Digital Cameras now available on the market, analog video acquisition is not necessary.

The Sony Digital Camera can input directly into the new G4 Macintosh. This information is digital and as a result no sampling is needed. Therefore, no loss in quality occurs.

**Guidelines in Shooting the Video**

- The camera is as stable as possible. Using a tripod with a ‘fluid head’ helps to avoid unnecessary movement of the camera. This is important because moving images take up more file space. When preparing footage for the web the file is compressed to decrease download time so the less movement there is the smaller the file will be. The camera movements should be motivated and there should be no reason to move them unless someone in the video moves around. Moves that have no artistic purpose draw attention to themselves as intrusive mechanics.

- Good cables and auxiliary microphone and headphones should be used.
• The camera should be moved very slowly. Otherwise the picture would not be visible on the Web.

*When deciding on the picture composition of the video shoot:*

• It is important to leave space around the subject in the film. This is an issue of *picture framing*. Vertical Framing is where the subject is focused on from the front. Then using vertical framing, particularly on close-ups, it is important to avoid too little or too much headroom. The subject’s head should not touch the top or the end of the frame, their chin should not rest on the bottom of the screen or ears should not be cut off at the side. A person’s face is comfortably in the picture when the bridge of the nose is about two-thirds of the way up the picture. If the person is looking to one side then they should be placed slightly on the other side of the picture. This room should be given or else it will seem as if the person is staring at the side of the screen.

• The background should not be too busy or similar to the person being filmed. This is especially important for Web applications. A background object such as a bunch of flowers sprouting from the top of someone’s head should be avoided.

• To avoid starting and stopping the video camera it is important to sketch out a storyboard to show each scene that will be used.

• Exceedingly light or dark backgrounds should not be used.

• A person walking in a picture needs to be given walking room.

• It should be decide who or what is the main point of interest in the picture and frame the shot so that the viewer’s eye is lead towards it. The focus of the picture does not have to be
in the centre of the picture but it should be set in relation to other things in the picture, the lighting, the camera angle and the way the camera moves. A general shot should be avoided where the viewer is looking at the picture and wondering where he/she should be looking.

3.4.3.8 INTEGRATING VIDEO INTO WEB PAGES

Video clips can be inserted into a web page in two ways:

1. By embedding the clip into the web page
   The main advantage with integrating the video clip into a web page is that it adds more excitement to the web page. The disadvantage, however, is that it takes longer to download the web page and some people may not have the compatibility to play the video clip. A video clip can be inserted into a web page using the HTML EMBED tag and specifying the SRC attribute to point to the web page.

   `<EMBED SRC = "FILENAME.EXT">`

   The video clip will appear on the web page in the location that the above code is placed.
   When deciding on the height and width attributes of the video clip it is important to consider the browser and file format as different browsers view the clip in different sizes.

2. By allowing the user to download the clip so that it can be played back at any time.
   Using this approach the user can download the video clip, save it and view it when needed. This is done by allowing the clip to be available as a file. Using this method everybody can access the entire web page and those interested in the actual video will access it when
needed. The disadvantage of this method is that the page lacks a certain uniqueness that is supplied by using a video clip. One method of doing this is to take a screen shot of one frame in the video clip and save it as a GIF file. A link can then be set up between the still image and the actual video file.

Allowing the clip to be available as a file is the most popular approach when using video on the web. For this reason it is important to think of the client browser (the browser the viewers will be using). Each media clip file format is completely incompatible with others. Thus, all files should be in one particular format. QuickTime is an easy-to-use interface and is available for both Mac and Windows environments. Plug-Ins\(^\text{12}\) are also available for Web browsers which extend the capabilities of browsers and may provide support for many different video clip formats.

### 3.5 STORING MULTIMEDIA DATA FOR USE ON THE WEB

Since the advent of computers there has been a significant change in the way information is stored. Before the era of paper or computers information was documented on parchment. Following this parchment era the introduction of paper meant that documents were created on paper and stored in filing cabinets. A complete shift took place with the invention of computers where the storage of information on paper is decreasing significantly. In modern business most information is stored electronically.

\(^{12}\) Plug-ins are small add-on pieces of software that extend the capabilities of your web browser.
The arrival of World Wide Web (www) has now encouraged organisations to take advantage of the global customer base. This involves the creation of a Web site to advertise products, provide order forms, provide methods of payment through credit cards, etc. Cultural and heritage centre are also taking advantage of the Web where they advertise their premises and encourage people to visit it. The development of the WWW has brought an important consideration with it, the most important consideration being that of information storage. Because there has been a major shift towards use of multimedia applications, it has brought a major impact on storage medium used.

3.6 FILE SYSTEM STORAGE

Following the introduction of the first computers in the 1940s, the 1960s brought the development of the first application used to manage large quantities of data. These held data using file system storage. No collection of records needed to be kept in a back-end database. At this stage the database concept not yet arrived. This file system storage made use of the standard file access methods via third generation computer languages such as Fortran, PASCAL, and C. Today, it is used more for storing multimedia data associated with Web sites. [Brosnan 1999]
3.7 WORLD WIDE WEB

There are many different definitions of the World Wide Web. It can be described as a 'worldwide collection of text and multimedia files and other network services interconnected via a system of hypertext documents'. [Learn the Net 2000] Http (Hypertext Transfer Protocol) was created in 1990 at the European Particle Physics Laboratory (CERN) in Geneva. Hypertext is text containing a link to other text. CERN developed the HTML programming language to allow these links to be attached to other pages on the Web.

Hethmon (1997) describes the WWW as 'the largest client/server system implemented to date'. It is made up of clients and servers, all exchanging information. In a client/server system, a proprietary client talks to a proprietary server to accomplish some task. In order to accomplish this task certain protocols are used between the client and the server. A protocol is a standard or set of rules that two computers use to communicate with each other. These standards ensure that different programs and different network products can work together. Any product using a given protocol should work with any other product using the same protocol. TCP/IP (Transmission Control Protocol/Internet Protocol) is the language governing communications between all computers on the Internet. It is a set of instructions dictating how information is sent across multiple networks. It also has a built-in error-checking capability to ensure that data arrives at its final destination in the proper order.
HTTP is a request-response protocol where the client application sends a request to the server and then the server responds to the request. There are three general request-response chains in which HTTP operates. [Hethmon 1997]

1. **The user agent makes a request directly to the origin server.** Here the user connects to the origin server on the default port of 80 and sends the request. The server waits for incoming connections and then starts the process to answer the new request. Once this request is processed it sends the response back to the agent over the connection. See Figure 3.3.

![Figure 3.3: Basic client to server HTTP operation [Hethmon 1997]](image)

2. **Request-response chain needs a proxy or cache agent as an intermediary.** The user agent makes a request to the proxy instead of the origin server. The proxy then makes a request to the server on behalf of the client. The server replies to the proxy, which in turn sends the reply to the agent. This is usually used in firewall environments where the LAN (local area network) is isolated from the Internet. See Figure 3.4.
3. *An intermediate agent acts as a tunnel.* A tunnel funnels requests and responses between two HTTP applications by providing a path for the user agent to the server. A tunnel is different from a proxy in how it operates. The user agent sends and receives responses from the origin server. The tunnel does nothing to the requests and would only be used to route HTTP traffic over a non-TCP/IP link. See Figure 3.5.

**Figure 3.4:** Client to proxy to server HTTP Operation

**Figure 3.5:** Client to Tunnel to server HTTP Operation
Life on the Web can be a much richer experience when sound and movement are used to make information come alive. To experience multimedia online certain additions are needed for a computer:

1. A sound card and video card must be fitted to the computer
2. Special pieces of software called plug-ins are needed.

3.7.1 Plug-Ins

Plug-Ins are extend the capabilities of the web browser, such as Microsoft Explorer and Netscape Navigator. Plug-ins are small add-on pieces of software that conform to the Netscape Navigator standard. Microsoft Explorer supports Netscape's plug-ins even though it uses a different software standard called an ActiveX control, instead of a plug-in. Many of these plug-ins can be downloaded for free over the Internet. Popular plug-ins are Shockwave which can be used for animation and interactivity. This is a product Macromedia product. Macromedia also provides a plug-in called Flash. This also provides animation on your computer. QuickTime, a plug-in for playing video clips, can be downloaded from the Apple Computer website. This allows one to watch movie trailers and other multimedia programs. [Learn the Net 2000]
3.7.2 User Interface Design for Web Sites

*Keep it simple, stupid!*

When one finds a good user interface, one can use it almost intuitively and for this reason a user interface should be simple and easy to use. A user interface allows the user to interact with the application that is developed. Designing for printing and designing for on-screen viewing are completely different. Print design is based on letting the eyes walk over the information, and selectively looking at information. On the other hand, web design functions by letting the hands move the information by scrolling or clicking on objects. [Mouty 1999]

A Graphical User Interface (GUI) of a computer system *'includes the interaction metaphors, images and concepts used to convey function and meaning on the computer screen ...'*. [Lynch 1994] The purpose of a graphical user interface is to provide a visual environment for the user to work with. The graphic interface directs and focuses the user’s actions, making the system accessible to him/her. The structure of this interface consists of pull down menus, buttons, text fields and icons which are activated by clicking on them either once or twice with a mouse.

As web sites are primarily viewed on screen the main goal of graphic design for the computer screen is to establish a consistent visual structure, where important information is immediately obvious and everything else is subordinate and undistracting. Due to the low spatial resolution of many display screens, graphics must be carefully crafted to match the screen’s grid of pixels. Fine details in graphics and fonts should be avoided.
Graphic user interfaces combine visual and functional metaphors drawn from everyday experiences to help the computer to familiarise themselves with the uses of the system they are about to use. For example, in the normal windows environment a document is deleted by putting it in the trash can, new e-mails are found in the in-mailbox, a file is saved by clicking on an icon shaped like a disk, etc. Using relevant graphics to guide the user in the archive is very important as many potential users will have little computer experience.

Before designing the user interface it is important to know who the potential users of the system are. When the end-user needs and computing experience are known it is easier to create an interface that helps them achieve their goals. In the case of the archive developed there were two groups of potential users for the system and these were defined as follows:

**Group 1 – End-Users**

- The end user, i.e. the Heritage Centre visitors, will only be able to view the system.
- They can be of any age group interested in researching the history and music of Sliabh Luachra.
- They need access to an Information System that will supply them with easy access to the above information.
- Many will be researchers or musicians visiting the Heritage Centre whose levels of computer literacy differ.
- The culture and nationality of people varies, as the archive is for use in a public centre.
Group 2 – Database Administrators

- These people have a basic level of computer literacy and know how to input information to a database.
- They will use the database to add, delete, edit and search for information.
- They will show visitors to the heritage centre how to use the information system.

Some aspects of user interfaces attract attention more than others do. The human eye is a non-linear device which possess edge-detection abilities. It also has a motion-detection hardware, which means that our eyes are drawn to animated areas of the screen more quickly than static areas. [Talin 1998]

It is also important to listen to what people have to say. Valuable insights can be gained by watching people using the system and by listening to the opinions. It is important to develop a design which, though it may not satisfy everyone, will satisfy most of the system users. It is important to keep in mind that the skill of using a computer is actually much more difficult than it appears. For this reason the system must be easy enough to use for a user with very little, if no computer knowledge. [Talin 1998]
3.7.3 Guiding Users through Information

Many problems arise when designing multimedia documents. These include how to inform and
guide the user through a complex and vast amount of information and how to create a visual
design, which enables interactive computer displays. As an aid to creating a well designed web
page/GUI certain rules should be followed:

1. **Be consistent.** A consistent approach when designing a web site help to ensure that the
   web site looks good, that information is presented clearly and that navigation symbols are
   consistent through the site. This reduces the amount of mental effort the users needs to get
   around.

2. **Use Informative Graphics.** Nonverbal symbols, icons, and other graphic metaphors
dominate user interfaces. Graphics used in the web site for navigational purposes may be
buttons with text on them (as is the case is this project). They are kept consistent
throughout the site so that, as the users go through the site, they will make an association
with the buttons and know that these buttons will take them forward or back, or to a search
page as requested or central starting point (home).

   In developing the database user interface buttons were also used. These were clearly
   labelled so that the database administrators know how to navigate the database.

3. **Make it easy to use by making it easy to read.**
4. **Navigating.** Users should be able to get to all the main parts of the web site from any location. Every page should provide links to every major section of the site. For this reason a special frame is set up at the left of each page of the archive user interface to guide people through the web site of the Sliabh Luachra archive.

When selecting names/text as links to other pages of a web site it is important that these links are meaningful. If the user reaches a useless information page then the effort was a waste of time and it caused unnecessary traffic on the Internet. This problem is minimized by ensuring that:

- Link names reflect the content of the page point to
- Link names should be specific and
- Technical words and terms that are not commonly understood should be avoided.

Links to other documents on the Internet are known as **hyperlinks.** On the World Wide Web, pages written in HTML use hyperlinks to link to other documents. When one clicks on hyperlinks it opens another web page, sound file or graphic. Http (HyperText Transfer Protocol) is a method used to transfer hypertext files across the Internet.

5. **Provide Index Pages.** An index of the topics on a Web site allows quick access to the pages with much navigation. By providing this the user can get to any section of the site easily without having to sift through it to find out what is in the site.
6. **Forgive User's Mistakes.** The user should always feel in control of the computer interface, and shouldn't feel that the computer will choose a topic or delete data if the user didn’t choose to do so. A well designed interface will be able to recover easily if the user makes a mistake.

3.7.4 **Users Technologies**

As regards developing the Web pages, HTML is platform-independent so the type of machines the end-user is using is generally irrelevant. As long as the computer being used can run a browser, they will be able to view the pages.

As the web is a visual medium, it is important to know what type of monitor the site is being developed for. If not sure it is best to design it for a lower-end standard such as a 14-inch monitor measuring 640 x 480, with the standard 256-color Windows palette. This ensures that all users will be able to view the site as not everyone has large, expensive monitors.

Browser software needs to be looked at as not all software support all the HTML tags. For a while America Onlines (AOL) browser did not process the HTML table tags, which meant many people could not view sophisticated layouts that can be created using tables. In general Netscape Navigator and Microsoft Internet Explorer support all the latest extensions to HTML. When adding audio or video clips or multimedia information a separate viewer program may be needed, for example, a helper application like QuickTime to run movies. Alternatively, plug-in
may be needed to view some content on the page. Thus, it is important that the end-user has the software needed to view these.

It is also important to consider the **Loading Time** for the web pages developed. Loading time depends on a number of factors:

- The speed of the server
- The speed of the internet backbone
- The speed of the Internet Service Provider
- Speed of the connection hardware modem or broad-band cable speed, which depends on the number of current users at the time. [Smith 1999] Some designers design their pages and browse through them at the same machine. By doing this they do not have to wait impatiently for a page to download over a 14.4 kbps modem. An image of 356k with a modem connection of 14.4 kps takes approximately 4 minutes to download which is far too long for any user to wait. For this reason some multimedia content may have to be eliminated to avoid long downloading times. The total size of graphics on a page should amount to no more than 35k. An image this size on a modem connection of 14.4 kps will download in 31 seconds. Another option is to set up links to large multimedia items and thus the user has the option whether they want to download the file or not. This option is given to users of the web site developed for this archive.

Another important aspect is to check the web site on different browsers and to check the download time on different machines. This will show up any problems that may occur. It
will also show how long it takes for each page to download. A popular rule of thumb is that any page shouldn’t take more than 15 seconds to download.

3.8 CLARIS HOMEPAGE

Claris Home Page version 3 was used to create the web pages for the Sliabh Luachra archive. Claris Home Page is a WYSIWYG Web authoring tool for creating Custom Web Publishing solutions for FileMaker Pro.

It contains a FileMaker Connection Assistant which allows it to read files from the FileMaker Pro database. In order to connect to the database an IP address of the computer on which the database is open and running on must be specified. This enables Home Page to connect to the server.

Before FileMaker Pro files can be published on the Web, the Web Companion plug-in File Maker Pro must be enabled and configured. This is done in the Application Preferences menu, in the Web Companion Configuration dialog box. Following this the homepage for Sliabh Luachra created and stored in the Web Folder in the FileMaker Pro folder. The Web Companion was configured so that it automatically displays this home page when opening the archive. Finally, the Web Companion Sharing was enabled for each database file that was published using Home Page. This was carried out using the Sharing option in the File menu.
Netscape Navigator is the Web browser used for viewing the files. In order to view the web site, Netscape Navigator is opened and the database files are running in the background. The URL is entered in the following format:


In this address the x’s refer to the IP address. A port number 591 was specified in the Web companion Configuration dialog box, so the colon and 591 represent this port number. The webpages represent the folder that contains the homepage.htm file. This webpages folder is stored in the Web directory of the FileMaker Pro database.

### 3.8.1 Problems Encountered with Claris Home Page

The main problem encountered in using FileMaker Pro (database software) with Claris HomePage was when Claris HomePage had to play video clips or MIDI files directly from container fields created in FileMaker Pro.

As regards video files, Claris HomePage extracted the video clip from the database field as if it was an image. It did not have the power to play this video clip directly from the database. As a result separate web pages containing video clips were created. The MIDI files created using CUBASE were not compatible with Claris HomePage. For this reason the sound files can only be heard in the archive database.

A possible solution to these problems would be the use of a product called Tango for FileMaker by Everyware Development Corporation which is a product that enables one to build database
Web publishing solutions for FileMaker Pro. Alternatively, Blue World Communications’ Lasso product line enables the creation of flexible database Web publishing solutions for FileMaker pro. Lasso supports additional tags and commands not included in FileMaker pro. Both of these products only work on the Mac Operating System.

### 3.9 CONCLUSION

The Web interface mechanism was used to provide a unique identity for the archive and it was developed in such a way that anybody, whether a computer expert or someone with basic computer literacy, would be able to use it. Pictures and animated gifs were kept to a minimum to avoid users loosing their patience waiting for images to load. To overcome problems which may arise with loading large files, the user is given a choice as to whether they want to view pictures or not.

The content on each Web page was kept to a minimum. Researchers or people visiting the Sliabh Luachra Archive are, for example, given a brief history of some musicians. To view more information they must search the back-end database.

In conclusion, the combination of all the different aspects of multimedia helped bring the Sliabh Luachra culture and history onto a computer screen, alive and available for viewing by people worldwide, in a way that can be preserved for our present and future generations to appreciate.
CHAPTER FOUR
CHAPTER FOUR

DATABASES

4.1 INTRODUCTION

The aim of this chapter is to define the purpose of using a database for storing the archive material available in Scartaglen. Following this the development stages of the database are outlined.

4.2 BACKGROUND

As can be seen from Chapter 1 the Scartaglen Cultural and Heritage Centre currently store all their material manually which presents the problem of wear and tear on the archive material. The centre needed to offer a facility to the public where those visiting the Centre could access
the archive material without damaging the original copies. The information had to be available on demand. Thus, the development of an Information System using a database was the obvious choice for storing this folklore, history and music.

The system used by the centre prior to the development of the Information System was a manual filing system which was used in many offices up to the advent of the database. This manual filing system worked well when only a small number of items had to be stored. However, when the system grew and cross-referencing had to be introduced the system began to break down. For example, a musician's details were stored in the file containing all musicians born in a certain year, more information on this musician was stored in the file containing all musicians from a certain area, more again in a file containing information on musicians who also recited poetry, etc. Thus, a person looking for a complete review on this one musician would have to search several files according to the cross-referencing structure. With data isolated in separate files, it was much more difficult to access data that should be easily available. Also, in recording this information there was a significant amount of duplication of data.

The above resembled the older manual filing systems of many organisations. As these organisations progressed, just as the heritage centre did, their needs for accessing files and records increased and it became increasingly difficult to manage data. Traditional file-based systems were developed as an early attempt to computerise the manual filing systems but these were inadequate for integrating files and could not create links between records. From this the concept of the file was gradually replaced by that of the database.

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FileMaker Pro (version 4.1) was used to design the system for storing the historical data of Sliabh Luachra.

4.3 WHAT IS A DATABASE?

A Database is a collection of persistent related data. Data are known facts that can be recorded and have implicit meaning. A database has the following implicit properties:

- A database represents some aspect of the real world, which is referred to as the miniworld. In this project, the miniworld is the music archive of the Scartaglen Cultural and Heritage Centre.

- A database is a logically coherent collection of data with some inherent meaning.

- A database is designed, built and populated with data for a specific purpose. It has an intended group of users and some preconceived applications in which these users are interested. In this case the database is being built to increase the accessibility of the Scartaglen archive. The users it is being designed for include archivists and researchers among others.
A database is a collection of *interrelated* data which are:

- *shared* by multiple applications (users and/or programs),
- stored *less redundantly*,
- made *independent of applications*, and organised so as to provide a foundation for future
  application development

[Elmasri/Navathe 1994: 2]

Connolly & Begg see a database as "a shared collection of logically related data (and a
description of this data), designed to meet the information needs of an organisation." [Connolly,
Begg, 1999].

The database contains not only the organisational data, but a description of the data referred to as
the system catalog or meta-data. In traditional file-processing systems, the description of the
data is stored with the application program. Therefore, if the data structure changed, the
application program had to be changed. In a database, because information about the structure of
the data is stored with the data, any changes to the structure does not necessarily mean that any
application program accessing the data need be changed. This is referred to as data
independence. For example, an application displays the musician name and address from the
Musicians’ file. A new field is added to the file by another application. If the application is data
dependent (the data structure is stored with the application), even though the application does not
use the new field, to access the file, the data structure in the application must be modified. If the
application is data-independent, there is no need to change the application.
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The database is a single repository of data, which may be shared by many users. This sharing of data removes the requirement for unnecessary duplication of data. Unnecessary duplication is referred to as **data redundancy**. Data redundancy increases the requirement for disk storage. To update the data, several copies may be required to be updated to ensure that the data is consistent. Data inconsistency gives rise to incorrect information being retrieved and used for decision-making.

### 4.4 DATABASE MANAGEMENT SYSTEMS

A **database management system** (DBMS) is a collection of programs that enable users to create and maintain a database. The DBMS is a *general-purpose* software system that facilitates the process of defining, constructing and manipulating databases.

- **Defining** a database involves specifying the data types, structures and constraints for the data to be stored in the database
- **Constructing** the database is the process of storing the data itself on some storage medium that is controlled by the DBMS
- **Manipulating** the database includes such functions as querying the database to retrieve specific data, updating the database to reflect changes in the miniworld, and generating reports from the data

A DBMS organises information in such a way that it is stored in only one location and manipulated by many different applications using special database management software. It
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consolidates data management and operates independently from application programs, making it more efficient and cost effective.

