By acknowledging these limitations, we can recognize the potential areas for future improvement and development of the MelodyMix music app, and ensure that the app continues to evolve and meet the changing needs and preferences of music lovers.

**1.6 DEFINITION OF TERMS**

* MP3s- This stands for MPEG-1 Audio Layer 3. It is a widely used audio coding format for digital audio compression, designed to reduce the file size of audio content without significantly compressing its quality.
* Streaming services- They are digital platforms that deliver multimedia content, like music, movies, shows, and podcasts directly to users over the internet.
* OS- This stands for Operating system. It is the software that manages computer hardware and provides common services for computer programs. It mainly acts as an intermediary between the hardware and user applications.
* User Interface- They are the visual elements, layout and interactions and through which users interact with the application.
* Playlist- A list of Audio tracks that users can create, edit and save for sequential or random playback
* Back-end- The part of the application that handles data processing, business logic, and interactions with databases or file systems, separate from the user interface.
* Playback controls- Buttons or functions that allows users to control the playback of audio tracks, such as play, pause, stop, forward/backward, and repeat.
* Metadata- Information about audio files such as title, artists, album, genre and track number, which is stored within the file and managed by the music player.

**CHAPTER TWO**

**LITERATURE REVIEW**

Computer science has developed rapidly in the last few centuries and has influenced people's lives so much that most of our daily activities are confirmed to be using computer science. Through computer science, many technical marvels have been created and enabled the emergence of extensive corporate management, social networking sites, and much more. Nowadays, the smart phones we use are some of the gadgets that use this computer science technology, and it is hard to imagine how to live without computer science technology. The development of research in the field of computer science is still being developed and explored, and in its development, it is combined with many things according to its uses and applications, including music. Music is an art form that has been a big part of human cultural activity since time immemorial, and over time, it is only natural that we should explore the possible applications of computer science to music. Meanwhile, the term music is a sound that is arranged in such a way that it can be heard by humans, which contains rhythms, songs, tones, and sound harmonies that can be produced naturally, such as the sound of the wind blowing or produced with one or a combination of several musical instruments designed to produce a musical sound. In addition, music can also be accompanied by a human choir consisting of six types, of which there are three types of female voices, namely alto, Mezzo-Soprano, and Soprano, as well as three types of male voices, namely bass, baritone, and tenor. In this paper, we conduct a literature review as a starting point for researching the knowledge of computer science which limits the use of unstructured data, namely data in the form of sound.

**2.1 LITERATURE REVIEW IMPLEMENTATION**

This section will explain the four steps of literature review activities carried out in this paper; paper collection, selective filtering, classification, and analysis and summary.

1. **Paper collection**:

The first step in this paper is to collect many academic papers using Google Scholar, a free web search engine that can show us scientific literature of various formats and disciplines. To keep it a generic search, we use the search term "music in computer science" in google scholar. The search returned minimal results, with only 20 papers for publication published at any time from 1989 to 2020. To keep work current and relevant, we use a filter that will only show academic papers from 2015 to 2021. Figure 2 shows the result of searching on google scholar. To address this, we use more specific search terms with different levels of focus. From the results of filtering and searching for papers using Google Scholar, we collect papers with titles that seem related to our main topic, some of which have special requirements if we want to access them. In this case, we find and limit the total to 120 papers. Next, the search terms used are digital music, music technology, music education technology, computer music, music generation, and music composition technology

1. **Selective filtering:**

After collecting papers, we do not use all of them in this second stage and limit them. We only want to use papers relevant to our research related to applying computer science technology to unstructured data in the form of sound, so we do selective filtering. This stage is done by skimming all academic papers obtained from the next stage, and if the topic is not related to music in computer science, then we discard it. So that after selective selection, there were 62 papers left.

1. **Classifications:**

In this third stage, the classification stage is carried out in 2 sub-stages starting with subtopic classification, where the classification will be divided into three sub-topics, namely the rise of digital music, how computer science can be integrated into music education, and the creation of music through the use of computer science.

The next stage is paper quality sub-classification which is divided into two sub-stages, namely subtopic classification and paper quality

1. **Subtopic classification:**

Although all the remaining papers have topics related to music in computer science, we feel that each paper individually focuses on a different subject matter, and if we were to make a literature review of it, it would not be systematic and structured. Therefore, This is why we need a way to divide the filtered papers. In order to review the academic paper most effectively and cohesively, we have divided it into three parts, namely:

1. **The rise of digital music**

The newest form of music media is digital music, and in this section, we will explore and limit it to only papers discussing how digital music emerged and its impact on the music industry. In addition, we also explore some of the exciting uses of computer science in music.

b. How computer science can be integrated into musical education Music education has become an integral part of keeping our musical culture alive. This section will be limited to papers on how computer science technology can assist music education.

c. Music creation through the use of computer science In this section, we limit ourselves to papers that show how computer science technology can help people with or without musical composition experience become more creative in creating music.

**2.2 LITERATURE REVIEW**

As mentioned before, this section will explain in detail the three sub-topic classifications such as the rise of digital music, how computer science can be integrated into music education, and music creation through computer science.

1. **The Rise of Digital Music:**

Music has become a big part of human life and has played a significant role in human life for a long time. Tracing its origins means understanding many things that can be extracted from the music itself. In line with the sound, the almighty created the ear as a tool humans can use to listen to this sound or music. The formation of the human ear when referring to the theory of evolution, the formation of the human ear was when mammals evolved, where they formed rib bones from the jaw spine, which would be used to receive sound waves in the air and, of course, these ribs would become part of the ear. With a better level of intelligence and sense of hearing, humans learn to do vocalizations to increase the beauty of the sound produced with sound and its combination with musical instruments, which can change the mood or please the mood when hearing certain types of music.

Over time, humans began to experiment with creating a harmonious sound. Traces of this can be found in our ancestors, where early hominids would form groups to sing and bond together. Finally, they began to make instruments that can produce sounds, and so these sounds, called musical instruments, are combined with the human voice to produce sound sounds which are called music and, in essence, can bring human emotions and feelings when listening to music certain. In his paper, M. Williams reviews research conducted by other researchers and concludes that after humans evolved to utilize language, music was created to take advantage of the greater efficiency of language as a bonding mechanism [1]. According to H. Sun, the most popular way of recording music before the digital era was to use a technique called analog recording. This allows music to be played back at a later time. The shift from analog to digital is believed to have started with the creation of the compact disc, or CDs for short, in 1982. When Peer-ToPeer, P2P for short, a file-sharing service, was introduced, the music industry began to thrive forever changing. Responses to these changes are varied and complex. Some major labels try to defend themselves by reaffirming more vigorous copyright enforcement, while independent labels embrace new opportunities. As the digital transition occurred, Apple, a technology company, made the first significant advances. They developed the iPod as a media player and iTunes, a media management application. It created a platform for people to enjoy digital music, and soon after, several other companies created similar platforms. However, the nature of their system left some to be desired [2]. Aguiar and J. Waldfogel describe their findings on how unpredictable music quality uses digital sales in the United States, Canada, and 15 other European countries by time and vintage. They concluded that the digitization of music had brought many positive side effects. They point out that the overall quality of music has improved worldwide after the change. Their research note notes that products with modest release prospects will occupy the top positions despite the concentration of growth in sales and product numbers[3]. Aguiar and Martens found significant changes in how people consume music based on data obtained from the IFPI