DBMS is a foundational tool for organizing information in our global economy. The usefulness of information depends largely on how it is stored, organized and accessed. Poor management of information makes it difficult for a company to compete at its greatest potential.

4.4.1 ADVANTAGES OF A DATABASE MANAGEMENT SYSTEM (DBMS)

[Connolly, Begg 1999: 11-30]

It is now possible to explore the benefits to be derived from implementing a database management system for archiving the music and history of the Sliabh Luachra area.

1. **Control of data redundancy** – At present, much of the data regarding locations and musicians are duplicated in different locations. A database management system removes the need for unnecessary duplication – data redundancy – by allowing the data to be shared by different users and different applications. Any redundancy in the system can be controlled by ensuring that all copies of the data are updated.

2. **Data consistency** – By controlling redundancy we are controlling the risk of inconsistencies occurring. If an item is stored more than once the system is aware of this and can ensure that all copies of the item are kept consistent. This is very important when storing historical data such as the dates and eras of Sliabh Luachra musicians to ensure that dates are not
recorded two or more times differently. The DBMS ensures consistency by allowing a mechanism to be set up which prevents two concurrent users from accessing information in conflicting ways.

3. **More information from the same amount of data** – With the integration of the data more information can be derived. A person seeking information on a particular musician could also get information about other musicians who perhaps played the same instrument.

4. **Sharing of data** – The database can be shared by all authorized users as it belongs to the entire organisation. Thus, researchers looking for information in the heritage centre will have access to all files stored on the database. Similarly, if one user updates a record this changed data will be accessible to other users. Existing applications can share the data in the database and new applications can be developed to operate the same stored data.

5. **Improved data integrity** – This means ensuring that the data is consistent and that the data entered in the system meets certain requirements. An example of a lack of integrity is where there is an inconsistency as regards a fact, for example, a musician's date of birth may be entered as 1924 in one place and 1925 in another.

6. **Improved security** – This refers to the protection of the database against unauthorized access and use, from accidental or malicious damage. Thus, a system must be set in place to control who uses the database. A password system is the most common method. The
Database Administrator (DBA) normally has the authority to issue people with passwords and decide what level of access the person can have. In doing this the DBA must decide what information should be shared with everyone but cannot be changed, what information is sensitive and should be hidden from the occasional user or should the database be shared at all. [Kennedy 1999: 285]

7. **Enforcement of standards** – Certain standards can be implemented to ensure that all users, formats, and day-to-day operations are performed throughout the organisation uniformly. These standards may include access rules, data formats, update procedures, etc.

8. **Economy of scale** – When an entire organisation combines all it’s operational data into one database and creates a set of applications to work on this data, it cuts costs. The amount of wasteful overlap between activities of data-processing personnel in different departments is reduced considerably. This also applies to the Heritage Centre situation. All information will be contained and edited on one system.

9. **Balance of conflicting requirements** – Each user of the system may have different needs which may be in conflict with the needs of others. It is up the DBA to decide on a system which will provide the best use of resources for the organisation.

10. **Improved data accessibility and responsiveness** – As a result of the integration of data, all data will be available to all users unless otherwise restricted by the DBA. As soon as an update is applied to the database, all users can immediately see this update.
11. **Improved maintenance through data independence** – This is a major advantage provided by a DBMS. Independence occurs when the structure of a database can change without affecting the underlying programs that access the database or requiring them to change. In a DBMS the data descriptions are separate from the applications, thereby making applications immune to changes in the data descriptions. An example is where the view of the data can be changed without the changing the data itself.

12. **Increased concurrency** – DBMS are usually multi-user systems. They allow any number of transactions to access the database at the same time. To allow this, the DBMS must have a concurrency control mechanism to ensure that concurrent transactions do not interfere with each other’s operations. In FileMaker Pro a record locking system can be enforced to prevent multiple users from trying to make an update to the same record at the same time. This means that the user has exclusive rights to the locked record and no one else can access it until the lock is released. Another user trying to gain access would be informed that someone else is using it.

13. **Improved back up and recovery services** – Because damage to databases occur some form of recovery must be possible. Recovery means returning the database to a state that we know is correct from a state that we know is incorrect. [Kennedy 1999: 19] Recovery for most systems usually takes the form of a backup. If a problem then occurs the backup data can be loaded into the system. But sometimes a backup may not have been taken often enough or it may only be taken once a day. Modern DBMSs provide facilities to minimise
the loss of data such as the facility to recover the database and the ability to back up the database.

14. Protection of original material – Original music manuscripts, tablatures and miscellaneous documents are scanned into the database and stored there for viewing purposes. This avoids damage to original documents as the originals are left untouched. Copies of the documents can be obtained by printing them from the database instead of photocopying original material.

4.5 DEFINITION OF A DATABASE SYSTEM

There are many definitions of the term “database systems”, many placing emphasis on different areas.

Occardi sees it as a “large, integrated, shared pool of information in a form suitable for handling by a computer which is a basis upon which the computer user community within an organisation can draw inferences in conducting its business.” [Occardi 1992: 1] The information can be a fact such as the instrument a musician plays. Occardi looks at the purpose a database serves to the people who are going to use it. He also looks at the database as an ‘integrated, shareable’ repository for all the information needed to run the business or an organisation.
Kennedy defines a database system as ‘a computerized record system, that is a system whose overall purpose is to maintain information and make that information available on demand.’” [Kennedy 1999] In his view the database system consists of four major components:

1. **Data**: The data is the material stored in the database. Different users access the same data, but very often they differ in the way that they perceive the data. The perception depends on the operation each user wants to perform. Data is usually held in the database that can be shared among users in an organisation.

2. **Hardware**: This is the storage medium for the database. The database physically resides on the hard disk of the computer or may be stored externally on a Jaz drive, Zip drive, etc.

3. **Software**: This is what resides between the database and the users. FileMaker Pro 4.1 is the software used in this project. This database management system (DBMS) handles all the operations requested and performed by users of the system.

4. **Users**: These are the people for whom the database has been designed. The End User is the person who interacts with the database from a workstation which may be a standalone user or a user on a network. Connolly and Begg look at two types of end-users – naive users and sophisticated users. The database developed focuses on the naive-users where the user is unaware of the DBMS. They invoke operations by entering simple queries, for example, by entering a musicians name in order to find information about that musician. The scripting...
code written using FileMaker then searches the database for the users request and displays the information on screen. (See Appendix 5 for scripting code).

4.6 DATABASE SYSTEMS

The database approach provides some level of data abstraction by hiding storage details that are not required from the user. 'A data model is a set of concepts that can be used to describe the structure of a database'. [Navathe : 23] The structure of a database includes the data types, relationships and constraints that should hold for the data. The data model also includes the basic operations that take place on the data.

Data models can be categorised based on the types of concepts used to describe a database. **High-level or conceptual** data models provide concepts that are close to the way the user perceives data. **Low-level or physical** data models provide concepts that describe how the data is stored by the computer. Between these two extremes, there are **implementation** or **representational** models that provide a bridge between them. Representational data models hide some of the storage detail but are sufficiently detailed to allow storage on a computer system.

High-level data models use concepts such as entities, attributes and relationships. An entity represents a real-life object or concept such as a musician or an area. An attribute is a property of interest that describes the entity. For the entity musician, an attribute of interest is Name. A
relationship between two or more entities represents an interaction among the entities, for example, the Plays relationship between Musician and Tune.

Representational data models are the ones most used in commercial DBMSs. They include hierarchical, network, relational and object-oriented data models. The first three are record-based systems. Object-oriented data models are more akin to the conceptual data model.

Physical data models describe how data is stored in the computer, representing information such as record structures, records ordering and access paths.

In any data model it is important to distinguish between the description of the database, which is referred to as the database schema, and the data itself. A database schema is specified during database design and is not expected to change frequently. The actual data in the database may change frequently. The data in the database at a particular time is referred to as a database instance.

4.7 The ANSI-SPARC Three-Level Architecture

In 1975 the American National Standards Institute Standards Planning and Requirements Committee (ANSI-SPARC) recognised the name for a three-level approach to database architecture. This identifies three levels of abstraction – an external, conceptual and internal level as depicted in the diagram below. The goal of the three-level architecture is to separate each user’s view of the database form what is physically represented. This allows for:
• Users being able to access the same data but have a different view of the data from other users. Users should be able to change the way they view data without having to affect other users.

• Users should not have to concern themselves with the physical data storage

• The internal structure of the database should not be affected by changes to the physical aspects of storage.

• The DBA should be able to change the database storage structures without affecting the users' views.

**Figure 4.1:** The ANSI-SPARC Three-Level Architecture

![Diagram of the ANSI-SPARC Three-Level Architecture]
The way the user perceives the data is called the external level. The way the DBMS and the operating system perceive the data is the internal level. The conceptual level describes what data is stored in the database and the relationships among the data. It provides the mappings between the external and internal levels.

The overall description of the database is called the database schema. There are three different types of schema in the database.

The internal level has an internal schema which describes the physical storage structure of the database. It uses a physical data model and describes the complete details of data storage and access path for the database.

The conceptual level has a conceptual schema. This describes the structure of the database for a whole community of users. It hides physical storage structure details and concentrates on describing entities, data types, relationships, user operations and constraints.

The external level includes a number of external schemas. Each external schema describes the database from the point of view of a particular user group. Parts of the whole database may be ignored as the user is not aware or does not use them. The conceptual level supports each external view, in that any data available to a user must be contained in, or derivable from, the conceptual level.
In a DBMS based on the three-schema architecture, each user group refers only to its own external schema. The DBMS must transform a request on an external schema into a request on the conceptual schema and then into a request on the internal schema for processing. If the request is data retrieval, the data extracted from the stored database must be reformatted to match the user group’s external view. The processes of transforming requests and results between levels are called mappings. [Elmasri, Navathe 1994] The DBMS is responsible for mapping between the three schema.

4.7.1 Data Independence

A major objective of the three-schema architecture is to provide data independence. This is defined as the capacity to change the schema at one level without affecting the schema at the next highest level. There are two kinds of data independence:

- **Logical data independence** is the ability to change the conceptual schema without having to change the external schemas or application programs. [Elmasri/Navathe 1994] This means that the conceptual schema can be changed by the addition or deletion of record-types or data types without having to change the external schema unless the external schema is using a deleted record type or data type.

- **Physical data independence** is the capacity to change the internal schema without having to change the conceptual schema or external schema. [Elmasri/Navathe 1994]
4.8 DBMS LANGUAGES

DBMS support the two following sub-languages:

4.8.1 Data Definition Language

A data definition language (DDL) is used to specify or modify the database schema. It cannot be used to manipulate data. The DDL creates tables stored in special files, collectively called the system catalog. The system catalog includes the meta-data or database schema.

4.8.2 Data Manipulation Language

Data manipulation operations include:

- the insertion of new data into the database
- the deletion of data stored in the database
- the modification of data stored in the database
- the retrieval of data stored in the database

_The DBMS must provide a data manipulation language (DML) allowing users to issue commands for data manipulation._
4.9 OVERVIEW OF THE DATA MODELS

Modelling is an activity aimed at producing a correct, complete and consistent representation of the real world. This real world representation must be understood by both the user and the designer so that both know what is needed in order to establish a functional system. The representation must also be implementable in a certain environment. [Stanezyk 1990: 10] The basic elements of data modelling (entities, attributes and relationships) provide the basis for understanding the information domain of a problem. Using high-level data models we identify the problem close to the way many users perceive data.

There are many categories of DBMSs including hierarchical, network, relational and object-oriented. [Elmasri, Navathe 1994: 34-35] The hierarchical and network models were developed in the early 1960's whereas the relational model was not developed until the early 1970s. For this reason the hierarchical and network models are more closely linked to the traditional file processing concepts where they process one record at a time.

4.9.1 Object-Oriented Data Models

The object-oriented model represents data as a set of objects. These objects have attributes and methods. They can also relate to other objects. Object-oriented databases were developed to handle complex applications that other data models were not suited to.
4.9.2 Hierarchical Model

The hierarchical model represents data as ordered sets of tree structures and was developed in the 1960s. Each hierarchy represents a number of related records. One record forms the root of the tree and all others form dependencies. If a root of a tree or subtree is deleted then so are all its dependencies. In order to change to new applications or alter an application it may cause problems as the underlying structures were set up to suit the original application. With this model the user has to know the physical database being accessed.

4.9.3 Network Model

Similar to the hierarchical model, this network model was also developed in the 1960s. It was designed by CODASYL (Conference on Data Systems Language).

The Network Model is a system in which the user views the database as a number of individual record occurrences which may have any number of superior or subordinate nodes. It can handle one-to-one relationships, one-to-many and many-to-many relationships more easily than the hierarchical method.
4.9.4 Relational Model

The Relational Model was introduced by Codd in 1970. It is a formal model for representing relationships among attributes of an entity set and the associations between entity sets. [Codd 1970]

Codd based the model on three fundamental principles:

- Clear distinction between the logical and physical aspects of database management which resulted in data independence

- Structural simplicity, so that all users and programmers (irrespective of their computing knowledge) have a common understanding of the data and can communicate easily with one another about the data

- Set-oriented process i.e. the ability to express in a single statement the processing of multiple sets of records at the time. [Stanezyk 1990: 37]

In this model data and relationships are viewed through two-dimensional tables each of which has a number of columns. These two dimensional tables are known as relations. A relation holds data about an entity type in a database. Each tuple describes one occurrence of the entity type. The attributes describe a feature of the entity type. Each table has a fixed number of
columns called attributes and a variable number of rows called tuples. Thus the rows in the tables represent the data records. (see figure 4.2 for an example of this table).

**Figure 4.2:** Relational Tables

<table>
<thead>
<tr>
<th>Musician Name</th>
<th>Instrument Played</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnny O’Leary</td>
<td>Fiddle</td>
<td>Knocknagree</td>
</tr>
<tr>
<td>Padraig O’Keeffe</td>
<td>Fiddle</td>
<td>Scartaglen</td>
</tr>
<tr>
<td>Dan Herlihy</td>
<td>Accordion</td>
<td>Ballydesmond</td>
</tr>
<tr>
<td>Maurice O’Keeffe</td>
<td>Fiddle</td>
<td>Kiskeam</td>
</tr>
<tr>
<td>Emma O’Leary</td>
<td>Fiddle</td>
<td>Castleisland</td>
</tr>
<tr>
<td>Denis O’Connor</td>
<td>Banjo</td>
<td>Castleisland</td>
</tr>
<tr>
<td>Nicky McAuliffe</td>
<td>Fiddle</td>
<td>Castleisland</td>
</tr>
</tbody>
</table>

Attributes = Musician Name, Instrument Played, Area
Tuples = MSN001, Johnny O’Leary, Fiddle, etc, etc
Relation Name = Musicians

An important feature of this relational model is that all physical implementation details are hidden from the user. This means that no background structures are visible.

4.9.4.1 ENTITY-RELATIONSHIP MODELLING

The Entity-Relationship model is a high-level conceptual data model developed by Peter Chen in 1976 to facilitate database design [Connoll, Begg 1999]. The main purpose of using a high-level conceptual data model is to capture the users’ requirements and to conceal the technical aspects of the design.
In database design, the first step involves requirements collection and analysis. Users are interviewed to discover their data and functional requirements. These are documented as fully as possible.

The external schema provides a view of how each individual user will see the data in the system. It includes only the entities, attributes and relationships that the users is interested in. Other attributes, entities and relationships that are not of interest to the user can be included in the database but the user will be unaware of them. Any number of external schemas can be defined. The views may include data from several different entities. In this archive different views had to be defined for the potential users of the system.

- A schema was developed for musicians who would be looking for information on the musicians from the area. Musicians would look for the history of the musician they are seeking information on and information on his life history.

- These musicians would also look for information on the instrument that that person played so another schema had to be developed to show information about instruments.

- A schema was developed for those seeking some new music tunes. In this the researcher would get information on the music tune in question and also see the notated music tune. In some instances they would also hear the tune (via a sound sample) and perhaps see a musician play this tune (from a video clip).
• Tourists would be interested in information about the area in question, thus a schema designed to show details on a specific area was designed. Some expressed the fact that they would also like a link to show them the musicians from the area in question so this was taken into account when designed the schema for this user.

• Tourists/visitors to the area would like to learn about the different music categories that exist in Irish music. This gave rise to developing a schema to provide this information.

The next step is conceptual database design. Here, a conceptual schema is designed using a high-level conceptual data model. The conceptual schema is a concise description of the data requirements of the users and includes detailed descriptions of the data types, relationships and constraints; these are expressed using the concepts provided by the high-level data model. [Elmasri/Navathe] The high-level data model does not include implementation details and so are easier to understand by non-technical users. It is also independent of the DBMS to be used.

Once the conceptual schema has been designed, the functional requirements can then be taken and high-level transactions can be specified. If the conceptual schema cannot support any of the functional requirements, the schema can be modified to accommodate them.

Having completed this stage, the design is taken and a model is created to suit the implementation model of the DBMS to be used. This step is referred to as logical database design.
The last step is **physical database design** where internal storage structures and file organisations are specified. The database design is now DBMS dependent – designed to suit the particular database management system used.

### 4.9.4.2 ER MODEL CONCEPTS

The ER model describes data as entities, attributes and relationships.

#### 4.9.4.2.1 ENTITIES AND ENTITY TYPES

An **entity type** represents a real-world object (e.g. a musician, an instrument), an action (e.g. playing a tune), an event (e.g. a concert) or a place (e.g. a concert hall), of interest to an organisation about which information is recorded.

An **entity** is an uniquely identifiable instance of an entity type. For example:

- Maurice O’Keeffe, Kiskeam
- Dan Herlihy, Ballydesmond.

Both Maurice O’Keeffe and Dan Herlihy are of the entity type Musician. Their names and areas are attributes that describe them.
4.9.4.2.2  **ATTRIBUTES**

Every entity type has attributes that further describe it. For example, attributes describing a musician may be their name or date of birth. Attributes are defined over a domain which corresponds to the range of values which the particular attribute can hold. For example, the range of values for 'gender' is either M or F. The range of values of date-of-birth would be less than the present day. These are referred to as attribute domain constraints.

4.9.4.2.3  **KEY ATTRIBUTES**

An entity type usually has an attribute or set of attributes which have the property that for each occurrence of the entity type, the value of the attribute or set of attributes is unique. This is referred to as the key attribute. Some entity types have more than one key attribute.

4.9.4.2.4  **RELATIONSHIPS**

'A relationship type is a set of associations between two or more participating entity types.'

Each relationship type is given a name that describes its function. [Connelly, Begg 1991: 157]

For example, a Musician is associated with an Instrument through the relationship plays.

A relationship is an association between several entity types.
The **degree of a relationship type** is the number of participating entity types in a relationship. The entities involved in a relationship are the **participants** in that relationship. The number of participants in a relationship is called the **degree** of that relationship. There are different **degrees** of relationships. For example the plays relationship type is of degree two which is known as **binary**. A relationship type of degree three is known as **ternary**. A relationship type of degree four is known as **quaternary**. The most common degree for relationships is binary and the cardinality ratios for these relationships are: one-to-one (1:1), one-to-many (1:M), and many-to-many (M:N).

**Cardinality Ratio** specifies the number of relationship types that an entity can participate in.

### 4.9.4.2.4.1 One-to-one relationship (1:1)

A one-to-one relationship is a relationship between two entities, in which each occurrence of the first entity is related to one occurrence of the second entity type and each occurrence of the second entity type is related to one occurrence of the first entity type.

In the following one-to-one relationship example a single tune can have only one manuscript and each manuscript can have only one tune. Thus, the cardinality ratio for this relationship is 1:1. The relationship type is displayed as a diamond-shaped box, connected by straight lines to the rectangular boxes representing the participating entity types.
A one-to-many relationship is the most common type of relationship. In a one-to-many relationship, each occurrence of the first entity type is related to many occurrences of the second entity type and each occurrence of the second entity type is related to only one occurrence of the first entity type.

In the following example, a single area can have many musicians living in it but a musician can only come from one area. The binary relationship is comes from. In deciding on the cardinality of the relationship we look at the entities involved in the relationship and choose the relationship using the higher cardinality. A musician can come from only one area so from the Musician point of view the relationship is a 1:1 relationship applies. An area can have many Musicians.
coming from it so a 1:M relationship applies. As the relationship with the higher cardinality is used the cardinality ratio for the comes from relationships is 1:N.

**Figure 4.4:** One-to-many relationship

![One-to-many relationship diagram](image)

### 4.9.4.2.4.3 Many-to-Many Relationship (M:N)

In a many-to-many relationship, each occurrence of each entity type can be related to many occurrences of the other entity type. In the example below any musician can play any number of instruments. On the other hand, any instrument can be played by any number of musicians. This relationship between MUSICIAN and INSTRUMENT is known as a ‘many-to-many’ relationship.
Entity types that may not have any key attributes of their own are known as weak entity types. These entities are identified by their relationship with entities from another entity type. The other entity is known as the owner entity. Thus the primary key of the weak entity is fully or partially derived from the owner entity. The relationship relating a weak entity type to its owner is the identifying relationship of the weak entity type. Because the weak entity cannot be identified without its owner entity it always has a total participation constraint as regards its identifying relationship.

For example, in this system, two entity types were identified – Musicians and Pictures. Pictures is used to store photographs of Musicians via a 1:N relationship. The attributes of Musician Pictures are Picture No and Picture Title. Two pictures of different musicians may have the
same value for Picture No and Picture Title but they are still distinct entities. They are identified as distinct entities only after determining the Musician entity to which each is related. Each musician entity is said to own the dependent entities that are related to it.

Weak entity types usually have a partial key which is a 'set of attributes that can uniquely identify weak entities related to the same owner entity.' [Elmasri 1994: 56]

Having specified the entity types, attributes and relationship types, we can then draw an ER diagram. ER diagrams emphasise the schema rather than the instances. The diagram notation is included in Appendix 6.

Once the conceptual data model has been developed, the model is used to develop the implementational model. For this project, the relational data model was used.
4.10 RELATIONAL MODEL

The relational model represents the database as a collection of relations. Informally, a relation is referred to as a table.

A relation schema R, denoted by \( R(A_1, A_2, ... A_n) \) is made up of a relation name R and a list of attributes \( A_1, A_2, ... A_n \).

A relation \( r \) of the relation schema \( R(A_1, A_2, ... A_n) \) is a set of n-tuples \( r=\{t_1, t_2, ... t_n\} \). Each n-tuple \( t \) is a list of n values \( t=<v_1, v_2, ... v_n> \) where each value \( v_i, 1 \leq i \leq n \), is an element of \( \text{dom}(A_i) \) or is a null value.

A relation is defined as a set of tuples or rows. Mathematically, the elements of a set are unordered.

The values in a tuple are atomic values. Therefore, composite and multivalued attributes are not allowed. This assumption is referred to as the first normal form. Multi-valued attributes must be represented in separate relations. Composite attributes are represented by the atomic component attributes.
4.10.1 Relational Model Constraints

4.10.1.1 DOMAIN CONSTRAINTS

The value of each attribute A must be an atomic value from the domain of that attribute.

4.10.1.2 KEY CONSTRAINTS

A relation is defined as a set of tuples. By definition, the elements of a set must be distinct. No two tuples can have the same combination of values for all their attributes. There is a subset of attributes that have the property that no two tuples have the same combination of values for these attributes. This subset of attributes is called a superkey.

A superkey can have redundant attributes. A key K is a superkey of a relation schema R with the additional property that the removal of any of the attributes leaves a set of attributes K' that is not a superkey of R [Elmasri p.144]. A key is a minimal superkey. The value of a key attribute can uniquely identify a tuple. No two tuples can have the same combination of values for the key attributes.

A relation may have more than one key. Each of the keys is then referred to as a candidate key. One of the candidate keys is selected to be the primary key of the relation. This is the candidate key that is used to identify the tuples in a relation.
4.10.1.3 ENTITY INTEGRITY CONSTRAINTS

The entity integrity constraint states that no primary key value can be null. The primary key value is used to uniquely identify a tuple. Having null values for the primary key implies that we cannot identify some tuples. If two tuples had null values for their primary key, it would not be possible to distinguish between them.

4.10.1.4 REFERENTIAL INTEGRITY CONSTRAINTS

To understand referential integrity constraint, we must first understand what a foreign key is. A set of attributes FK in relation schema $R_1$ if it satisfies the following two conditions:

- The attributes in FK have the same domain as the primary key attributes PK of another relation schema $R_2$; the attributes FK are said to reference or refer to $R_2$.

- A value of FK in a tuple $t_1$ of $R_1$ either occurs as a value of PK for some tuple $t_2$ in $R_2$ or is null. [Elmasri/Navathe 1994: 147]

If referential integrity occurs it means that ‘if the foreign key contains a value, the value must refer to an existing occurrence in the parent relationship’. [Connolly, Begg 1999:257]
4.11 BUILDING A DATABASE MODEL WITH THE RELATIONAL MODEL

In order to design and implement a database system a bridge between the real world and the
computer must exist. The operations of the organisation are analysed to determine the types of
data of interest to that organisation.

Designing any system can be broken down into three phases:

1. Conceptual
2. Logical and
3. Physical database design. [Connelly, Begg 1999: 227]

During the conceptual stage a model is constructed of the information used in the organisation.
Following this the logical stage is the process of constructing a model of the information used
based on a specific data model. Finally, the physical stage produces a description of the storage
structures and access methods used to efficiently access the data. Decisions taken at the physical
design stage may affect the other two stages due to the fact that the designer decides on a
physical design for improving performance.
4.11.1 Stage 1: Conceptual Data Model

During this phase a requirements analysis is carried out in order to determine what is required of the system by potential users. In developing the archival system this stage of the process was carried out by conducting meetings with these potential users (researchers, musicians, students).

From these meetings certain assumptions were made about the system:

- The system would be designed for communities to store the history of their area. The focus was on the Sliabh Luachra area but it would be adaptable to any area.
- The system would be designed for use on-line.
- It would serve as a marketing tool for the community where it will be an attraction for people to visit the heritage centre and for this reason it would serve as an on-line advertisement for the centre.

As regards the database the assumptions were:

- Each musician will play one or many instruments and will come from a particular area. They will play a music type whether it is Irish traditional music, song or air. They will also play music tunes that belong to a particular music type.
- The musician may or may not have photographs, video clips or music manuscripts.
- Each area can have many musicians from/living in it but each musician can only come from one area.
• The music tunes may have manuscripts associated with them and these manuscripts will belong to a particular music type. Each music tune will have only one manuscript and/or tablature.

• The music type will belong to a particular music category and each music type will be played by many musicians.

The output from the system was then decided upon. It had to be set up so as to output any information needed by potential people who may requested information on a particular topic.

The following are some of the outputs decided upon for the system:

(a) **Musician Information**

A person requesting information on any musician simply needs to type in either the first or last name of the persons name or the first letter of the first or last name and the will get all the following information

• Quote about Musician

• Musician Name

• Area they come from/live in

• Date of Birth

• Family History

• Musician History

• Musical History and Influences

• Web Pages (if existant)
Recordings

Area

Information sought on the different areas in Sliabh Luachra will provide:

- Area name
- Description of the area
- Listing of all the musicians from this area (in the form of a portal)

Instruments

Information output by typing an instrument name:

- Instrument
- Description

Musicians Music Samples

A person seeking to hear examples of the different music played will be provided by the following information:

- Musician Name
- Music Title
- Instrument
- Music Sample (the music sample is played using a MIDI keyboard connected to a MIDI system which is connected to the computer – further explained in the MIDI chapter. The music was stored as a MIDI file using sequencing software called CUBASE.)
(c) Padraig O’Keeffe’s Tablatures Scored

Anybody interested in the Tablatures of Pádraig O’Keeffe can see the original tablature and a copy of the transcribed tablature into standard notation. By using this search they will get the following information:

- Music Title
- Tablature of Pádraig O’Keeffe
- Transcribed version of tablature into standard notation.

It was then decided that as it was being designed for archival purposes the system would not be changed on a daily basis. New information would be input to the system on a continuous basis as new information was located by the Heritage Centre staff but data already input to the system would not be changed.

The following information would be needed and the initial information input to the system would serve as a basis for the way any extra new archive material will be stored:

- The system would contain the history and folklore of the music and musicians of Sliabh Luachra. (This information is stored in text form.)
- Video clips would be included of some musicians. (These were imported from Adobe Premiere and are stored in container field in the database.)
- The music manuscripts (those converted to standard notation) of Padraig O’Keeffe would also be stored in the system. (Music manuscripts have been imported from Finale, the
music notation software used to transcribe the music from Pádraig O’Keeffe’s tablature form to standard notation. This music is stored in container fields in FileMaker Pro.)

- The original tablatures of Padraig O’Keeffe would also be stored. (These images are scanned and stored in container fields in FileMaker Pro.)

- Photographs would also be input to the system and would be entered on a continuous basis as they are acquired by staff of the heritage centre. (Some photographs were edited in Adobe Photoshop and later placed in container fields in the database. Some of these photographs were taken with a digital camera, others were scans of photographs taken with a regular camera.)

4.11.1.1 IDENTIFY ENTITY TYPES

Following the determination of the requirements of potential users an ERD (entity-relationship diagram) was drafted. In order to do this the entities, relationships and attributes of these had to be determined. The entities determined are:

- Musician
- Area
- Instrument
- Music Tunes
- Music Category
- Music Type
- Pictures
- Video
- Tablatures
- Notation

Every entity type has attributes that further describe it. For example, attributes describing a musician may be their name or date of birth. Figure 4.6 shows the attributes used for the entities in the archive:
Figure 4.6: Examples of Entities and their Attributes

<table>
<thead>
<tr>
<th>Entity</th>
<th>Attributes</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musician</td>
<td>Musician Name</td>
<td>Padraig O’Keeffe</td>
</tr>
<tr>
<td></td>
<td>Date of Birth</td>
<td>1884</td>
</tr>
<tr>
<td></td>
<td>Address</td>
<td>Kiskeam, Co. Cork</td>
</tr>
<tr>
<td>Instrument</td>
<td>Instrument Name</td>
<td>Violin</td>
</tr>
<tr>
<td></td>
<td>Instrument Description</td>
<td>Four stringed object</td>
</tr>
<tr>
<td>Area</td>
<td>Area Name</td>
<td>Kiskeam</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Kiskeam is a</td>
</tr>
<tr>
<td>Pictures</td>
<td>Musician</td>
<td>Johnny O’Leary</td>
</tr>
<tr>
<td></td>
<td>Picture Number</td>
<td>PIC001</td>
</tr>
<tr>
<td></td>
<td>Picture</td>
<td>Johnny at home</td>
</tr>
<tr>
<td></td>
<td>Explanation</td>
<td>This is</td>
</tr>
<tr>
<td>Video Clips</td>
<td>Video Clip</td>
<td>Maurice plays tune</td>
</tr>
<tr>
<td></td>
<td>Musician Name</td>
<td>Maurice O’Keeffe</td>
</tr>
<tr>
<td></td>
<td>Explanation</td>
<td>This is</td>
</tr>
<tr>
<td>Tablatures</td>
<td>Tablature Number</td>
<td>TB001</td>
</tr>
<tr>
<td></td>
<td>Tablature Name</td>
<td>Saddle the Pony</td>
</tr>
<tr>
<td></td>
<td>Tablature Creator</td>
<td>Padraig O’Keeffe</td>
</tr>
<tr>
<td>Music Manuscripts</td>
<td>Manuscript Name</td>
<td>Harvest Home</td>
</tr>
<tr>
<td></td>
<td>Manuscript</td>
<td>Insertion of manuscript</td>
</tr>
<tr>
<td>Music Tunes</td>
<td>Music Title</td>
<td>Shandon Bells Jig</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>This tune is ....</td>
</tr>
<tr>
<td></td>
<td>Sound Sample</td>
<td>Insertion of MIDI sample from CUBASE</td>
</tr>
<tr>
<td>Music Type</td>
<td>Music Type</td>
<td>Irish Traditional Music</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>This music ......</td>
</tr>
<tr>
<td>Music Category</td>
<td>Music Category</td>
<td>Hornpipe</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>A hornpipe is ....</td>
</tr>
</tbody>
</table>

4.11.1.2 IDENTIFYING RELATIONSHIPS

The next step was to identify the relationships that existed between the identity types identified.

Figure 4.7 identifies these relationships:
4.11.1.3 IDENTIFY AND ASSOCIATE ATTRIBUTES WITH ENTITY OR RELATIONSHIP TYPES

The next step was to determine the attributes of each entity and its relationships. Information for each attribute was also recorded at this stage, for example, the attribute name and description, the data type and length, whether the attribute allows null values. When working with FileMaker Pro the data types supported are:

- Text, Number, Date, Time, Container, Calculation, Summary and Global.

The Container option allows a field to contain a graphic, image or QuickTime movie. Graphic images can include CGM, BMP, TIFF, GIFF, JPEG, PCX, WMF, DRW and PLC. Movie formats include: EPSF, PICT, MOVIE, etc. OLE objects can also be stored and used in container fields. Figure 4.8 illustrates the attributes used for the archive database:
Figure 4.8: Attributes Identifies for the Database

<table>
<thead>
<tr>
<th>Entity</th>
<th>Attributes</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musician</td>
<td>Musician Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Date of Birth</td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td>Date of Death</td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td>Family History</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Musician History</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Musical History and Influences</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Web Page URL</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Recordings</td>
<td>Text</td>
</tr>
<tr>
<td>Area</td>
<td>Area Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Text</td>
</tr>
<tr>
<td>Instruments</td>
<td>Instrument Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Text</td>
</tr>
<tr>
<td>Music</td>
<td>Music Title</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Sound Sample</td>
<td>Containers</td>
</tr>
<tr>
<td>Music Type</td>
<td>Music Type Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Text</td>
</tr>
<tr>
<td>Music Category</td>
<td>Music Category Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Text</td>
</tr>
<tr>
<td>Music Manuscripts</td>
<td>Manuscript Name</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Manuscript</td>
<td>Container</td>
</tr>
<tr>
<td>Padraig’s Tablatures</td>
<td>Tablature Title</td>
<td>Text</td>
</tr>
<tr>
<td></td>
<td>Tablature</td>
<td>Container</td>
</tr>
<tr>
<td></td>
<td>Information</td>
<td>Text</td>
</tr>
</tbody>
</table>
4.11.1.4 DETERMINE ATTRIBUTE DOMAINS

The domain of an attribute is the set of acceptable values for an attribute.

4.11.1.5 DETERMINE CANDIDATE AND PRIMARY KEY ATTRIBUTES

A superkey is any set of attributes that uniquely identifies each occurrence of an entity. A candidate key is a minimal superkey – a minimal set of attributes that uniquely identifies an occurrence of an entity. There is possibly more than one candidate. If there is more than one candidate key, one is selected to be the primary key. In selecting a primary key Connolly and Begg identify the following guidelines:

- Select the candidate key with the minimal set of attributes.
- Select the candidate key that is less likely to have its value changed.
- Select the candidate key that is less likely to lose uniqueness in the future.
- Select the candidate key that is easiest to use from the user’s point of view.

A weak entity type is one that does not have any key attributes of its own. Entities belonging to a weak entity type are identified by being related to specific entities from another entity type in combination with some of their attribute values. This other entity type is referred to as
Figure 4.9 illustrates the primary keys of each entity type:

### Figure 4.9: Primary Keys of Each Entity Type

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Primary Key</th>
<th>Strong/Weak Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musician</td>
<td>Musician Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Area</td>
<td>Area Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Instruments</td>
<td>Instrument Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Music</td>
<td>Music Title</td>
<td>Strong</td>
</tr>
<tr>
<td>Music Type</td>
<td>Music Type Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Music Category</td>
<td>Music Category Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Music Manuscripts</td>
<td>Music Manuscript Name</td>
<td>Strong</td>
</tr>
<tr>
<td>Padraig's Tablatures</td>
<td>Tablature Title</td>
<td>Strong</td>
</tr>
<tr>
<td>Musicians Pictures</td>
<td>Picture Name (i.e. musician name)</td>
<td>Weak</td>
</tr>
<tr>
<td>Musicians Video</td>
<td>Video Name (i.e. musician name)</td>
<td>Weak</td>
</tr>
</tbody>
</table>

### 4.11.1.6 DRAW ENTITY-RELATIONSHIP DIAGRAM

An ERD's are used to represent entities and relationships. ER diagrams are used to produce a model that is easily understood by users as well as computer personnel. Thus the names used in the diagram must be readable. For this reason, entity sets are usually labeled by nouns whereas relationship sets are labeled by verbs.

### 4.11.1.6.1 NOTATION FOR ENTITY-RELATIONSHIP DIAGRAMS

- An entity type is represented as a rectangular box enclosing the entity type name.
- Attribute names are enclosed in ovals are attached to their entity types by straight lines.
- Multivalued attributes are shown in double ovals.
- Diamond-shaped boxes represent the relationship types between the entities.
- A double line from the entity type box to the relationship type box represents total participation between one entity type and another.
- An identifying relationship type is represented by a double diamond shaped box.
- A primary key is represented by an underlined word surrounded by an oval.
- A partial key is represented by a dashed or dotted underline.
- A weak entity type is represented by a double lined box surrounding the entity type name.

4.11.1.7 REVIEW LOCAL CONCEPTUAL DATA MODEL WITH USER

Before completing this part of the development of the system the database design was reviewed and was looked at by potential users of the system to ensure that it represented a true analysis of the information needs of the Heritage Centre. No obstacles were foreseen in the system design at this stage.

4.11.2 Stage 2: Logical Database Design for the Relational Model

4.11.2.1 DERIVE RELATIONS FROM LOCAL LOGICAL DATA MODEL

This step derives relations from the local logical data model to represent the entities and relationships of the user’s description of their organisation. Primary keys and foreign keys are used to show the relationship that an entity has with another entity. Before deciding on the foreign key the ‘parent’ and ‘child’ entities in the relationship must be identified. The parent is
the entity that posts a copy of it’s primary key into the relation that represents the child entity, to
act as the primary key. [Connelly, Begg 1999: 251]

In order to convert an ERD to a set of relations each set in the ERD is replaced by a relation
(table). The name of the set becomes the relation name and the attributes of the set become the
table columns. Each row of the table contains a set of values which describe an occurrence of
the entity type.

A relational notation is used to show this data where only the relation name and it’s attributes are
shown. Each relation is represented by one line. Each line starts with the relation name is and is
followed by the names of the relation attributes in brackets. Relation keys are represented by an
underline.

4.11.2.2 TRANSFORMING ENTITY TYPES

Transforming a relation depends on the degree of the relationship and the membership class of
the participating entity types.

4.11.2.2.1 STRONG ENTITY TYPES

For each strong entity, a relation that includes all simple attributes of that entity is created. For
composite attributes only the constituent simple attributes are included. For example Address
may be made up of Name, Street, Town, County and each would be included as the primary key.
Entities that do not have key attributes of their own (weak entity types) are identified by their relation to other specific entities from other entity types along with some of their attribute values. The other entity type is the **identifying owner**.

### 4.11.2.2 WEAK ENTITY TYPES

Entity types that may not have any key attributes of their own are known as weak entity types. These entities are identified by their relationship with entities from another entity type. The other entity is known as the **owner entity**. Thus the primary key of the weak entity is fully or partially derived from the owner entity. The relationship relating a weak entity type to its owner is the **identifying relationship** of the weak entity type. Because the weak entity cannot be identified without its owner entity it always has a total participation constraint as regards its identifying relationship.

Weak entity types usually have a **partial key** which is a ‘set of attributes that can uniquely identify weak entities related to the same owner entity.’ [Elmasri 1994: 56]

Figures 4.10 and 4.11 shows examples of the weak and strong entity types in the Sliabh Luachra database:
Figure 4.10: Strong and Weak Entity Types

MUSICIAN (Musician Name, Date of Birth, Date of Death, Family history, Musician history, Musical history and Influences, Web Page, Recordings, Quote)

PICTURES (Picture Number, Information)

The resulting relation is: PICTURES (Picture Number, Musician Name, Picture, Description)

The rule for deriving relations from weak entity types is that the resulting relation will include as the primary key or part of the primary key, the primary key of the owner entity type. In the above example the Musician Name of the owner entity type and the Picture Number make up the primary key of the weak entity type relation.
**Figure 4.11**: Example 2 of the Strong and Weak Entity Types

**MUSICIAN** (Musician Name, Date of Birth, Date of Death, Family history, Musician history, Musical history and Influences, Web Page, Recordings, Quote)

**VIDEO** (Video Number, Video Clip, Explanation)

The resulting relation for videos is:

**VIDEOS** (Video Number, Musician Name, Video Clip, Explanation)
4.11.2.3 TRANSFORMATION OF RELATIONS

4.11.2.3.1 ONE-TO-ONE RELATIONSHIPS

For each 1:1 relationship a copy of the primary key attribute(s) of one relation acts as a foreign key in the second relation. In order to do this a parent/child entity has to be decided on and this is done by looking at the participation constraints. Participation constraints determine whether the existence of an entity depends on it being related to another entity through the relationship.

Two types of participation constraints exist—total and partial. If all entities must appear in at least one relationship then their participation in the relationship is mandatory. If each entity need not appear in the relationship, its participation in the relationship is optional.

The entity that partially participates in the relationship is designated as the parent entity. The entity that totally participates in the relationship is designated as the child entity. A copy of the primary key of the parent entity is placed in the relation representing the child entity. Where both entities totally or partially participate in a 1:1 relationship, the designation of the parent and child entities is optional.

4.11.2.3.2 1:N RELATIONSHIP

For each 1:N relationship we can put a copy of the primary key attribute(s) of one relation into a related relation to act as a foreign key. As with the 1:1 relationships type, a copy of the primary key of the parent entity is placed in the relation representing the child entity, as a foreign key. In the following example Musician is the child entity and Area represents the parent entity. The
relationship is established by placing a copy of the primary key of the Musician (parent) entity, Musician Name, into the Area (child) entity. Thus the Musician and Area relation is as follows:

![Diagram of the relationship between Musician and Area entities]

**Musician** *(Musician Name, Date of Birth, Date of Death, Family History, Musician History, Area Name, Musical History and Influences, Web Page URL, Recordings)*

**Area** *(Area Name, Description)*

Area Name is the foreign key in Musician. This is a mandatory relationship where a musician belongs to one area.

Other such relations in the database include:

**Music Category** *(Music Category, Description)* – child entity

**Music Tune** *(Music Title, Music Category, Description, Sound Sample)* – parent entity

Music Category is a foreign key in Music Tune where a Music Tune belongs to a Music Category.

**Music Type** *(Music Type Name, Description)* – parent entity

**Music Category** *(Music Category Name, Music Type, Description)* – child entity

Music Type Name is a foreign key in Music Category where a music type belongs to a music category.

**Music Manuscript** *(Music Manuscript Name, Music Category, Manuscript)* – child entity

**Music Category** *(Music Category Name, Description)* – parent entity
4.11.2.3 MANY-TO-MANY RELATIONSHIPS

M:N relationships are transformed into a relation in which the primary key is made up of the primary keys of the participating entity types. Any attributes of the relationship type are also stored in the resulting relation.

For example:

- A musician can play many instruments.
- An instrument can be played by many musicians.

**Musician** (Musician Name, Date of Birth, Date of Death, Family History, Musician History, Musical History and Influences)

**Instruments** (Instrument Name, Description)

**Musicians Instruments** (Musician Name, Instrument Name, Description)

- An Instrument can belong to many Music Types.
- A Music Type can have many Instruments

**Instruments** (Instrument Name, Description)

**Music Type** (Music Type Name, Description)

**Instruments Music Type** (Instrument Name, Music Type Name, Description)
• A Musician can perform many Music Tunes

A Music Tune can be performed by many Musicians

**Musician** *(Musician Name, Date of Birth, Date of Death, Family History, Musician History, Musical History and Influences)*

**Music Tunes** *(Music Tune Name, Description)*

**Musicians Music Tunes** *(Musician Name, Music Tune Name, Description)*

• A Musician can play many Music Types.

A Music Type can be played by many Musician.

**Musician** *(Musician Name, Date of Birth, Date of Death, Family History, Musician History, Musical History and Influences)*

**Music Type** *(Music Type Name, Description)*

**Musicians Music Type** *(Musician Name, Music Type Name, Description)*

4.11.2.4 **VALIDATE MODEL USING NORMALIZATION**

"The rules leading to and including the third normal form can be summered up in a single statement: Each attribute must be a fact about the key, the whole key, and nothing but the key."

[Wiorkowski, Kill]

Normalisation of data is the process where unsatisfactory relation schemas are decomposed by breaking up their attributes into smaller relation schemas that possess desirable properties.
Normalisation provides database designers with:

- a formal method of analyzing table schemas based on their keys and on the functional dependencies among their attributes and
- a series of tests that can be carried out on individual table schemas so that the relational database can be normalized. [Elmasri 1994: 407]

The **normalization process** is a crucial part of relational databases and was first developed by Codd in 1972. It is the process of taking a relation schema through a series of tests to certify whether or not it belongs to a certain normal form. This is done through analysis of relations based on their primary keys and functional dependencies.

A properly normalized design allows one to:

- use storage space efficiently
- eliminate redundant data
- reduce or eliminate inconsistent data
- and ease the data maintenance.

Relations can be normalised to different forms. These forms are known as first normal form (1NF), second normal form (2NF), third normal form (3NF), fourth normal form (4NF) and fifth normal form (5NF). The concept of the first three normal forms is based on functional dependencies among the attributes of the relation. The fourth normal form considers multivalued
dependency and the fifth normal form considers joint dependency. The first three forms are those most often used.

The primary reason for normalizing databases to at least the level of the 3rd Normal Form is that normalization is a prevention against the possible corruption of databases anomalies. Anomalies are types of errors that can creep into databases that are insufficiently normalized. [Wyllys]

There are three types of anomalies:

a. insertion anomalies
b. deletion anomalies
c. modification anomalies

a. An insertion anomaly is a failure to place information about a new database entry into all the places in the database where information about that new entry needs to be stored. In a properly normalized database, information about a new entry needs to be inserted into only one place in the database. For example, when a new musician is entered in the database his/her area is also entered. For example, a new musician called Tom Jones is entered in the Musician relation and part of his details are that he comes from Scartaglen. The Area relation should automatically updated to include Tom Jones in the list of musicians that come from Scartaglen.
For example the relation described below:

Musicians (MusicianName, DOB, DOD, Area, Description of Area)

Information cannot be inserted about an area that has no musicians.

b. A **deletion anomaly** – If in the previous, the text for a Musician from the Kishkeam area was deleted, the details relating to Kiskeam are also lost. This is a deletion anomaly.

c. **Modification (update) anomalies** may occur if the value of an attribute is changed. For example, if the name for a ‘fiddle’ is changed to ‘violin’ then all the tuples in the musician form must be updated to accommodate this change. Otherwise, the database will become inconsistent where some musicians will have two different values for the instrument. This should not happen.

4.11.2.4.1 **DISADVANTAGES OF UNNORMALIZED FORMS**

1. Redundant information in tuples and update anomalies may occur. A goal of schema design is to minimize the storage space that a relation occupies. Grouping attributes into relations is a method of doing this and minimizes redundant information. For example, if the database was arranged with one relation called musician which contained the attributes Musician Number, Musician Name, Instrument Code, Instrument, Description.
Musician (Musician No, Msn_Name, Inst_Code, Inst_Name, Description)

In this example the determinant key for Instrument is Inst_Code but it is not a key or part of a key. For this reason two relations could be formed from the above relation:

Musician (Musician No, Msn_Name)

Instrument (Inst_Code, Inst_Name, Description)

Properly normalized databases are much less susceptible to corruption than are unnormalized databases.

2. Null Values in Tuples. In some schema designs attributes may be grouped together in a relation. If some attributes do not apply to all tuples in the relation then we end up with many nulls. This wastes storage space and it brings about other problems where null values can have multiple interpretations:

- The attribute does not apply to this tuple.
- The attribute value for the tuple is unknown.
- The value is known but has not been recorded. [Elmasri 1994: 398]

For this reason nulls should be avoided as much as possible.
3. In an inadequately normalized database, information about an entry may need to be deleted from more than one place, and due to human error, some of the needed additional deletions may be missed.

4.11.2.5 DEPENDENCIES

Before defining normal forms, the concept of functional dependency needs to be addressed as it is used to define normal forms.

4.11.2.5.1 FUNCTIONAL DEPENDENCY

'This is a constraint between two sets of attributes from the database'. [Elmasri 1994: 401]

For example, A and B are attributes of the relation R where B is functionally dependent on A (written \( A \rightarrow B \)). If each value of A is associated with exactly one value of B, then functional dependency occurs. For example, Musician Name and Musician History are attributes of the relation Musician. The Musician History is functionally dependent on the Musician Name as each Musician Name is associated exactly with only one Musician History.

Thus, the values of Musician History are determined by the values of the Musician Name. Thus, Musician name is shown on the left-hand side of the arrow as it uniquely determines the values
of Musician History. When functional dependency exists, as in this case, the attribute on the left of the arrow is called the determinant.

4.11.2.5.2 FIRST NORMAL FORM (1NF) – NO REPEATING GROUPS

First Normal Form is states that 'the domains of attributes must include only atomic (simple, indivisible) values and that the value of any attribute in a tuple must be a single value from the domain of that attribute'. This means that a 1NF disallows 'relations within relations' or 'relations as attributes' of tuples. [Elmasri 1994, 409] Only single atomic values are allowed. An atomic value has no composite or multi-valued attributes. Multivalued attributes must be represented by separate relations, and composite attributes are represented only by their simple component attributes.

An example of normalizing a relation is as follows. Data for a relation may be taken directly from a written form as shown in Figure 4.12.
The relation derived may be as follows:

**Musician** (Name, Address, DOB, DOD, Instruments)

The problem here is that each person would have:

- one name        Pádraig O’Keeffe
- one address     Kiskeam
- one date of birth October 1900
- one date of death January 1963
- but many instruments. Fiddle, flute, whistle.
In order to normalize the above relation we can break it into two relations – Musician and Musicians Instruments. The Instrument attribute, which violates the 1NF, must be removed and placed in a separate relation with the primary key Musician Name and Instrument.

4.11.2.5.3  SECOND NORMAL FORM (2NF)

The Second Normal Form builds on the first normal form and is based on the concept of full functional dependency. In this the relation must satisfy the additional constraint that all the attributes in the table must only contain data about the entity that is defined by the primary key. A relation schema R is in 2NF if every nonprime attribute A in R is fully functionally dependent on every key of R. [Elmasri 1994: 413] For a relation to be in 2NF, it must also be in 1NF. If a partial dependency exists, the functionally dependent attributes are removed from the relation by placing them in a new relation with a copy of their determinant.

4.11.2.5.3.1  Partial Dependency

A functional dependency A → B is partially dependent if there is some attribute that can be removed from A and the dependency still holds. For example:

\[ \text{AreaName, MusicianName} \rightarrow \text{AreaDescription} \]

In this example the (Area Name, Musician Name) is associated with one Area Description. If the Musician Name is removed the dependency still holds. Thus partial dependency occurs. See Figure 4.13.
This relationship is not in 2NF because, though all attributes are dependent on the key, musician DOB is also dependent on part of the key – Musician Name. To transform this relation into 2NF, 2 relations will be produced:

Musician Pictures (MusicianName, PictureNo, PictureTitle, Picture)

Musicians (MusicianName, MusicianDOB)

A relation with a non-composite key that is in 1NF, is, by default, in 2NF.

4.11.2.5.4 THIRD NORMAL FORM (3NF)

The 3NF is based on the concept of transitive dependency. Transitive dependency is ‘a condition where A, B, and C are attributes of a relation such that if A → B and B → C, then C is transitively dependent on A via B (provided that A is not functionally dependent on B or C)’. [Connelly, Begg 1999: 206] For example:

MusicianName → InstrumentName, → InstrumentDescription
Musician Name determines the Instrument Name and the Instrument Name. (Figure 4.14)

**Figure 4.14:** Transitive Dependency

\[\text{MusicianName, InstrumentNo, InstrumentName, InstrumentDescription}\]

As mentioned above the 3NF is based on the concept of transitive dependency. A functional dependency \(X - Y\) in a relation schema \(R\) is a transitive dependency if there is a set of attributes \(Z\) that is not a subset of any key of \(R\), and both \(X - Z\) and \(Z - Y\) hold.

A relation schema \(R\) is in 3NF if it is in 2NF and every nonprime attribute of \(R\) is:

- Fully functionally dependent on every key of \(R\), and
- Nontransitively dependent on every key of \(R\). [Elmasri 1994: 416]

Thus, no nonprime attribute of \(R\) is transitively dependent on the primary key.

For example:

**Musician** **Musician Name**, Date of Birth, Date of Death, Family History, Musician History.

**Area** **Area Name**, Description.

**Instrument** **Instrument Name**, Description

**Picture** **Picture Number**, Picture
4.11.2.5.5  **BOYCE-CODD NORMAL FORM (BCNF)**

Every relation in BCNF is also in 3NF although a relation in 3NF is not necessarily in BCNF.

The definition of Boyce-Codd states that ‘a relation schema R is in BCNF if whenever a functional dependency X → A holds in R, then X is a superkey of R’. [Elmasri 1994: 416] This can be stated as a relation in which every determinant is a candidate key – remove nontrivial multi-valued dependencies

4.10.2.5.6  **FOURTH NORMAL FORM (4NF)**

If a relation is in fourth normal form it is in third normal form and there are no multivalued dependencies. A **multi-valued dependency** is where a dependency between attributes occurs in a relation. For example a dependency between attributes A, B and C may occur where for each value of A there is a set of values for B and a set of values for C. The set of values for B and C are independent of each other. These may occur due to the first normal form, which disallows an attribute in a tuple from having a set of values. If two multi-valued attributes are present in a relation it means repeating each value of one attribute with every value of the other attribute. This leads to data redundancy. For example see Figure 4.15.

**Figure 4.15:** Multi-valued Dependency

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Musician Name</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scartaglen</td>
<td>Padraig O’Keeffe</td>
<td>Violin</td>
</tr>
<tr>
<td>Scartaglen</td>
<td>Padraig O’Keeffe</td>
<td>Accordion</td>
</tr>
<tr>
<td>Scartaglen</td>
<td>Emma O’Leary</td>
<td>Violin</td>
</tr>
<tr>
<td>Scartaglen</td>
<td>Emma O’Leary</td>
<td>Accordion</td>
</tr>
</tbody>
</table>
In this example Padraig O’Keeffe and Emma O’Leary are from Scartaglen and the instruments are played in Scartaglen. As there is no direct relationship between Musician Name and Musician Instrument a new tuple must be created for every combination of Musician and Instrument. This represents a multi-valued dependency in the Area_Musician_Instrument relation. A multi-valued dependency occurs because two independent 1:N relationships are represented in a relation.

Even though this relation is in BCNf, it is poorly-structured due to the presence of the multi-valued dependency.

4.11.2.5  FIFTH NORMAL FORM (5NF)

This is a relation that contains ‘no join dependency’. When a relation is decomposed into two relations the new relations have a lossless-join property where one can rejoin the resulting relations to produce the original relation. However, it does happen that a relation must be decomposed into more than two relations. These are managed by join dependency and the fifth normal form.

**Lossless-join dependency** is ‘a property of decomposition, which ensures that no spurious rows are generated when relations are reunited through a natural join operation. [Connelly, Begg 1999: 220]

4.11.2.6  DRAW ENTITY-RELATIONSHIP DIAGRAM (See Next Page)


4.11.2.6.1 ERD Description

- A Musician can play many Instruments.  
  An Instrument can be played by many Musicians.

- A Musician is from one Area.  
  An Area can have many Musicians coming from it.

- A Musician can have many Pictures.  
  A Picture can have only one Musician.

- A Musician can have many Video Clips.  
  A Video Clip can have only one Musician.

- A Musician can perform many Music Tunes.  
  A Music Tune can be performed by many Musicians.

- A Musician belongs to many Music Types.  
  A Music Type has many Musicians.

- A Musician has many Tablatures.  
  A Tablature can have many Musicians.

- An Instrument belongs to many Music Types.  
  A Music Type is played by many Instruments.

- A Music type belongs to one Music Category.  
  A Music Category has many Music Types.

- A Music Category has many Music Manuscripts.  
  A Music Manuscript has one Music Category.

- A music Type has many Music Tunes.  
  A Music Tune belongs to one Music Type.

- A Music Tune has one Music Manuscript.  
  A Music Manuscript has to have one Music Tune.

- A Music Tune can have one Tablature.  
  A Tablature has one Music Tune.
### Entity Types and Relationships

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Attributes</th>
<th>Cardinality</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Musician</strong></td>
<td>(Musician Name, Date of Birth, Date of Death, Family History, Musician History and Influences, Web Page URL, Recordings) – Strong Entity Type</td>
<td>1:N</td>
<td>Mandatory – Identifying Relationship Type</td>
</tr>
<tr>
<td><strong>Pictures</strong></td>
<td>(Picture No, Picture, Description) – Weak Entity Type</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td><strong>Relationship:</strong> Musicians Have Pictures</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardinality:</strong></td>
<td>1:N</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participation:</strong></td>
<td>Mandatory – Identifying Relationship Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Video Clips</strong></td>
<td>(Video No, Video, Description) – Weak Entity Type</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td><strong>Relationship:</strong> Musicians Have Video Clips</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardinality:</strong></td>
<td>1:N</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participation:</strong></td>
<td>Mandatory – Identifying Relationship Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td>(Instrument Name, Description)</td>
<td>M:N</td>
<td>Optional</td>
</tr>
<tr>
<td><strong>Relationship:</strong> Musicians Play many Instruments</td>
<td>Instruments are Played by many Musicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attributes:</strong></td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardinality:</strong></td>
<td>M:N</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participation:</strong></td>
<td>Optional</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Music Type</strong></td>
<td>(Music Type Name, Description)</td>
<td>M:N</td>
<td>Optional</td>
</tr>
<tr>
<td><strong>Relationship:</strong> Musicians Play a Music Type</td>
<td>Music Type is Played by many Musicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attributes:</strong></td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardinality:</strong></td>
<td>M:N</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participation:</strong></td>
<td>Optional</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Music Tune</strong></td>
<td>(Music Tune Name, Description)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Relationship:</strong> Musicians Performs a Music Tune</td>
<td>Music Tune is Performed by many Musicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attributes:</strong></td>
<td>Description</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Cardinality and Participation

<table>
<thead>
<tr>
<th>Entity</th>
<th>Cardinality</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musician</td>
<td>M:N</td>
<td>Optional</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attributes</td>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

#### Musician
(Musician Name, Date of Birth, Date of Death, Family History, Musician History and Influences, Web Page URL, Recordings)

#### Area
(Area Name, Description)

#### Relationship
Musicians Comes From an Area
An Area has Many Musicians Coming From it.

#### Attributes
- Description

#### Cardinality
- M:N

#### Participation
- Mandatory

### 4.11.2.6.3 Derived Relations

- Musicians Pictures (MusicianName, PictureNo, Description)
- Musician Video Clips (MusicianName, VideoNo, Description)
- Musicians Instruments (MusicianName, InstrumentName, Description)
- Musicians Music Types (MusicianName, MusicType, Description)
- Musicians Tunes (MusicianName, MusicianTuneName, Description)
- Musicians Area (MusicianName, AreaName, Description)

### 4.11.2.7 REVIEW LOCAL LOGICAL DATA MODEL WITH USER

This local logical data model represents the structure of the stored data for an organisation. All entity types and attributes are now represented in the diagram presented to the user. The completed ERD was shown and assessed by potential users of the archive system. The logical data model supported the functional requirements of the users.
4.11.3 PHYSICAL DATABASE DESIGN

The logical design phase is concerned only with what appears in the database. The physical design concentrates on how the database stores the information. The database designer must know how the computer system hosting the Database Management System operates and must be aware of the functionality of the target DBMS.

The first step in producing a physical database design involves translating the logical data model into a form that can be implemented in the target relational DBMS. There are two steps in this:

- one involves collecting all the information gathered during logical data modelling and
- the second requires a good knowledge of the functionality of the DBMS chosen.

During physical database design, the information gathered during logical database modelling is used. A description of each relation is created. This includes the relation name, the attributes, the primary, alternate and foreign keys and the integrity constraints. For each attribute, a data dictionary entry exists containing information about the domain of the attribute. (See Figure 4.8)

This design is then implemented in the target DBMS. With FileMaker Pro, base relations are created through a form-based interface. Foreign keys and relationships can be defined through look-ups. Primary keys are not implemented in FileMaker Pro. To implement a primary key in FileMaker Pro, a unique index is created to ensure uniqueness.

Because FileMaker Pro does not support composite keys, the relations requiring them, such as Musicians Pictures, were modified. In Musicians Pictures, Musician_Number and
Picture_Number were identified as the primary key. The physical implementation has Picture_Number as the unique index. Picture_Number is a text field with the initials of the musician and a 3-digit number to identify the picture. For example, POK001 is the first picture for Pádraig O'Keeffe.

Relationships in FileMaker Pro are defined using the Define Relationships menu item. However, FileMaker Pro does not support chaining of relationships. For example, Music Tunes is related to Music Categories. Music Categories is related to Music Types. There is no direct way of retrieving information about Music Types in Music Tunes. It can only be done by creating calculated fields.

Referential integrity is supported in FileMaker Pro through relationships and through the use of lookups or value-lists. These allow us to view the values of fields on another table and select one from the list. Only values from the list can be selected or the field may be left null. This then implements the referential integrity constraint.

Business rules or enterprise constraints should also be considered. Business rules can be implemented in Filemaker Pro through the validation options in the Define Fields menu item. For example, the Date of Death field's possible values are after the Date of Birth. The validation rule is then a calculation – Date of Death > Date of Birth. If this calculation does not return a time value, the value will not be accepted. A message is displayed to explain to the user why this is the case. The calculation for validation can be quite complex, involving fields from other
relations. Fields requiring that data must be entered (such as primary key fields). A field can be set to require data entry by selecting the Not Empty option in the Field Validation.

Once the base relations and constraints have been designed it is necessary to determine the optimal file organisations and access methods for the tables. FileMaker Pro provides only limited facilities to make such alterations to the database structures. The developer cannot select the file organisation method, for example. However, decisions can be made that may improve the performance of the system.

The first step is to analyse transactions that will occur on the system. As this is an archive, the vast majority of transactions will be retrievals. Analysis of transactions show that the tables are accessed frequently but Musician table is required most often.

Secondary indexes can improve the performance of retrieval operations. However, the performance of update operations may be adversely affected as the operation may require the secondary indexes to be rebuilt. Since the main concern here is with retrieval, secondary indexes are used to improve performance on fields regularly searched.

Data redundancy is the unnecessary duplication of data. However, it may improve the performance of a database by introducing some controlled data redundancy. In Musicians’ Music Information, the field Music Category is stored, though the information could be retrieved through accessing the table Music Tunes. However, because this table is accessed frequently in queries, such as Tunes played by Musicians, Instruments played by Musicians, Types of Music
played, etc, the duplication here improves the performance. To ensure that the redundant data is
maintained correctly, a script is run to ensure that the data is maintained correctly.

When defining fields in FileMaker Pro, field lengths are not defined. For example, the text data
type can hold up to 64,000 characters. It is possible to estimate the size of ‘average’ entries and
based on that, estimate the disk space.

Having designed the physical implementation of the database, security must be considered.
Specific security requirements were identified during logical design phase. In this stage these
requirements must be realised.

In designing the database, user views were developed, describing the requirements of user types.
Three user types were identified:

- A database administrator who requires access to update and retrieval of data for all items,
- A researcher who requires retrieval access to the data only and a
- Web user who requires access to data via a web interface.

To support these, different layouts for the different user views were created.

To secure the contents and functionality of a database (data and definitions), FileMaker Pro
provides a password mechanism. There is no user identification system. Passwords are visible
to the database administrator. Access privileges are assigned to the password. Each time a file is
accessed, the password must be provided. This can become very cumbersome. To reduce the
‘annoyance factor’ for the user, a blank password is set up for each file, allowing the user to read

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the data only. The administrator must enter their password each time to get read/write access.

Different menu systems are available for the different type of user.

All fields on the forms for viewing by the public are locked. This formatting is applied to the fields to ensure that no unauthorized changes are made. This is specified in FileMaker Pro using the Field Format menu, where the behaviour of the field can be specified as either disabling or allowing entry into the field. The fields are not disabled in ‘layout#1’ in each table as this layout is for use by the database administrators. Thus, data can only be changed by the database administrator (DBA) using the DBA interface.

4.12 CONCLUSION

The development of a database worked well for storing the archive material of Sliabh Luachra. Visitors no longer need to search through reams of paper to get the information they need.

Although FileMaker Pro is not a true relational database system, it was quite useful for this project due to the fact that it is easy to maintain and is reasonably priced. These factors were important in developing the archive as the requirements for the heritage centre were based on an easy to maintain, cost-effective and user friendly system.
CHAPTER FIVE

SOUND AND RECORDING

5.1 INTRODUCTION

This chapter considers the nature of sound and how we hear sounds. Initially, the different methods of recording music with a focus on MIDI and how MIDI has evolved since its establishment in the 1980's are investigated. The chapter proceeds with a look at MIDI files and how the MIDI language is represented. Finally, how MIDI and computers interact is discussed, along with the different hardware and software necessary to run a workable MIDI system. MIDI files are included in the archive so that musicians, who do not read standard notated music, can learn and retain the tune by listening to it.
5.2 SOUND

Sound is produced by the vibration of an object in the air or in water. Musical sounds are produced by the force of a vibration such as a voice or a plucked banjo string. Noise is produced by irregular vibrations. Sound travels by successive compressions and rarefactions of air molecules. It is governed by the laws of physics and can be modelled by mathematical equations. Because of this mathematical basis, given sufficient power and storage space, computers can be used to analyse, synthesize and alter sound as much as required.

During the evolution of computing, digitally recording sound was not practical for two reasons:

1. The tools for manipulating sound were not available and
2. Digitally recorded sound required a lot of storage space.

Sound travels in waves and a single musical note or audio tone can be represented by a sinewave diagram shown in Figure 5.1.

**Figure 5.1: Sinewave Diagram**
Using an electronic transducer, such as a microphone, these sound waves can be transformed into a corresponding variation in an electrical quantity, such as voltage. This is shown in Figure 5.2.

The transducer converts energy from one form, i.e. air pressure, to another form such as a varying voltage, which is an electrical representation of the original sound wave.

**Figure 5.2: Sinewave Diagram for Electrical Sounds**

Irregular vibrations cause noise to be produced. When a signal is converted to an electrical analogue we meet another type of noise – electrical noise. The cause of this noise is due to the random motion of hot electrons in electronic equipment. The noise may add or subtract from the amplitude of the original signal. The effect of noise on the signal is show in Figure 5.3.

**Figure 5.3: Soundwaves in an Electrical Quantity (Voltage)**
When noise occurs in an analogue system it is difficult to separate it from the desired signal. As a result, when the sound is heard through a loudspeaker a slightly distorted signal is heard. For this reason digital techniques have advantages over analogue ones.

Sound waves have two distinguishing properties – **amplitude** and **frequency**. The **amplitude** is the height of the wave and represents the amount of energy or power in the wave. The height of the wave is based on the force of the sound. This is what is perceived as loudness. The distance between two successive peaks in a waveform is called the period. The period of the wave is the time for one wavelength to pass a point. See Figure 5.4.

**Figure 5.4**: Properties of Sound Waves

The number of vibrations that pass a given point every second is the **frequency** of the sound wave. This number of vibrations arriving per second is measured in Hertz (Hz) and is named
after Henrich Hertz, a German physicist who worked on electro-magnetism. These units of measurement are thousands of Hertz or Kilohertz (kHz), and millions of Hertz or Megahertz (MHz). [McNutt 1994] If 7 wavelengths of a wave pass a point in 1 second then its frequency would be 7 Hz. See Figure 5.5.

**Figure 5.5:** Frequency of Sound (7Hz)

![7 Hz signal](image)

1 second

The speed of sound in air is about 150 miles per hour. Sound which is audible to the human hearing is within the frequency band 20 Hz to 20,000 Hz. This is called the AUDIO RANGE. This range decreases with age.

When sound is recorded on a tape it is imprinted on a magnetic tape as electrical pulses. On a computer it must be converted to digital data. The computer samples the waves thousands of times per second, reads the amplitude and encodes it as a series of bytes. The quality of the sound is better the more often a wave is sampled. This concept is further discussed in the section 'Recording Digital Audio'.
5.2.1 Characteristics of Sound

Sound can be characterised by 3 variables:

1. Pitch
2. Quality (timbre)
3. Intensity (Loudness)

**Pitch** is the characteristic of a sound, which we describe as high or low. The pitch determines the position of a note on the musical scale. For example, the musical note A is taken as 440 Hz. A musical note is associated with a particular frequency. Doubling the frequency of a note produces a note one octave\(^{13}\) higher.

**Quality (Timbre)** is the characteristic tone, which distinguishes one sound from another of the same frequency and loudness. In relation to musical instruments, the timbre is normally affected by the material from which an instrument is made, its shape and size and the manner in which the sound is produced, e.g., by blowing, plucking, banging, etc. There are also different types of instruments and voices, i.e. string instruments, percussion instruments, men and women singers. All of these have different tones.

As mentioned earlier musical sounds are produced by regular vibrations. Sound waves cannot pass through an empty space or vacuum, but they can travel through water, air or solids. Musical instruments have a part which vibrates and a hollow sound-box or resonator which makes the

\[^{13}\text{The eighth tone above a given pitch, with twice as many vibrations per second, or below a given pitch, with half as many vibrations.}\]
sound louder. The timbre of sound is important when looking at different media for recording and storing music clips.

**Loudness** is the characteristic tone, which distinguishes it from others of the same frequency and quality. It is the subjective measure of the intensity of a sound. When the human ear perceives sound it is dependent on both the amplitude and the frequency of the sound.

### 5.3 RECORDING OF SOUND

Since the evolution of the computer different forms of media have become popular. In the 1980s graphics were the focus but since the 1990s, putting music on the Web has become a major focus for both musicians and multimedia/computing experts. Two types of recording exist – audio and digital. Recording through audio requires recording the music, inputting it to the computer and editing/converting it to a web-friendly format. Creating music digitally means simply recording the music on a hard disk. The final product is a computer file, usually a .wav file on a PC or an .aiff file or perhaps a MIDI file on the Mac.

#### 5.3.1 Analog Audio

Audio is a physical phenomenon, an analog quantity where it varies continuously with time. Thomas Edison created the first device for recording and playing back sounds in 1877. He used a simple method to store an analog wave mechanically, where a diaphragm controlled a needle, which scratched an analog signal onto a tin foil cylinder. As one spoke into a device while
rotating the cylinder, the needle ‘recorded’ what was said onto the tin. What actually happened was that the needle vibrated as the diaphragm vibrated, and the vibrations impressed themselves onto the tin. To play back the sound, the needle moved over the groove scratched during recording. The vibrations then pressed into the tin causing the needle to vibrate, which caused the diaphragm to vibrate, resulting in sound. Emil Berliner (1887) advanced on this to produce the gramophone. Today, signals that were originally read by a needle are amplified electronically rather than directly vibrating a mechanical diaphragm. [Brian 2000] This is the basis of analog audio where analog waves are produced to represent the vibrations created by voice or musical instruments. While storage methods have changed there has been no fundamental change in the way that sound information was captured and stored, until the advent of digital recording.

Limitations of Analog Audio

- With analog audio, any type of waveform is allowed. Therefore, the playback mechanism has no way of differentiating noise and distortion which has combined with the original signal.
- The total system noise accounts for the sum of all distortion and noise from each component in the signal path.
- Every copy of the sound track introduces more noise than the parent. This is because the playback and recording mechanism must physically contact the media, which causes further damage or introduces more noise each time it passes. [Buckley 1994]
Using a microphone to detect the sound wave generates analog sound. This pressure is then transformed to an electrical signal. The signal is processed by an amplifier, which sends another signal to the speakers, which vibrate and finally create sound. [Villamil-Casanova, Molina 1996: 109] See Figure 5.6.

Figure 5.6: Analog Signal Processing

5.3.2 Digital Audio

Digital recording converts information to numerical combinations that can be stored, retrieved and manipulated on a computer. In digital recording changes in electrical values are measured (sampled) by an analog to digital converter (ADC). This records the samples as numeric values. This numeric representation can be transferred back to analog signals by a digital to analog converter (DAC) for playback.
The advantages of digital audio over analog audio are:

1. **Less unwanted noise.** Magnetic media that passes over the head of a tape recorder produces a hiss that lowers the quality of sound produced. Digital recordings avoids this as noise and distortion can be separated from the audio signal.

2. **Random Access** Sound stored on optical or magnetic disk allows one to go forward or back to a particular section within a second. On an audio tape player one has to physically rewind back and forward and wait until the particular section needed is reached.

3. **No Corruption when Transferring Information.** When transferring sound from one analog tape to another the sound deteriorates. With digital sound, the quality of sound can be maintained if properly transferred from one digital medium to another.

4. **Accurate Positioning of a Sound.** With digital techniques it is far easier to select a location to approximately 20 microseconds.

5. **Tapes Degrade.** Tapes deteriorate over time, which causes sound information to be lost. Although CD and magnetic disks do decay, the code on them does not. This code can be transferred to new media and it will not lose information. Sound information will not be lost unless the code is destroyed. [Lindstrom 1994: 285 – 291]
With the advent of digital audio, analog audio may be reserved for the role of input at the microphone in the studio and output at the speaker in a listening environment.

5.3.2.1 RECORDING DIGITAL AUDIO

Computers are digital devices, operating on, and having their states described by sets of discrete numbers. To represent sounds on a computer, they must be digitised. *Sampling* is the mechanism used to perform this task.

Digital/Audio playback is often a feature added to sequencers. The sequencer is designed to record and playback tracks of digital audio in sync with the MIDI tracks. Along with this, the data is represented in a way that makes it easy for musicians to view and edit. For example, the data can be displayed graphically on a screen and manipulated with the mouse.

Certain requirements are needed in a computer system to record Digital Audio. These are as follows:

1. **Analog to Digital Convertor**
   A card with an Analog to Digital Converter circuitry is needed to convert analog signals into digital information where numbers are used to represent the digital waveform. Digital memory represents an audio signal with a binary code that stores a huge amount of numbers. These numbers are used to represent a signal.
This Analog to Digital Converter is attached to the Line In jack of an audio card and converts an incoming analog audio to a digital signal which the computer software can store on the hard drive. These signals are displayed on the computer's monitor. Incoming analog audio can be received from an electronic instrument, an acoustic instrument or voice which are recording through a Microphone plugged into the sound card’s Mic In. While the incoming analog audio is being recorded the Analog to Digital Converter is converting the audio to Digital Audio. These digital values are passed through the sound card and onto the software program which is controlling the recording. This process is called sampling.

Some data is temporarily stored in the computer’s RAM and is eventually stored permanently on the hard drive. When sampling we must sample at a frequency of twice the highest audio frequency. For example, an audio signal with a frequency response of 1 – 20 kHz would theoretically require a sampling frequency of 40 kHz for proper digital encoding. The more often a sound wave is sampled the better the perceived quality of the sound. A sampling rate of 22 kHz is suitable on a small speaker. A 44 kHz produces sound nearing CD-audio quality, but this requires much more storage. [McNutt 1994]

Sampling is dictated by the Nyquist sampling theorem which states how quickly samples must be taken to ensure an accurate representation of the analog signal. The basic principle of sampling is that the value of signal is taken at small intervals of time. These sample values are used to patch the signal back together again.

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14 In digital audio recording, a sequencer is a program that puts together a sound sequence from a series (or sequence) of Musical Instrument Digital Interface (MIDI) events. The MIDI sequencer allows the user to record and edit a musical performance without using an audio-based input source.
In Figure 5.7 the diagrams on the right have signals sampled to see what values they have at every $t$ seconds. In order to recover the signals from these samples the dots are joined together. The diagrams emphasize the point that the more often we sample, the more accurate the *joined dots line* will be.

**Figure 5.7:** Sampling
2. Digital to Analog Converter

To play back the digital audio a Digital to Analog Converter is needed on the sound card. This is attached to the Line Out Jack of the audio card, and converts the digital audio values back into analogue audio values. The analog audio can then be routed to headphones, a mixer or speakers so that you can hear the sound that was created.

5.4 RECORDING METHODS

This section gives an introduction to the different recording and file compression methods available. Following this, the chosen recording methods for the Sliabh Luachra Archive – Musical Instrument Digital Interface (MIDI) – is discussed in detail.

5.4.1 Tape Recorders

Magnetic recording is the backbone technology of the electronic age. It is a method of permanently storing information. As regards audio, magnetic tape is used to distribute music. Video tape is used in the broadcasting industry and also for home use. For computers, magnetic recording is used on floppy disks, hard disks and magnetic tape for data storage.

There are two parts to an audio magnetic recording system: the recorder and the tape used for storage.
The tape consists of a thin plastic base material, coated with ferric oxide powder. This oxide is known as ferromagnetic material meaning that if exposed to a magnetic field it is permanently magnetised by the field. For this reason we can:

1. Record anything instantly and the tape will remember what was recorded and play it back.
2. Erase the tape and record something else at any stage.

These features of tapes being instant and easily changed are what makes tape recording so popular. [Brian 2000]

The tape recorder has an electromagnet, which applies a magnetic flux to the oxide on the tape. The electromagnet consists of an iron core wrapped with wire. The audio signal is sent through the wire to create a magnetic field in the core. Magnetic flux forms a fringe pattern to bridge the gap on the iron core. It is this flux that magnetizes the oxide on the tape. When playing back, the motion of the tape pulls a varying magnetic field across the gap that creates a varying magnet field in the core. This results in a signal in the wire. The signal is amplified to drive the speakers. [Brian 2000] See Figure 5.8.


5.4.2 Compact Disks (CDs)

The CD was introduced in the 1980s to replace the vinyl LP records in the audio market. The audio compact disk is a high density media for storing digitally sampled audio. It holds about 74 minutes of stereo music recorded with 16-bit resolution and can hold up to 640 megabytes. It also incorporates error reduction, detection and correction techniques. [Kuhn 1999]

A CD is a piece of plastic about 1.2 millimeters thick. Most of it consists of an injection-molded piece of clear polycarbonate plastic. This is impressed with microscopic bumps arranged as one continuous, long spiral track of data, during manufacture. A reflective aluminum layer is sputtered onto the disk, and a thin acrylic later is sprayed over the aluminum to protect it. Finally, the label is printed onto the acrylic. See Figure 5.9. [Brian 2000] The information layer is read by a laser beam which shines through the transparent polycarbonate plastic.
Sound Reproduction from a CD

Disks are written from the center to the outside. Compact Disks contain information in digital format. Data is stored in the form of pits and lands. The edges of the pits correspond to binary “1”s.

Limitations of CD Audio

- Once CD audio is pressed the content of the disk is permanent.
- As the music is uncompressed, the file sizes are large. One music file can measure up to 30 or 40 megabytes. [Bossett 2000] This makes the usage of these files unsuitable for use in Web pages.
Limitations of Cassette over CD Audio

CD audio is recorded in digital form, i.e., as a series of numbers. The information read from the CD during playback is identical to the information that was originally recorded. This is not true of analog recording on a cassette tape. Audio is recorded as ‘magnetizations of the tape surface that are proportional to the air pressure fluctuations associated with the original sound’. [Bloomfield 2000] These magnetisations are used to recreated sounds during playback, but the tape itself introduces imperfections in the reproduced sound. Thus, the sound is not exactly the sound that was originally recorded.

5.4.3 MiniDisk (MD)

Minidisks were introduced to the consumer audio market by Sony in 1991. They are a disc based digital medium for recording and distributing consumer audio that is near ‘CD’ quality. The unique advantage of this recording system is that the discs are rewritable. The MD has a table of contents structure that links the audio on the disc into a continuous stream. This allows tracks to be segmented, combined, deleted or moved. The space that becomes available after deleting a track can be recorded over. This can be done without uploading the music onto a hard disk.

MD records digital signals using magneto-optical recording by a magnetic field modulation system. [Yoshida 1994] The technology evolved from the rewritable CD technology. The MiniDisc has a diameter of 64 mm, which is much smaller than a CD. For this reason it can only
hold 1/5 of the data a CD can hold. ATRAC, a high-quality audio compression technology, is used for MiniDisc (audio format). The MD-Data disc can hold approximately 140-Mbytes of data.

MiniDisc uses techniques similar to MP3 to compress files. It is almost completely lossless\(^\text{15}\) which results in it giving better quality than MP3.

### 5.4.4 MP3

MP3 is a file format that compresses audio data, while preserving the quality, and allowing one to download songs from the Internet in a reasonable amount of time. It is an abbreviation for MPEG 1 developed by Motion Picture Expert Group. (See Chapter 2) MP3 files are about one-tenth the size of uncompressed audio files, which has made the distribution of songs and music over the Internet possible. On a CD one minute of music takes up about 10 megabytes of space. For this reason, very few people would bother to download the file. MP3 compression has greatly improved these large file sizes. With MP3 one minute of music is about one megabyte. Thus, an average song is about 4 megabytes. With a 56 K modem the song can be downloaded in a few minutes and in seconds if a high-speed connection is available. Although 4 megabytes is still significant, people are still a lot more likely to download a file this size than a 40 megabyte file. To play these files an MP3 player is needed. Once this is installed on a computer, songs can be downloaded and played as many times as required. MP3 files can be played by the Media Player that comes with Windows or with QuickTime 4 for Macintosh.

\(^{15}\) Lossless – this means that when a file is compressed no data is lost during compression. The result is a high quality sound.
An MP3 file compresses audio using a *lossy* compression scheme, which means that some of the original data is lost during compression. As a result MP3 files are not truly the equivalent of CD quality. Although data is lost, there is only a slight loss in quality.

To record MP3s to a MiniDisc you need a MiniDisc recorder, a writeable Minidisc, a cable to connect a sound card to the MiniDisc. MiniDiscs can record digitally or using analogue recording. A digital optical port is needed for digital recording which is not available for the Mac.

### 5.4.5 Musical Instrument Digital Interface - MIDI

MIDI is the universal language of electronic music hardware. It is not a tangible object, a thing to be had. Instead it is a standard. ‘*MIDI is the acronym for Musical Instrument Digital Interface. It is a data communications protocol, an agreement among manufacturers of music equipment, computers, and software that describes a means for music systems and related equipment to exchange information and control signals.*’ [Rothstein, 1995]

A MIDI file does not contain recordings of sounds. Instead, it gives instructions to a synthesizer on how it ought to produce a sound. Thus, when the synthesizer receives a message that it needs to send out a violin sound, it acts on a unique digital number called a patch number, which results in the synthesizer sending out the manufacturer’s idea of a violin sound. Thus, the MIDI message is simply a Patch number. The information exchanged between two MIDI devices is
series of digital numbers which represent the note and type of instrument required. So, it can be concluded that it is musical in nature.

Advances and cost-efficiencies in synthesizer technology have caught the music world by storm. Much research was done on synthesizers due to the fact that musicians were creating new and different sounds worldwide. Finally the musical world began to recognize the synthesizer as a legitimate musical instrument. But musicians were still limited in what they could do so a group of synthesizer design technicians from different manufacturers got together to discuss different ideas. These manufacturers realize that the industry as a whole would benefit if their machines (synthesizers) could speak to each other and execute each other’s commands. Their results were revealed at the first North American Music Manufacturers show in Los Angeles in 1983. Here they connected two synthesizers, not manufactured by the same company, with two cables. One of the synthesizers was played but the audience heard sound from both synthesizers. The process was then reversed to show the two-way nature of the communication. [Lipscomb, 1995]

Since its conception MIDI has been widely accepted and utilized by musicians and composers. It is an efficient method of representing musical performance information as electronic data, and this makes MIDI an attractive protocol not only for composers or performers, but also for computer applications which use sound, in multimedia presentations or computer games. [Heckroth 1995] The adoption of this one standard allowed the industry to grow at a brilliant rate as hardware and software developers now knew that they could market their products to the entire electronic music community.
5.4.5.1 HOW MIDI WORKS

Just as two computers communicate via modems, two synthesizers communicate via MIDI. The information exchange between the two MIDI devices is musical in nature.

5.4.5.2 MIDI FILES

A MIDI file is a BINARY file, not an audio one. It is a list of instructions that instruct synthesizers that are connected to the computer what to do. Thus, a MIDI file contains only performance information, not the sounds themselves. A standard MIDI file is identified by its extension .MID.

Whether sounds are played back on external instruments or internal devices, the computer doesn’t need to store the entire recording in memory or on disk; it just has to store instructions to play the notes in the proper sequence. A MIDI file containing the MIDI messages for a soundtrack requires just a few kilobytes of memory. They are extremely small when compared with audio files. Files containing high quality stereo audio require about 10 Megabytes of data per minute of sound, while, a MIDI sequence might only need about 10 Kilobytes of data per minute of sound.

When a note is played on a keyboard, a message is sent to the computer identifying the key, how hard you struck it, for what duration you held it down, etc. The synthesizer, for example CUBASE, stores this information in a file. Once all the performance information has been
recorded, the user can edit the piece of music and transpose the music to a different key if required. In the case of CUBASE, the MIDI data can be displayed on screen as music notation for other musicians to read.

Thus, the type of performance data that is communicated by MIDI includes:

1. Turning on and off notes
2. Sending program changes
3. Sending the velocity of each note
4. Timing of MIDI notes and events
5. Use of sustain pedal
6. Use of pitch bend or modulation wheel.

**Standard MIDI File:** ‘is the protocol that is used to transfer MIDI information from one type of device to another.’ [Raschke, P. J., 1999] The sequencer file can be translated to a notation editor. The standard MIDI file is a universal language that saves all MIDI notes, velocities, and controller codes as a generic file thus allowing the file to be interpreted by any program that supports Standard MIDI Files.

There are three types of Standard MIDI Files:
Type 0    Combines all tracks or staves into a single track
Type 1    Saves files as separate tracks or staves for a complete score. The time signatures
          and tempo are only included in the first track.
Type 2    Saves files as separate tracks or staves. Includes the tempo and time signatures
          for each track. [Raschke, P. J., 1999]

5.4.5.3 THE INS AND OUTS OF MIDI

5.4.5.3.1 MIDI PORTS

'A port, or interface, is a place where two otherwise incompatible systems perform the necessary
conversions that enable them to pass data from one to the other.' [Rothstein 1995]

The MIDI connectors/ports are DIN 5-pin 180° female panel mount receptacles, which convert
data from MIDI code (digital) to electrical voltages that represent this code (analog) – or vice
versa. Pins 4 and 5 (data) and pin 2 (ground) are used. Pins 1 and 3 are not used, and are left
unconnected in the receiver and transmitter. They may be used at a later date. These connectors
are labelled MIDI IN, MIDI OUT, and MIDI THRU and they control all of the information
routing in a MIDI system.

The MIDI data stream is usually originated by a MIDI controller, such as a musical instrument
keyboard. The MIDI controller translates the performance into a MIDI data stream in real
The MIDI IN port accepts MIDI data, data coming ‘in’ to the unit from the MIDI controller and converts these incoming voltages to digital format. The MIDI sequencer allows these MIDI data sequences to be captured, stored, edited, combined, and replayed. In order to send this data out, data are converted from digital to analog format and the analog signals travel along a MIDI cable to another MIDI device. The data output from the MIDI controller or sequencer is then transmitted via the devices’ MIDI OUT connector. See Figure 5.10 for a simple MIDI setup.

Figure 5.10: A Simple MIDI System [MMA 1998]

The MIDI THRU port also sends data out to the MIDI system. But the MIDI Thru port simply echoes what is received at the MIDI In port. There is no change made to the data from the time it arrives at the IN port to the time it leaves the Thru port. [Lipscomb 1995]

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16 Realtime refers to as it is played, i.e. as the MIDI controller is played as an instrument.
Several MIDI sound modules can be daisy-chained by connecting the THRU output device to the IN connector of the next device in the chain. Figure 5.11 shows the MIDI System connecting several MIDI devices. The MIDI controller is used as the input device to the sequencer. Several sound modules are then connected to the sequencer’s MIDI OUT port. This scenario could be used where three different effects of a tune are played into the sequencer by the keyboard (controller). Each effect would represent a different instrument sound. Each sound is assigned a different channel. The sound module is then set to receive instructions from a particular channel. For example, sound module 1 might play the tune received on channel 1 using the violin, sound module 3 might play the tune received on channel 2 using the piano sound and so on. The drum machine might then play the percussion part received on MIDI channel 10. [MMA 1998]

¹⁷ A MIDI channel is divided into 16 channels. An instrument such as a keyboard can transmit on any one of the 16 MIDI channels. Thus, 16 instruments could be played together, with each instrument on a different channel.
5.4.5.3.2 CONNECTIONS

The hardware interface is the physical connection between two separate pieces of equipment. These connections include a MIDI port and a special 5-conductor MIDI cable that transmits the electrical voltage signals to the next device’s MIDI port, which converts the voltages back to digital data. The MIDI cables should have a maximum length of 15 meters and are terminated on each end by a corresponding 5-pin DIN male plug. The cables transmit the voltage signals from one MIDI device’s connector to another MIDI device’s connector and this MIDI data travels in one direction only over a particular MIDI cable. See Figures 5.12, 5.13 and 5.14 for diagrams of connectors and cables.
MIDI data transmission is **serial** and not parallel as one might expect with 16 MIDI channels. This is because parallel connectors and cables are more expensive and fragile. Also data being transmitted via a parallel interface can only reliably travel approximately 3 meters before bits of information get lost.
A MIDI message is serial:

1001 0000 0011 1100 0100 0000 1001 0001 0100 0000 0100 0000 1001 0010 0100 0011 0100 0000

and not parallel:

1001 0000 0011 1100 0100 0000
1001 0001 0100 0000 0100 0000
1001 0010 0100 0011 0100 0000

MIDI data is transmitted in one direction only. See figure 5.14.

**Figure 5.14:** Data goes in one direction

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18 MIDI information is transmitted in MIDI messages, which are instructions which tell a music synthesizer how to play a piece of music.
The MIDI cables connect the MIDI jacks of various instruments together so that those instruments can pass MIDI signals to each other. The MIDI OUT of one instrument is connected to the MIDI IN of another instrument. If the MIDI THRU port is used the THRU jack is attacked to another instrument’s IN jack. Figure 5.15 shows the connection between the Computer’s MIDI interface and a MIDI keyboard that has built-in sounds.

Figure 5.15: Basic Connection between Computer’s MIDI interface and MIDI Keyboard

5.4.5.4 COMPUTERS AND MIDI

Since MIDI devices and computers are digital devices, computer manufacturers were not long realising that the computer would be ideal for MIDI. The problem that faced them, however, was that the MIDI data transmission rate was 31.5 kBaud which is different from any computer data rate. Thus, manufacturers had to design a MIDI interface to allow the computer to talk at MIDI’s speed.
5.4.5.5 THE MIDI LANGUAGE

The MIDI language is represented with binary code where each 0 or 1 is called a bit. Eight bits equals a byte. MIDI uses digital words. Each digital word consists of 10 bits with MIDI: 8 bits and one start bit and one stop bit.

5.4.5.6 MIDI MESSAGES

MIDI information is transmitted in ‘MIDI messages’, which can be thought of as instructions which tell a music synthesizer how to play a piece of music. The synthesizer receiving the MIDI data must generate the actual sounds.

MIDI is a set of ‘musical commands’ that electronic instruments use to control each other. All MIDI communication is achieved through multi-byte ‘messages’. In general, these messages consist of one Status byte followed by one or two Data bytes.

<table>
<thead>
<tr>
<th>Status</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1XXX XXXX</td>
<td>0XXX XXXX</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>Status</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1XXX XXXX</td>
<td>0XXX XXXX</td>
</tr>
<tr>
<td></td>
<td>0XXX XXXX</td>
</tr>
</tbody>
</table>

The exceptions to this are:
System Real-Time messages and some System Common messages which are followed by Zero Data Bytes:

Status

1XXX XXXX

These messages are generally sent to synchronise MIDI devices. System Real-Time messages have the highest priority and can interrupt any commands. These messages consist of single status bytes – they do not contain data bytes.

System Exclusive messages are followed by any number of Data Bytes:

<table>
<thead>
<tr>
<th>Status</th>
<th>Data</th>
<th></th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1XXX XXXX</td>
<td>0XXX XXXX</td>
<td></td>
<td>0XXX XXXX</td>
</tr>
</tbody>
</table>

The System Exclusive status byte carries out a variety of functions. It requires at least three additional bytes – the manufacturer’s ID number, the data format or function byte and the ‘end of transmission’ byte. They are designed to be read only by a particular brand of synthesizer and exist so that manufacturers can develop new features on their synths and still have their machines conform to the MIDI standard. In general, System Exclusive messages are manufacturer specific.

A pattern of numbers tells an instrument to make a sound. When a musician pushes down a key on the piano to start a sound the gesture is known as a Note-On to MIDI message. This Note On message carries information about the channel, the pitch (the property of a musical tone which is
determined by frequency) to be played and the velocity (volume) at which the pitch is to be executed.

In general a NOTE ON message is as follows:

\[
\begin{array}{ccc}
\text{1001nnn} & \text{0kkkkkkk} & \text{0vvvvvvv} \\
0 - 15 & 0 - 127 & 0 - 127 \\
\text{channels 1 to 16} & \text{pitches 0 to 127} & \text{velocities 0 to 127} \\
\end{array}
\]

Example

\[
\begin{array}{ccc}
\text{10010010} & \text{00111100} & \text{01000000} \\
\text{NOTE ON channel 3} & \text{pitch C4 (middle C)} & \text{velocity 64} \\
\end{array}
\]

In the above example the last four numbers of the channel selection ‘0010’ determine that channel 3 will be used.

A different pattern of numbers tells an instrument to stop making a sound. This is known as ‘Note-Off’ to MIDI and it occurs when the musician releases the piano key, thus stopping the sound. This message is sent out of the keyboard’s MIDI OUT jack. Like the ‘Note-On’ message, it also consists of three numeric values but one of the values is different to the ‘Note-On’ message.

In general a NOTE OFF message is as follows:

\[
\begin{array}{ccc}
\text{1000nnn} & \text{0kkkkkkk} & \text{0vvvvvvv} \\
0 - 15 & 0 - 127 & 0 - 127 \\
\text{channels 1 to 16} & \text{notes 0 to 127} & \text{velocities 0 to 127} \\
\end{array}
\]

Example

\[
\begin{array}{ccc}
\text{10000010} & \text{00111100} & \text{01000000} \\
\text{NOTE OFF channel 3} & \text{pitch C4 (middle C)} & \text{velocity 64} \\
\end{array}
\]
Two additional bytes are required – a pitch byte, which tells the MIDI device which note to play, and a velocity byte, which tells the device how loud to play the note.

Software packages quickly became available with sequencers first coming on the market. These were based on a hardware device that simply recorded and replayed MIDI data. The software sequencer allowed the computer to record, store, replay and edit MIDI data into ‘songs’. Patch editors then became available which allowed the user to edit sounds away from the synthesizer.

5.4.5.7 SEQUENCERS

Shortly after MIDI was introduced, hardware ‘sequencers’ were developed. These sequencers are like tape recorders except there is no tape involved. The musician plays a tune on a keyboard and the MIDI output port sends the data directly to the sequencer to record the tune. The tune can be heard by pressing the ‘play’ button on the sequencer.

This program records and manipulates MIDI instructions and not the sounds produced by the keyboard. When the sequencer plays the recorded data back it re-transmits the instructions and not the actual sounds. Thus, the sequencer records all finger and foot movements, along with the musical beat and rhythm of movements. When replayed the sequencer plays the instrument by electronically recreating all of the movements recorded. The sequencer sends the recorded messages to the instrument through the instruments MIDI In jack.
Messages are stored in RAM during recording and later stored on floppy disk/Jaz Drive or hard drive. These MIDI files are small and require very little storage space - a few kilobytes vs a CD's 30 megabytes for a 3-minute song. [MIDISOUND Productions]

The most popular sequencer program for Macintosh computers is Cubase, published by Steinberg.

5.4.5.7.1 FEATURES OF SEQUENCERS

- **Polyphony:** The ability to play more than one note at a time is the polyphony of a sound generator. Earlier synthesizers were monophonic, which meant that they could only play one note at a time. If 10 keys were pressed together at one time on the keyboard of a monophonic synthesizer, only one would be heard. In modern keyboards more voices are built in so that all 10 sounds are heard when pressed. The different sounds that a synthesizer or sound generator produces are called ‘patches’ or ‘timbres’. Synthesizers assign patch numbers to each sound. The most popular patch number is number 1 for the acoustic piano sound. Thus, using MIDI, a sequencer could set up a device to play the piano sound by sending a Program Change message for a particular Channel with the data byte number one.
MIDI Channels and Multi-timbral Mode: 'A synthesizer or sound generator is said to be multi-timbral if it is capable of producing two or more different instrument sounds simultaneously.' [Heckroth 1995] With enough instrument sounds a single synthesizer could produce the sound of a band or orchestra.

Sequencer software is required to send the various MIDI messages. For example, a violin part could be on Channel 1, piano on Channel 2, flute on channel 4, and so on.

MIDI has been structured as a multi-channel system allowing for up to 16 independent sets of channel messages to be simultaneously transmitted. Channel messages use four low-order bits of the Status byte to specify which of the 16 MIDI channels the message is meant for. These messages are intended for any devices in a system whose channel number matches the channel number encoded into the Status Byte.

Each MIDI channel can be set up to play a different instrument (patch number) with each Channel having a choice of hundreds of patches to chose from. Each channel can play only one instrument at a time but can play many notes from that instrument at one time – even though the original instrument e.g. flute may be incapable of sounding more than one pitch at a time. A MIDI Program Change message instructs the MIDI Channel which instrument is to sound. There is individual control of volume, pitch, etc. on each MIDI Channel. To decide which note is played a MIDI Note message is sent. Each channel ignores messages that are not associated with it. In order to change the volume of each instrument a Volume Controller message is sent. Thus, there is control of actions in each Channel due to the fact
that there are 16 MIDI channels and one MIDI cable runs into the multi-timbral module's MIDI In.

Today, most MIDI sound modules and synthesizers are 'multi-timbral'. Thus, the sound module can listen to all 16 MIDI Channels at once, and play any 16 of its 'patches' (instruments) simultaneously, with each of the 16 patches set to a different MIDI channel.

The synthesis module used for this project is the X5Dr AI² Synthesis Module by KORG. It has a tone generator with an 8Mb capacity, amplifier and effect units, and all the audio is handled in the digital domain. It has 430 built-in Multisounds, which are multi-sampled PCM waveforms. These allow one to simulate a range of acoustic sounds, from drums and percussion to piano, guitar and trumpet. It has a 64-voice polyphonic capability which allows the creation of complex ensemble and large-scale orchestral sounds. It also has a built-in computer interface which enables a direct connection to the serial port of the Apple Macintosh. It can be connected to the computer through either a MIDI connection using a MIDI interface, or through a direct connection using a serial cable.

5.4.5.7.2 ADVANTAGES OF USING A SEQUENCER

1. The sequencer has a tempo control so the performance can be played faster or slower. When the MIDI sequencers playback tempo is changed it will not alter the pitch unlike that of digital audio playback.
2. One can easily transpose musical parts, mute different parts or create individual solo parts or choose different individual instruments to play simultaneously.

3. Notes can be change, entered or edited using the notation editor facility in the sequencer program. This is an advantage to people whose performance techniques may not be very good. The idea is that the person can enter each musical note slowly and specify what bar they want the new addition to the tune played in. The note can be entered by clicking the mouse on the graphical staff notation on the screen. Editing music is similar to editing a document in a word processor. This cannot be done using digital recording techniques.

4. Some sequencers produce a Scored version of the performance, which can be printed out if needed. This is useful if one cannot notate music.

5. MIDI sequencing software allows many different instruments to be played simultaneously, thereby creating a very rich musical environment.

6. Sequencing software includes 'mixing facilities' in the form of software mixing disk. This allows one to select an instrument, add effects such as reverb, set volumes, etc. All of these facilities help to bring life and feeling to the music.
5.4.5.7.3 THE USE OF COMPUTERS AND SEQUENCING SOFTWARE

The MIDI sequencer is the most common computer program designed to store and manipulate MIDI data. It records MIDI instructions, called *Events*. The sequencer only records the instruction emanating from a MIDI instrument and not the sounds produced.

Sequencer software allows multitrack MIDI and Digital Recordings on a PC or Mac. When looking at the interface of a MIDI sequencer, it is similar to that of a tape-recording. But, the difference is the way the information is recorded. Using an analog recorder the waveform is recorded on a magnetic tape. With a digital tape recorder digital numbers are recorded to represent the acoustic signal. ‘*A MIDI sequencer records MIDI events.*’ [Raschke, 1999]

When MIDI sequencing and digital audio are mixed it allows the user to have MIDI files playing synthesizers in sync with digital audio tracks. These programs are expensive and need fast microprocessors and a large storage capacity to store the digital files.

The two types of software which have been used in this project are:

1. Sequencer Software and
2. Music-Notation Editor Software.
Due to the high quality sequencers and notation editors now available for the Mac, the Mac has been used for creating this Information System. Also MIDI editing is fundamentally a graphic process, a task for which Macs are still the favourite over the PC.

Sequencing packages are primarily geared towards the recording of tracks but also allow for displaying and editing of notes, etc. They can be worked similar to a tape recorder and music can be recorded and played back from beginning to end. Notation editors on the other hand allow for the translation of standard music notation into MIDI files and vice versa. [Govind 1998]

5.4.5.8 RECORDING MIDI

Software programs are now available which change the computer into a sequencer. A sound card is installed inside the computer with speakers attached and the sequencer can play back musical performances without needing external MIDI sound modules. Examples of sequencer software are Cubase, CakeWalk, Logic and FINALE.

5.4.5.8.1 SEQUENCER SOFTWARE (CUBASE)

Cubase, published by Steinberg, is the most popular sequencer program across the Macintosh computer platforms. Logic and Emagic are other popular ones. Cubase was used for recording the sound samples for this project due to its ability to record MIDI and thus, create small files which can be used over the web. Cubase will also notate the MIDI files created. The
disadvantage, though, of Cubase's notation facility is that changing the score is practically impossible. In addition, the score can be very complicated to read and thus would not be suitable for an archive where people with all different levels of score reading ability will be searching for tunes. For this reason, Cubase was only used to record sound samples for the music of Sliabh Luachra.

The system requirements for running Cubase VST on a Power Macintosh are:

- Apple Power Mac or compatible computer with 16-bit 44.1kHz audio capability or ASIO compatible soundcard
- Minimum 16 MB RAM, recommended 24 MB RAM
- 2nd-level cache required
- System 7.5.3 or higher

5.4.5.8.2 NOTATION EDITING SOFTWARE

During the 1980s desktop music publishing became accessible to anybody who had a computer and a good quality printer. Laser printers with PostScript music fonts create high quality music manuscript.

Most notation programs allow the user to enter the music in two ways:

1. By playing the music using a MIDI controller in Real Time Mode.
2. Step Time Mode allows an individual to input notes one step at a time from the controller using the computer keyboard or mouse. The graphical user interface gives many different options to enter musical marking symbols, score titles, song words, etc.

5.4.5.8.2.1 FINALE (Coda Music software) Synthesizer and Notation Program

‘Finale is a powerful integrated program for music transcription, notation, playback, and publishing. It incorporates elements of a word processor, a graphics designer, a sequencer, and a page-layout program.’ [Coda Music Technology 1997]

Finale provides ways to create, edit, hear, view, layout, print music and transcribe music. The transcription within this project of the old music tablatures of Padraig O’Keeffe to present day staff notation was completed using Finale.

Reasons for choosing FINALE as the score producer for this project instead of CUBASE include:

- It allows Simple Note Entry where values and symbols are selected from various palettes and can be directly clicked into the score using the mouse. Also, programmed macros speed up this technique by allowing the use of the computer’s number keys to determine note values as the score is entered.
‘Simple Note Entry’ makes it very easy to edit music or to type directly onto the manuscript sheet on the screen. When the Simple Entry Tool is clicked a floating palette appears on the screen showing the different note options available to the musician. The note option include: semibreve (whole note), minim (half note), crotchet (quarter note) and quaver (eighth note), etc. Finale also gives the options of $16^{th}$ Notes, $32^{nd}$ Notes, $64^{th}$ Notes and $128^{th}$ Notes. The options used for the recording of Pádraig O’Keeffe’s music were the first five options.

- The option to insert grace notes is provided in Finale. Pádraig O’Keeffe used a lot of grace notes in his music and for this task Finale proved excellent. A grace note could be inserted simply by entering a normal note, then clicking on the grace note option and clicking on the normal note just entered. This note was then converted to a grace note. Examples of this feature are shown in O’Keeffe’s music.

- An Eraser option is also given which allows easy deletion of unwanted notes. This option is much easier to use in Finale than in Cubase. When a note is deleted in Finale, Finale simply enters a rest note to the value of the deleted note. On insertion of an alternative note, this rest disappears. The opposite happens in Cubase. Deletion of notes meant that the whole tune moved back until the space for the deleted note is full. Thus, entering a new note causes such confusion the manuscripts that when it comes to editing the score it is easier to begin the tune again.
• The **Dot** function allows easy entry of dotted crotchets or dotted quavers. This is not possible with CUBASE.

• Finally the **Tie** option was a very useful function in this project as Pádraig O’Keeffe’s tablatures showed his bowing styles using ties. Thus, this facility was used to show the original bowing style of O’Keeffe. This was done by clicking on the first note to be included in the tie and then clicking on the last note. This option was not available in the version of Cubase VST in use for this project.

• Having entered the music it was important to hear the completed tune. Finale’s **Playback** feature allowed this given that it was connected to a MIDI system. This facility was important as Pádraig O’Keeffe’s tunes had to be replayed to discover which key the translation should be made in. Frequently the key had to be changed as the playback did not produce the correct sound.

  Parts of the tune could also be identified while scoring and played back allowing the score to be heard.

• Finale also has a **Graphics tool** for importing and exporting PICT, TIFF, and EPS files. The notated tunes had to be exported as Graphic files in order to embed them into fields in the Filemaker Pro database which was used to store all the history of Sliabh Luachra. This feature for exporting the Music Score was not available in Cubase VST.
In order to export the files they were firstly saved as Standard MIDI files. Using the Graphics tool the section of the score needed for the database was highlighted and saved as a PICT file which could then be read by Filemaker Pro.

- The **Articulations** function allowed the insertion of different marks into the Score. One particular mark was needed for translating the music of Pádraig O’Keeffe, namely the 'v' mark. When O’Keeffe wrote his score he placed the letter 'v' over a note where a musician was to use an 'up bow.' In order to insert this symbol I used the Articulations function. The Articulations functions allows the insertion of many other accent marks.

- An added advantage of Finale for this project was that it allowed the use of **multiple music fonts**. In addition to the published, engraver-style look of fonts several fonts emulate the appearance of handwritten notation which is important for this project.

5.4.5.9 **MIDI CONTROLLERS**

The controller keyboard is an electronic piano keyboard. It contains a MIDI OUT jack that can be connected to the MIDI IN jack of other units.

Often, controller keyboards make no sound themselves as they do not have in-built sounds. Instead they generate MIDI signals for other devices to interpret and act on. The MIDI IN of the devices which produce sound are connected to the MIDI OUT of the controller keyboard. Synthesizers produce the sounds specified by the incoming MIDI messages.
The keyboard is the most common MIDI controller. The most basic keyboards send only two types of information: when a key had been pressed and the key in question. These correspond with MIDI's Note On and Note Off messages. Other keyboards can detect how fast or hard a key is pressed. The faster you press down a key, the higher the velocity for that note is. The keyboard is also capable of transmitting MIDI Program Change messages.

The keyboard controller used in this project was the Master Controller Keyboard SL-161 by Studio Logic. It has 61 non-weighted keys, a pitch bend wheel and modulation wheel, four zones for splits and programmable layer, a rear panel which includes 2 parallel MIDI outputs, Sustain input jack, Volume input jack, DC input jack, power switch and LED.

5.4.5.10 MIDI IN MULTIMEDIA APPLICATIONS

Because MIDI takes up less space than digital audio files it means that it is used in many Multimedia programs. MIDI may be imported into the audio tracks of a QuickTime Movie. It may be embedded in programs such as Databases (Filemaker Pro for this project) and Multimedia programs such as Director. Also, many internet browsers have plug-in capabilities that allow MIDI files to be played over web sites. [Raschke 1999]
5.4.5.11 MIDI INTERFACE

The MIDI Interface used to connect all the MIDI devices up together and to synchronize computer software and other MIDI devices. The MIDI Interface was used to connect up the MIDI system for the purposes of this project was the MIDI Express XT. It is connected to the Macintosh computer by connecting one end of a DIN-8 AppleTalk cable into the MIDI Express XT Mac A port and the other into the modem port of the Macintosh as shown below. This allowed the Mac to communicate with the different MIDI devices connected to the MIDI Express.

5.5 PROBLEMS ENCOUNTERED WITH MIDI FILES

1. Although MIDI provided many advantages over other forms of recording and storing data the one major limitation of MIDI was the **Timbre** of the instruments. MIDI can produce the sounds of many different instruments such as violins, banjos, pianos, etc, but each instrument sound is static and does not give the feeling and depth which can be heard from the actual instrument. As regards Irish music, this was a big disadvantage as the feel, rhythm and energy of the Sliabh Luachra music is not heard in the sound samples produced. Also, the sound quality of the music when played back may not be great as the sound that is reproduced depends on the playback device which may be either the sound card or the synthesizer used. A low-end sound card can produce terrible sound.
2. As previously mentioned, the original tablatures of Pádraig O’Keeffe had to be converted to standard notation. At the beginning of the project CUBASE was used to do this. From working on CUBASE it was found that it was totally unsuitable for notating Traditional Irish Music as the notation produced was far too complex to read and very difficult to change.

On researching different notation software available on the market it was decided to use FINALE, a notation program. This proved very useful for writing notation and allowed easy manipulation of the music. It also allowed 'Grace' notes to be entered into the music which was an important feature of Pádraig O'Keeffe's music.

5.6 CONCLUSION

In using MIDI to record sound samples for the Sliabh Luachra Archive the following benefits over Waveform Audio were found:

1. The ability to connect several devices to a system and then link them with a computer allowed the integration of different aspects of sound and multimedia on one computer.
2. MIDI required little storage space as it is a series of instructions given to the computer.
3. Because of their smaller size they can be downloaded more quickly from the Internet.
4. A variety of sound effects can be added to the music.
5. There is no need to have a group of musicians available to do a recording as it is possible to recreate a band using MIDI software available.
6. By keying in music notation, MIDI software will play back the tune created.

7. Once captured a MIDI file can be edited using a sequencer.

Although MIDI was chosen for producing the sound samples of the Sliabh Luachra music, MP3 was another option. The difference between MP3 and MIDI is that MIDI files do not contain actual audio. The music sequence is recorded as a series of numbers, which explains how the music is to be played back. For this reason the files are very small, but the sound is totally dependent of the output device. The output device is usually the sound card on the computer. The major advantage is that because the files are so small they are excellent for use in Web pages and other applications such as the database developed for the Sliabh Luachra Archive. Also, MIDI files will play on almost any web browsers without having to install plug-ins.

I believe that MIDI was very useful for the purpose of developing sound samples of the Sliabh Luachra Archive and it gives people the opportunity to hear the music and get an idea of what it sounds like. The major disadvantage though is that it lacks CD quality and thus the real music cannot be heard. I would recommend the use of MP3 for presentation of the music as the quality and feeling of the music would be much clearer to the listener.
CHAPTER SIX
CHAPTER SIX

MARKET RESEARCH

6.1 INTRODUCTION

This chapter looks at Market Research and the research conducted in order to determine the requirements for the archive developed. It looks at secondary and primary research and gives the results emanating from the qualitative research carried out.

Market research was used to determine what information the potential users of the archive would be looking for. As Peters and Waterman state in their book 'In Search of Excellence' keeping 'close to the customer' is crucial for success, so, to ensure success of the archive it was necessary to talk to some potential users.
6.2 MARKET RESEARCH

Market research is used to obtain information about the potential market for a particular product. It covers product development, identifying the market, and suitable methods of selling, distribution, promotion, and sales/service facilities. [Chisnall 1997]

6.3 SECONDARY RESEARCH

Secondary research is the collection and use of applicable existing data, both from internal and external sources. When first performed it provides information for planning and guiding the primary research task.

Secondary research was the main focus of this project as much of the information needed for the archive had previously been collected. Thus, the task of this project was to develop an electronic archive to store and display the material collected.

The contents of the archive consist of information about the area, musicians, music, instruments, and history of the Sliabh Luachra region. This information was obtained from the staff of the Scartaglen Heritage Centre who had collected a lot of interesting data from the local people in Sliabh Luachra. This data was collected through interviews, which were recorded on video for use in the Heritage Centre.
An additional secondary source was the Irish Music Archives in Merrion Square, Dublin. On visiting these archives information was located in books, magazines and articles on Irish music located in the archives.

A further source of secondary data was from musicians who play and are interested in the music of Sliabh Luachra. Much information was gathered from attending local ‘sessions’ (or *seisins*)\(^9\). During these sessions musicians discuss the tunes they play and often talk about the musicians they get the tunes from. Musicians from Sliabh Luachra were often mentioned and thus valuable information was obtained.

Although much information had been collected from secondary sources, for the purposes of developing the archive, it was necessary to conduct primary research in order to determine what information members of the public would request when searching such an archive.

### 6.4 PRIMARY RESEARCH

Primary research is research ‘originated by a researcher for the specific purpose of addressing the problem at hand’. [Malhotra 1999: 112] This was carried out to establish whether an archive of local music and culture would be viable in certain regions. As mentioned in chapter one, Sliabh Luachra was used as the case study for developing the archive. Qualitative research was used to survey the market for such an archive.
Most of the contents of the archive were gathered from secondary sources, as mentioned above. Primary data was collected from Nicky McAuliffe and Maurice O’Keeffe, musicians from Sliabh Luachra, who provided very relevant information for the archive while talking to them.

Before carrying out qualitative research the first step was to define the research question. In defining the research question of archiving material for the Scartaglen Heritage Centre discussions were held with decision makers in the centre, industry experts (those in other Heritage Centres). Secondary data was then analysed and qualitative research was carried out.

The Michael Coleman Archive in Gurteen, Co. Sligo was also visited to gain an insight into the archival procedures they use. The Manager of this archive gave advice and suggested developing a very user-friendly archive which people could easily use. Their technical archive was developed by an English company and the user activated the archive by ‘touch screen’. This archive was very easy to navigate through but the major disadvantage was that it could only be updated by the original creators. For this reason, it was noted that the update facility would be a very important factor in developing an electronic archival system for the Scartaglen Heritage Centre as the system would need to be updated regularly.

In discussing the question of storing the archive material with the Scartaglen Heritage Centre committee, it was decided that they needed to store a copy of the original material in electronic form. The original material would then be stored for preservation and members of the public

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19 A seisiún is one of the defining characteristics of Irish music where players gather together in parlors or pubs to practice their music craft together, learning from each other while at the same time entertaining those who are lucky enough to be present. [Irish Cultural Centre of Boston 1999]
would view copies of the material on computer screen. Following this the problem of translating the music tablatures of Padraig O’Keeffe arose. It was decided that these tablatures would be scanned into the computer for viewing electronically. The tablatures would be converted to standard notation for musicians who read notation and sound samples of the music would be provided for those who learn by listening.

Thus, the problem definition was stated as the need to develop an electronic, updatable, archive to store a sufficient amount of relevant information about Sliabh Luachra.

6.5 RESEARCH METHODS

In order to find a solution to the problem defined above, qualitative research was carried out. Qualitative research is a method of exploratory research, which is used to explore a problem or situation and to provide an insight for developing an approach to the problem on hand. As regards this project, the problem was to decide what type of system to develop in order to archive the material containing the history of Sliabh Luachra.

Exploratory research does not require structured questionnaires or large samples. Instead, researchers listen to new ideas and insights as they proceed with their research. If a new idea is discovered they may go in this direction. This new idea is then developed until its possibilities are exhausted and new opportunities arise. Different methods of exploratory research exist including:
• Analysis of secondary data
• Survey of experts
• Qualitative research. [Malhotra 1999: 96]

All the above methods were used. As mentioned previously analysis of secondary data was firstly carried out and other archives were visited to gain an insight as to how their computerised systems worked. Following this qualitative research was undertaken.

6.5.1 Qualitative Research

The most commonly used qualitative research methods are ‘depth’ interviews and group discussions. Qualitative work was carried out for the purposes of this research to reveal the reasons why people would look for information on certain aspects of Sliabh Luachra and what material they would look for.

Qualitative research does not require a large sample size as very often indepth interviews are held. For this reason it would be unsuitable to have a large sample size. Qualitative research is concerned with the understanding rather than the measurement of things. [Hague, Jackson 1996: 64] Due to the fact that only one or two people carry out the qualitative interview it allows open-ended questions to be used. For example, the respondent was asked what information they would look for in an archive and they could answer exactly what they felt they would need. Thus, their answers were not restricted to a certain number of topics.
6.5.2 Sample Size

A sample of 10 people was used as a representative sample for analysis. The interviewees were from different industries and had different occupations including: teachers, musicians, dancers, computing lecturers, people working in the tourism industry, students from folk studies courses.

6.5.3 Research Results

The following results were drawn from this survey (See Appendix 7):

1. When searching for information about a particular area what specific information would you be looking for?

The people surveyed were asked what information they would seek when searching for archive information on a particular area. Most people stated that they would be interested in information about the musicians of an area, the history of the area and the music tunes from the particular area in question. For this reason the archive is developed so that people can retrieve information about these topics easily. The Sliabh Luachra archive is developed so that the visitor can get access to information about the most influential musicians in Sliabh Luachra without searching the database, i.e., separate web pages are developed for these musicians. These include Pádraig O’Keeffe, Johnny O’Leary and Maurice O’Keeffe.
As those surveyed also stated that they would be looking for the music tunes of the area, the tablatures of Pádraig O'Keeffe of Sliabh Luachra are translated into standard notation so that his tunes are available to all musicians who can read notated music. For those who learn tunes by listening, the tune is supplied through sound. With traditional music this is often sufficient as a traditional musician will apply their own style to the tune after hearing it. Also, Irish music was and is primarily learned and played by ear and this is the way it was passed on from one generation to the next. [Flynn 2000]

2. **In terms of information requirements would you be looking for specific or general information?**

In terms of information requirements some people needed specific information and others needed general information. Those carrying out research needed accurate, specific information which they could quote in their research projects. Entertainers needed general information, which they could use to give audiences a feel for the music they were playing. Many musicians were interested in the musicians who played certain music as they like to tell audiences about others who play the tunes they are about to hear. For this reason much of the information in the database is referenced and dated.

Information supplied from personal interviews with the people of Sliabh Luachra is dated as the date in which the interview took place. This information will be of great interest to those in the entertainment business as many light-hearted stories not published in books are
told by those interviewed on video. Also, the musicians of Sliabh Luachra have a story for every tune that they play.

3. Why would you source the data? Is it for use: In research, Personal reasons, Commercial purposes, For publication, For class purposes.

In order to determine why people would use an archive they were asked why they would source the data. The results were that musicians would source it for personal reasons so that they could learn the tunes of a particular musician or learn about the area in which the music came from. Students would source the information for research purposes and for use in college assignments. Lecturers/teachers would use it for gathering class material and again the information needs to be accurate and kept up-to-date for this reason.

4. How important is the relevance of the information?

As mentioned in the previous point, lecturers would use the material for class purposes, students and researchers for research, etc. Thus, the archive would need to be keep up-to-date with current news from Sliabh Luachra as the information they would seek would be very relevant to their research/teaching. For this reason the database is designed, so to that the administrators of the system can easily add new records, or update current records. As the database is archival in nature, there is no need to delete records.
5. **How often would you be required to source data?**

The survey concluded that most people would only source the data from the archive about twice a year. However, these people also knew many other musicians and people who would be interested in the history of localities who would also visit local heritage centres to get access to archives. Due to the fact that many people would only visit the archive once or twice a year there is a possibility that there may be quiet periods when the archive may be redundant. For this reason the archive user interface is developed using web software so that certain pages, such as the page on Sliabh Luachra, the page about the Scartaglen Heritage Centre, etc, may be launched on the Web as an advertisement for the Heritage Centre. This would perhaps encourage visitors to the centre.

6. **What current sources do you use and why?**

At present the sample primarily use music books, guide books and libraries to source the information. Very few of them use the Internet due to the fact that too much information is supplied and very little of it is relevant to what they need to know. For this reason, the archive is developed so that when a visitor looks for a certain topic they will only get information about that topic. For example, if they search for ‘Pádraig O’Keeffe’ they will only get information about him. As a result, visitors who do not have a lot of time to spare can get the information they need without having to read pages of information.
7. **How do you use existing systems that are available?**

When searching for information using these existing sources of information they use indexes to find the topics they need. Those using the internet use search words.

For this reason the database is designed so that the visitor can search using key words. For example, if looking for Maurice O’Keeffe’s record in the database they would simply type ‘Maurice O Keeffe’.

8. **What fault, if any, do you find with existing systems?**

The primary complaint with existing systems (such as the Internet), as mentioned above, is that too much information is given and it is not relevant enough. Those who used the Internet also complained that they were easily sidetracked to other topics due to the large quantities of information available.

Thus, the Sliabh Luachra Archive will only provide information about the topic requested or searched for.

9. **Would you use such an Archive instead of books/internet/any other publications?**

When asked would they use an Archive instead of existing books/internet and other publications, they answered yes. In particular, many showed a great interest in the Sliabh
Luachra music and culture and would be very interested in using the archive to source information.

10. **Would you visit a particular Heritage Centre in different parts of the country in order to gain access to such an archive of information?**

All the musicians stated that they would travel to a particular Heritage Centre in different parts of the country in order to get access to the tunes of a particular area. They stated that it was very difficult to get information on any one area at present because books tended to generalise about many areas.

Those who work in the Tourism industry stated that they would not travel to a Heritage Centre, unless it was in the same county, as it would take too much out of their work time. For this reason they hoped that such an archive would be available over the web.

As a result the Sliabh Luachra Archive includes a searching facility designed using web development software (Claris Home Page). If in the future the Heritage Centre wishes to launch the archive on the web they can do so with very little changes.

11. **Where would you expect to find such a database?**

When asked where they would find such an archive many expected to find one in local tourist centres, Heritage Centres and libraries. Also, as mentioned previously, many hoped that it would be available over the web.
12. Are you familiar with computers? To what extent have you used them?

In order to determine the computer skills of the archive target audience the respondents were asked what computer skills they had. At present, most of them use computers for e-mailing, searching the web and typing basic word processing documents. As a result it was decided to use a Web interface as the method whereby people would access the information. The reason for this is that many of the sample do not use computers but they have a general knowledge of how to use the Web. For those who do not use computers the Web user interface is designed for ease-of-use and so the staff of the Heritage Centre could give the visitor a quick guide through their system before searching the archive.

Due to the fact that a large share of the target audience have no great knowledge of how to operate computers, the archive is developed with a very simplistic user interface. Navigation is through hyperlinks created using web authoring software and also through the use of clickable buttons.

The user interface for the archive administrators is simplistic and navigation is through the use of buttons with text on them to guide the administrators in using the database.
6.5.4 SYSTEM REQUIREMENTS

As a result of the research carried out the user requirements were defined and the user interface designed. These include:

- The user should be able to search for a particular musician, instrument, music tune, etc, and get the results of these searches immediately.
- The user should be able to search the database using the database user interface.
- The user should also have access to a Web based user interface to search the database.
- The system should be reliable and fast.
- The system should be easily launched.

From co-ordinating with the staff of the Heritage Centre the following requirements were determined for the Database Administrators:

- The systems should be easy to use and easily updatable.
- Visitors should not gain access to change the contents of the archive. Thus, it should be password protected.
- If the contents of the database are changed these should be visible on the Web pages.
6.6 CONCLUSION

The system was developed on the basis of the users requirements. It is an easy to use system and is easy to update by the database administrator. As requested it is password protected to avoid unauthorised persons gaining access to change the contents of the system. Development of the system is detailed in chapters three and four.
CHAPTER SEVEN
7.1 INTRODUCTION

The development of technology has had effects on all aspects of living. As outlined in chapters one and two our traditional music has suffered the most from the influences of radio, television and now technology.

Although, the history of our music, dance and culture is static and will not change, this is not true of our present situation. Society is changing, and technology is developing more each day. As a result our music is open to many more influences from both abroad through the use of radio, television, the Internet and people visiting from foreign countries.
7.2 TECHNOLOGY

The development of multimedia technology has brought many possibilities with it. Photograph editing software, graphics software, video and file editors, music software and the Web are allowing people to develop new ideas each day.

Old photographs can be scanned and cleaned up. Numerous graphics can be brought together to create one image. Videos can be edited and music or voice-overs added to them. MIDI allows for the creation of small files that can be listened to over the Web. The Web can be used to advertise products to the whole world.

All of the above are changing our true culture, leading to 'multiculturalism' as stated in the first chapter. In preserving our culture we can take advantage of the many opportunities afforded by emerging technology.

7.3 PROBLEMS OF IMPLEMENTATION

In implementing the Archive two main problems occurred:

1. FileMaker Pro could not support complex queries. It supports many-to-many relationships through the use of calculated fields. It does not easily support chaining of relationships.

2. MIDI was not suitable for recording Irish traditional music. The final result produced a tune void of feeling and energy. Thus, the listener did not hear the true depth of the music.
7.4 VALIDATION SURVEY

A survey was carried out after completing the Sliabh Luachra Archive to validate the system and gain an insight into what people thought of the product. (See appendix 8).

7.4.1 User Information - Sample Size

A sample of 15 people visited the college to view the archive. These people came from different industries and had different occupations including: musicians, dancers, teachers, lecturers, and people working in the tourism industry.

Of those surveyed most people would use the archive through general interest in the music and culture of Sliabh Luachra.

7.4.2 Research Results - User Reactions

The Sliabh Luachra Heritage Committee were very happy with the archive as it provided them with a means of displaying the information and tablatures of Pádraig O’Keeffe without producing the original documents. The staff found the database easy to update and liked the use of the large buttons to navigate through the system. They can see expansion of the system to include the recording of master classes and concerts which could be stored as part of the archive. They can also see the possibility of holding master classes on-line to accommodate musicians living long distances from Scartaglen.
Most users thought the archive was educational as it provided much information and stories about Sliabh Luachra. They also found it easy to use as the buttons used on the screen helped them navigate and the system kept most of their attention also.

As regards Screen Layout people found the buttons used for navigating useful and thought that the icons were well arranged. Some thought more use of graphics would be useful but liked the green and white colour running throughout the web pages. They found the simplicity of the Web pages appealing and the interface intuitive.

As regards a learning tool, musicians who used and tested the system found it a great learning tool. They liked the idea that all the history of Sliabh Luachra was stored in one place for people to view. Musicians also took great interest in tablatures of Pádraig O’Keeffe. They were particularly interested in the way that they could view both the original tablature and the original tablature translated into standard notation on one screen. Many of these musicians stated that they learned a lot from this alone. The students of Irish Music/Folk Studies who were interviewed stated that the archive would be of great benefit to them.

A general comment passed by one person about the archive was:

'This is an innovative project leading to very interesting developments for the future in digital recording of Irish music.'
7.4 FUTURE CONSIDERATIONS

Due to the constant development of new and emerging technologies, this archive could be further developed in the future. The following are some of the recommendations for further development:

- At present concerts are held at the Scartaglen Heritage Centre. The development of a system using Video Conferencing technology over the Web would enable people in other countries to view these concerts on-line. Payment for such on-line concerts would increase revenue for the Heritage Centre. The Heritage Centre should consider this and other similar opportunities as part of an overall e-commerce strategy:

- E-commerce could also be used by the Centre to sell some of the products from their shop on-line.

- Samples of MIDI files have been incorporated into the database at present. There is a possibility that these files could be listed on a web page and people could click on the name of the tune they want to hear. On listening to the available tunes, they could choose the tunes they like, and then order them on a CD. A CD would then be customized specially for that customer. Thus, listening to, choosing the relevant tunes, and paying for the CD would be done over the Web.
A further area for development is in the area of a virtual music session where musicians from different areas could meet over the Web. Again this would involve the use of Video Conferencing equipment. Musicians could chat to each other and play tunes together, even though they would not be in the same place.

A follow on from this could be on-line music tutorials (as mentioned previously). Master Classes are held at the Heritage Centre from time to time. But, very often those living long distances from Scartaglen may not get the opportunity to attend these classes. In order to accommodate these people and give them the opportunity to learn some of the true Sliabh Luachra music, a system could be set up whereby they could log on to a Master Class over the Web. These classes would be advertised and hosted over the Web.

This system, though designed for the Scartaglen Heritage Centre, could be used in any Heritage Centre, allowing them to archive and present their regional musical past, present and future.

7.5 FINAL CONCLUSIONS

From the above it can be seen that the future of Irish music is promising due to the fact that technology holds no boundaries. Technology, though a threat to regional cultures, can also be used to preserve and increase interest in them. The archive developed is only the beginning of a major advance in the combination of communication technology and culture. The opportunities, which lie ahead are limitless.
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BIBLIOGRAPHY AND REFERENCES


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APPENDICES
Appendix 1

Location of the Sliabh Luachra Area
Appendix 2 (a)

Pádraig O’Keeffe’s Tablatures

Waltz and Polka
Appendix 2 (b)

Pádraig O’Keeffe’s Tablatures

Hornpipe and Polka
Appendix 2 (c)

Pádraig O’Keeffe’s Tablatures

Hornpipe – The Stack of Barley
Appendix 3

The Pádraig O'Keeffe Monument

Scartaglen Heritage Centre
(Officially Opened 19 May 2000)
Appendix 4

Johnny O’Leary (right) with Pádraig O’Keeffe
Appendix 5

Script used for the navigation button ‘Search for Musician by Name’ using FileMaker Pro Software

Enter Browse Mode
Set Error Capture[On]

Go to layout ["Enter Musicians Name"]

Enter Find Mode [Pause]
Perform Find []
Go to Layout ["Form Musician by Name"]
If ["Length(Musician) = 0"]
Show Message ["Not Available"]
Go to Layout ["Enter Musician Name"]
End If

Enter Find Mode [Pause]

Switches to browse mode
Allows or prevents error messages from displaying. This step allowed the message ‘Not Available’ to be entered when a choice was not available.

Allows us to view a specific layout.
In this case the layout which gives us the option to enter a musicians name.
Tells FileMaker Pro to enter find mode.

FileMaker Pro finds the records that match the current find request
Allows us to view the Layout that contains the information requested in Find Mode.

The ‘If statement’ allows us to tell the system user that if there was no match for the musician requested then the information was ‘Not Available.’
A message box appears saying ‘Not Available’

When the particular search request was not available, FileMaker will take the user directly back to the Layout which gives them the option to enter a new request.

FileMaker continues the above sequence until the user enters a request that is present in the database.
It then re-enters Find Mode and finds the request entered by the user.
Appendix 6

Notation for Entity-Relationship Diagrams

- Entity Type
- Weak Entity Type
- Relationship Type
- Identifying Relationship Type
- Attribute
- Key Attribute
- Multivalued Attribute
- Composite Attribute
- Derived Attribute
- Total Participation of E2 in R
- Cardinality Ratio 1:N for E1:E2 in R
- Structural Constraint (min, max) On participation of E in R
Appendix 7

Qualitative Research Questionnaire

Occupation of Person: ___________________________________________________________

Industry: ____________________________________________________________________

When searching for information about a particular area what specific information would you be looking for? Is it information on the:

Musician _________________________________________________________________

History of area ____________________________________________________________

Instruments ________________________________________________________________

Music Type ________________________________________________________________

Music Tunes ________________________________________________________________

In terms of information requirements would you be looking for specific or general information?

What kind … ? ______________________________________________________________

General … ? _________________________________________________________________

Explain _________________________________________________________________

Why would you source the data? Is it for use:

In research _________________________________________________________________

Personal reasons ____________________________________________________________

Commercial purposes _________________________________________________________
How important is the relevance of the information?  

How often would you be required to source data?  

What current sources do you use and why?  

How do you use existing systems that are available?  

By:  Search words  
     Click on pictures/words associated with topic  
     Indexes  
     Addresses available (e.g. web site address)  
     Other  

What fault, if any, do you find with existing systems?  

Would you use such an Archive instead of books/internet/any other publications? Why?
Would you visit a particular Heritage Centre in different parts of the country in order to gain access to such an archive of information? Why?

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

On average how much time are you willing to spend with secondary data? ____________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

Do you know of other people who would use such a system? Why?

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

Where would you expect to find such a database?

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________

__________________________________________________________________________________________________________________________________________________________
COMPUTER LITERACY

Are you familiar with Computers?

To what extent have you used them?

In research □
Typing document □
Graphs □
E-mail □
Searching the Web □
Searching Databases □
Developing Databases □
Appendix 8

VALIDATION SURVEY
for the
Sliabh Luachra Archive

USER INFORMATION

Occupation: __________________________________________________________

Have you a knowledge of Irish Music? Y/N ____________________________

If Yes, to what level (teacher, student, professional, general interest, hobby)? ______

Would you use an archive as A Researcher □
For General Interest □
Other (please state) ____________________________________________

USER REACTION

Please state your reaction to use of Archive.

Was it:

Educational? ______________________________________________________

Easy to Use? _____________________________________________________

Entertaining? ____________________________________________________

Screen Layout

<table>
<thead>
<tr>
<th>Screen Layout Helpful</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangement of Icons</td>
<td>illogical</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Choice of Colour</td>
<td>inconsistent</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Graphic Images</td>
<td>dull</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Balance of Media</td>
<td>incorrect</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

xiii
Were you able to navigate through the archive easily? Y/N ______________________

If not please state where ____________________________________________________

Would you describe the archive as a learning tool?

________________________________________________________________________

Please write any other comments you have in the box below:

________________________________________________________________________

EXPERIENCE IN COMPUTER USAGE

Are you familiar with computers?

To what extent have you used them? In research
Typing Text Documents
Spreadsheets
E-mail
Searching the Web
Searching Databases
Developing Databases
Computer Games
USER MANUAL

for

THE SLIABH LUACHRA ARCHIVE
The purpose of this manual is to provide information on how to search and update the archive for both the database administrators and the visitors to the Heritage Center.

The archive is created so that it can be viewed in three different ways:

1. The Administrator View - this is only available to the system administrator who is in charge of updating the archive.

2. The Visitor/Researcher View - the database can be viewed by visitors and researchers to the Heritage Centre but cannot be change by the.

3. Visitor View using a Web Interface - the visitor can search the archive using a display similar to the web.
WORKING WITH THE DATABASE

MAIN BUTTONS

ADMINISTRATOR

The following buttons appear on all Administrator Screens in the archive:

CLOSE

This is used to close the table currently being viewed.

To Use:

1. Click the Close button on the menu at the right side of the database screen.

MAIN MENU

This button will close the current table in use and bring the administrator out to the Administrators Main Menu.

To Use:

1. After working on a particular table click on the [Main Menu] button to get back to the main screen.
NEW MUSICIAN

This button will allow entry of a new musician to the database. It appears on all Administrator View tables. It is called New Musician in the Musician table but in other tables it will be labelled differently. For example, in the Instruments table it will read [New Instrument], in the Music table it will read [New Music Tune], etc.

To Use:

1. Click the [New Musician] button as shown in the above example.

2. Enter the details in the new blank record that appears by clicking in the blank fields as shown.

DELETE THIS MUSICIAN

This button allows deletion of the entire details about the musician being viewed. In other tables this button may read [Delete this Instrument], [Delete this Music], [Delete this Area], etc.

To Use:

1. Click the [Delete this Musician] button as shown in the above example. In other tables this button may read [Delete this Instrument], or [Delete this Music Type], etc.

PREV

Clicking this button will display the record before the current one being viewed/edited.
NEXT

Clicking on this button will display the next record after the current one being viewed/edited.

FIND ALL MUSICIANS

In order to find all musicians stored in the archive click on the button [Find All Musicians].

In other tables this button will have a different word instead of musicians, e.g., Find All Instruments, Find All Music Tunes, etc.

VISITOR

The following navigation buttons appear on all tables available for viewing and searching by a visitor using the archive:

CLOSE

Click on this button to close the table currently being viewed.

MAIN MENU

This button will close the current table in use and bring the administrator out to the Administrators Main Menu.

To Use:

1. After working on a particular table click on the [Main Menu] button to get back to the main screen.

PREV

Clicking this button will display the record before the current one being viewed/edited.
NEXT

By clicking this button it will display the next record after the current one being viewed/edited.

ADMINISTRATORS

The administrator will have access edit, update and delete records from the database. This access is not available to visitors who search the database as it is password protected.

TO BEGIN

1. Click on the Administrator button on the opening menu.
2. This will prompt the administrator to enter a password in order to gain access to the system.

![Password Entry](image)

3. Enter the password ADMINISTRATOR and click OK.

4. The Administrators Main Menu appears.

![Main Menu](image)

5. This menu enables the administrator to update any of the tables that are shown including: area, musician, music notation, instrument, music category, video clips, music type, music, photographs, and Padraig O'Keeffe's Tablatures.
6. The [Main Menu for Searching] enables the Administrator to gain access to the Visitors Main Menu.

7. The Exit button will exit the administrator from the system.

**UPDATING RECORDS**

Information in a record can be changed. For example, add more details to the description of the area, Ballydesmond.

1. Click on the [Area] button on the Administrators Main Menu. This will bring you to the area details form.
2. Click on the button [Find All Areas] on the top right of the screen.
3. Scroll through the records until the record on Ballydesmond is located. Use the [next] button to do this.

4. Click in the Description area to change the details about Ballydesmond. On doing this you will be prompted to enter an administrators password in order to gain access to change data in the archive. The following box will appear. Enter the password ADMINISTRATOR. As you type the word it will appear in black dots because it is a password.

---

**Sliabh Luachra Archive User’s Guide**

[Diagram of Administrator interface showing fields for Area Name, Description, and information about Ballydesmond.]

---

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5. Click OK.
6. Finally, click in the relevant area in the details box and type directly into it as required.

**CHECK HOW MANY RECORDS IN ARCHIVE**

In order to check the total number of records in a table carry out the following steps:

1. Click the [Find All Areas] button.
2. On the left of the screen the results will be displayed as follows:

3. The result shown above is 58 record in the database and record number 5 is showing.
VISITORS

TO BEGIN

1. Click on the Visitor button on the opening menu.

2. This will prompt the visitor for a password. Enter the password VISITOR in the password box in order to gain access to the system.

3. Click OK.

4. The Visitors Main Menu appears as follows:
5. This menu enables the visitor to view any of the tables that are shown including: area, musician, music notation, instrument, music category, video clips, music type, music, photographs, and Padraig O'Keeffe's Tablatures.

6. The Exit button will exit the visitor from the system.
SEARCH FOR AN AREA

To search for an area in Sliabh Luachra:

1. Click on the [Search for Area] button on the Main Menu.
2. This will open the search form as follows:

   ![Enter Area Name Form](image)

   - Area Name
     - Search

3. Click in the white box and type the name of the area required.

4. Click the [Search] button. This will open the record of the area requested.
   If the area is not available you will be prompted with a dialog box saying “Area not available!”. Click the OK button. The search will re-open.

5. To begin a new search click on the button [Search for Area by Area Name].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR A MUSICIAN

To search for a particular musician:

1. Click on the [Search for Musician] button on the Main Menu.

2. This will open the search form as follows:

3. Click in the white box and type the name of the musician required.

4. Click the [Search] button. This will open the record of the musician requested.

5. To begin a new search click on the button [Search for Musician by Name].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR AN INSTRUMENT

To search for a particular instrument:

1. Click on the [Search for Instruments] button on the Main Menu.

2. This will open the search form as follows:

   ![Search Form](image)

3. Click in the white box and type the name of the instrument required.

4. Click the [Search] button. This will open the record of the instrument requested.

5. To begin a new search click on the button [New Search for Instrument by Instrument Name].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR A MUSIC CATEGORY

To search for a particular music category:

1. Click on the [Search for Music Category] button on the Main Menu.

2. This will open the Music Category search form as follows:

3. Click in the white box and type the name of the music category required.

4. Click the [Search] button. This will present details of the music category requested.

5. To begin a new search click on the button [New Search for Music Category].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR A MUSIC TUNE

To search for a particular music tune (for example, Shandon Bells, Harvest Home, etc):

1. Click on the [Search for Music Tune] button on the Main Menu.

   ![Search for Music](image)

   (Tunes Names e.g. Harvest Home)

2. This will open the Music Tune search form as follows:

   ![Search for Tune Using Tune Name](image)

   **Music Title** Harvest Home  

   [Search]

3. Click in the white box and type the name of the Music Tune required.

4. Click the [Search] button. This will open the record of the Music Tune requested.

5. To begin a new search click on the button [New Search for Tune by Tune Title].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR PADRAIG O’KEEFFE’S TABLATURE

To search for a tablature of Padraig O Keeffe:

1. Click on the [Search for Padraig O’Keeffe’s Tablatures] button on the Main Menu.

2. This will open the Search for Music Tablature form as follows:

   ![Search for Music Tablature](image)

3. Click in the white box and type the name of the tablature required.

4. Click the [Search] button. This will open the details of the tablature requested.

5. To begin a new search click on the button [Search for Tablature].

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR MUSIC NOTATION

To search for the music notation of a tune:

1. Click on the [Search for Music] button on the Main Menu.

2. This will open the Search for Tune form as follows:

3. Click in the white box and type the name of the tune required.

4. Click the [Search] button. This will open the details of the tune requested.

5. To begin a new search click on the button [New Search for Tune by Tune Name] on the right of the screen.

6. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR VIDEO CLIPS

To search for a video clip of a musician:

1. Click on the [Search for Video Clips] button on the Main Menu.

2. This will open the Search for Musicians Video form as follows:

3. Click in the white box and type the name of the video clip required.
4. Click the [Search] button. This will open the video requested.
5. Double click the mouse on the video to play it.
6. A control bar as follows appears at the end of the video.

7. The first button will adjust the sound level of the video while playing. Hold the mouse down on the this button and move it up to increase the sound, down to lower the sound.
8. To stop the video press the following button: ▪️
9. To continue playing the video again press: ▶️
10. To rewind the video press ◀️.
11. To fast forward the video press ▶️.
12. To begin a new search click on the button [Search for Video by Musician Name].
13. To return to the Main Menu from this screen click [Main Menu].
SEARCH FOR PHOTOGRAPHS

To search for musicians photographs:

1. Click on the [Search for Photographs] button on the Main Menu.

2. This will open the Search for Musician Pictures form as follows:

3. Click in the white box and type the name of the Musician Picture required.
4. Click the [Search] button. This will open the musicians pictures requested.
5. To begin a new search click on the button [Search for Pictures by Musician Name].
6. To return to the Main Menu from this screen click [Main Menu].

SEARCH FOR MUSIC TYPE

To search for a specific Music Type, e.g. Irish Traditional Music, carry out the following steps:

1. Click on the [Search for Music Type] button on the Main Menu.
2. This will open the Enter Music Type form as follows:
3. Click in the white box and type the name of the music type required.
4. Click the [Search] button. This will open the details of the music type requested.
5. To begin a new search click on the button [Search for Music Type].
6. To return to the Main Menu from this screen click [Main Menu].
SEARCHING THE DATABASE USING THE WEB INTERFACE

The following section explains how a visitor to the Heritage Centre can search the Sliabh Luachra Archive using the Web interface.

TERMINOLOGY

Hypertext:

• is any text that contains links to other documents. Words or phrases in the archive may be selected by clicking on it with the mouse. This causes another document to be retrieved and displayed.
• This hypertext is blue and underlined and appears throughout the Sliabh Luachra Archive.
• When the mouse is moved over the picture it changed to a hand shape.
• When a Web Site has been viewed this text turns a green colour to distinguish the sites that are already visited.
• Some pictures/images are also hyperlinked. Pictures may be selected, which results in another document being retrieved and displayed.
TO BEGIN

1. The **HomePage** is the starting point of the Web Site. This contains a map of Ireland showing where Sliabh Luachra is located.

   
   ![Map of Ireland showing Sliabh Luachra](image)

   Music may sleep quietly in books, or it may lie dormant like a wintering root in musician's mind, but it thrives and flourishes only when given human energy: breath from the lungs and the power of arms, hands, and finger.

   James R. Cowdery
   The Melodic Tradition of Ireland

2. On the left of the screen is the navigation window which contains the navigation buttons which are used to get to different parts of the Web Site.

3. When the web site is launched, music is playing. This can be stopped and started suing the [Start/Stop Music] button on the navigation window.
4. Click on the map of Ireland. This opens the page giving details of Sliabh Luachra.

5. Click on the map of Sliabh Luachra. This displays information about Sliabh Luachra. This information can be viewed by scrolling down the page.

6. At the end of the page the option is available to search for information about a particular area in Sliabh Luachra or to return to the homepage.

**HOME**

1. To return to the first page (homepage) of the Web site click on the [Home] button on the navigation menu at the left of the screen.

Alternatively:

1. Throughout the Web site, a [Home] button appears at the end of each page. This can be used at any time to return to the homepage.
FIND PADRAIG O'KEEFFE’S WEBSITE

1. Click on the [Padraig O'Keeffe] button on the left pane.

2. This opens the Padraig O’Keeffe’s Web page.

3. On the right side of the page a menu with hyperlinked text appears. By clicking the mouse on this text it will bring you to the topic stated. For example, click on [Padraig’s Musical Influences]. This will bring you to the section on his Musical Influences.

WHO WERE PADRAIG’S MAIN MUSICAL INFLUENCES?

Padraig was influenced greatly by his mother Margaret Callaghan from Doon and inherited her musical ability.

Tom ‘Billy’ Murphy taught music to Padraig. Tom ‘Billy’ was a blind fiddle player of the Sliabh Luachra area who acquired a broad repertoire including 136 reels, and many extraordinary tunes and taught members of Denis Murphy’s family, and the renowned Padraig O’Keeffe and a long list of well-known musicians.

4. To get back to the menu from this point click the back button.
VIEW PADRAIG O'KEEFFE'S TABLATURES

1. Choose [Search Database] from the main menu at the left of the screen.
2. This opens the database searching menu.

3. Select the [Musician] option by clicking on the picture over Musicians. This opens the Musician Page.
4. Choose the option for Padraig O’Keeffe by clicking on the picture of Padraig O’Keeffe. This opens the Padraig O’Keeffe menu.

5. Choose the option [O’Keeffe’s Tablatures].
6. This opens the web page giving the option to search for a tablature as follows:
7. Type the Title of the music tablature required in the available box.
8. Click the [Start Search] button.
9. The results will appear.
10. To start another search click the text [Start New Search].
11. To return to the home page click the [Home] button.

FIND MAURICE O'KEEFFE'S WEBSITE

1. Choose [Search Database] from the main menu at the left of the screen.
2. This opens the database searching menu.

3. Select the [Musician] option by clicking on the picture over Musicians. This opens the Musician Page.
4. Select the option for Maurice O’Keeffe. This will open Maurice O’Keeffe’s Web page.
5. To navigate through the page use the scroll bar at the right side of the screen or use the hyperlinked text.
6. The [Back] text will bring you back to the top of the Web page at any stage.

FIND JOHNNY O’LEARY’S WEBSITE

1. Choose [Search Database] from the main menu at the left of the screen.
2. This opens the database searching menu.
3. Select the [Musician] option by clicking on the picture over Musicians. This opens the Musician Page.
4. Select the option for Johnny O’Leary which will open Johnny O’Leary’s Web page.
5. To navigate through the page use the scroll bar at the right side of the screen or use the hyperlinked text.
6. The [Back] text will bring you back to the top of the Web page at any stage.
SEARCH DATABASE FROM WEB INTERFACE

The following details how to search for data in Web view.

Search for a Musician

1. Click on [Search Database] button in the navigation menu on the left of the screen.
2. Click on the [Musician] Icon on new screen.
3. A new screen appears giving an option to view Web pages of three musicians. Choose the musician required. If the musician requested is not available click the Search for Musician text.
   
   ![Search for Other Musicians](image)

4. Enter the name of the Musician required. Type the word in full with no punctuation.
5. Choose the Search button.
6. Click Begin New Search at the end of the screen to begin searching again.
7. If you need to see a list of Musicians available in the archive click on the [See Musician List] text.

Search for an Area in Sliabh Luachra

1. Click on Search Database button in the navigation menu on the left of the screen.
2. Click on the Area Icon on new screen.
3. Enter the name of the Area required. Type the word in full with no punctuation.
4. Choose the Search button.
5. Click Begin New Search at the end of the screen to begin searching again.

Search for an Instrument

1. Click on Search Database button in the navigation menu on the left of the screen.
2. Click on the Instrument Icon on new screen.
3. Type in the name of the Instrument required. Type the word in full with no punctuation.
4. Choose the Search button.
5. Click Begin New Search at the end of the screen to begin searching again.
Search for a Music Tune

1. Click on Search Database button in the navigation menu on the left of the screen.
2. Click on the Music Tune Icon on new screen.
3. Enter the name of the Music Tune required. Type the word in full with no punctuation.
4. Choose the Search button.
5. Click Begin New Search at the end of the screen to begin searching again.

Search for a Music Category (e.g. Irish traditional music)

1. Click on Search Database button in the navigation menu on the left of the screen.
2. Click on the Music Category Icon on new screen.
3. Enter the name of the Music Category required. Type the word in full with no punctuation.
4. Choose the Search button.
5. Click Begin New Search at the end of the screen to begin searching again.

Search for a Music Type (e.g. hornpipe, jig, etc.)

1. Click on Search Database button in the navigation menu on the left of the screen.
2. Click on the Music Type Icon on new screen.
3. Enter the name of the Music Type required. Type the word in full with no punctuation.
4. Choose the Search button.
5. Click Begin New Search at the end of the screen to begin searching again.
RECORDS AVAILABLE IN THE SLIABH LUACHRA ARCHIVE

Musicians

1. Andrew Sonny Riordan
2. Anne McAuliffe
3. Annie O Connoll
4. Art O Keeffe
5. Billy Clifford
6. Brendan Scollard
7. Cal Callaghan
8. Carmel Leary
9. Celia Regan
10. Christine Cronin
11. Con Curtin
12. Con Sullivan
13. Con Cronin
14. Dan Cronin
15. Dan Herlihy
16. Dan Jeremiah O Connor
17. Dan Leary
18. Dan Lynch
19. Dan O Connor
20. Dan O Keeffe
21. Denis Doody
22. Denis McMahon
23. Denis McSweeney
24. Denis Murphy
25. Denis O Connor
26. Denis O Keeffe
27. Denis Paud Brosnan
28. Dermot Breen
29. Diarmuid Scollard
30. Din Tarrant
31. Donal Murhy
32. Donal O Connor
33. Donie O Sullivan
34. Eamonn Sheehy
35. Eddie Lenane
36. Edmond Peter Galvin
37. Ellen O Leary
38. Emma O Leary
39. Flor Lynch
40. Francie Davie O Connor
41. Francie O Connor
42. Helen O Leary
43. Jack Collins
44. Jackie Brown
45. Jackie Daly
46. James Culloty
47. Jer Collins
48. Jeremiah Leane
49. Jerry McCarthy
50. Jerry O Connor
51. Jim Marshall
52. Jim O Keeffe
53. Jimmy Connor
54. Jimmy Doyle
55. Jimmy O Connor
56. Joe Cahill
57. Joe Mulcahy
58. Joe O Sullivan
59. John Curtin
60. John Foley
61. John Reedy
62. John Spillane
63. John 'Tailor' Brosnan
64. John Walsh
65. Johnny Cronin
66. Johnny O Leary
67. Julia (Murphy) Clifford
68. Kevin Barry
69. Mairead O Connor
70. Mary Jameseen Danny O Sullivan
71. Maurice O Keeffe
72. Maureen McMahon
73. Maureen O Carroll Cronin
74. Michael J Cronin
75. Michael McFaucaude
76. Michael Mulcahy
77. Mick Culloty
78. Mick Mulcahy
79. Mike Brosnan
80. Mike Cronin
81. Paddy Brosnan
82. Paddy Cronin
83. Paddy Jones
84. Paddy O Connell
85. Paddy O Connor
86. Patie Curtin
87. Patrick Downey
88. Patrick O Connor
89. Patsy O Connor
90. Paudie Gleeson
91. Paudie O Connor
92. Paudie Walsh
93. Paudie Walsh
94. Paudie Walsh
95. Paudie Walsh
96. Sean Hickey
97. Sheela Hewitt
98. Taidhghin an Asail
99. Terry 'Cuz' Teahan
100. Thomas Morgan
101. Tim Browne
102. Tim Gleeson
103. Timmy Clifford
104. Timmy Clifford
105. Timmy Clifford
106. Vincent Warren
107. Willie O Connell
### Areas

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### Music Manuscripts

1. Boys of Bluehill - Hornpipe
2. Green Little Cottage - Polka
3. I had no Wife of my Own - Hop Jig
4. Off to California - Hornpipe
5. Merry Blacksmith - Reel
6. Munster Jig - Jig
7. Shandon Bells -Jig
8. Stack of Barley - Hornpipe
9. Take Her Away - Polka
10.Untitled Hornpipe 1 - Hornpipe
11.Untitled Polka 1 - Polka
12.Untitled Waltz 1 - Waltz
Instruments

1. Banjo
2. Bodhran
3. Bones
4. Bouzouki
5. Button Accordion - Box
6. Concertina
7. Drums
8. Flute
9. Guitar
10. Harp
11. Keyboard
12. Mandolin
13. Melodeon
14. Mouth Organ
15. Piano
16. Piano Accordion
17. Tin Whistle
18. Violin/Fiddle

Musicians Pictures

1. Billy O Shea
2. Dan Herlihy
3. Dan O Connor
4. Denis Murphy
5. Johnny O Leary
6. Julia (Murphy) Clifford
7. Maurice O Keeffe
8. Michael O Leary
9. Mick Culloty
10. Mike Duggan
11. Ned O Connor
12. Padraig O Keeffe

Tablatures

1. Boys of Bluehill
2. Green Little Cottage
3. Hornpipe for Accordion
4. I have no wife of my own
5. Jimmy mo mil astor
6. Merry Blacksmith
7. Munster Jig
8. Munster Jig 2
9. Off to California
10. Rose of Tralee
11. Shandon Bells
12. Stack of Barley
13. Take Her Away
14. Untitled Hornpipe 1
15. Untitled Jig 1
16. Untitled Waltz 1
17. Untitled Polka 1

Music Tunes

1. Boys of Bluehill
2. Going for Water
3. Green Little Cottage
4. Harvest Home
5. Hornpipe
6. Job of Journeywork
7. Johnny Cope
8. Knocknaboul - Knocknabower Polka
9. Merry Blacksmith
10. Mo Grathereen Og Mo Chroi
11. Munster Jig
12. O Keeffe’s Slide
13. Polka 1
14. Shandon Bells
15. Stack of Barley
16. The Blackbird
17. Tom Billy’s

Music Category

1. Hornpipe
2. Jig
3. Polka
4. Reel
5. Set Dance
6. Slide
7. Slip Jig
8. Slow Air

Music Type

1. Irish Traditional Airs
2. Irish Traditional Music
3. Irish Traditional Singing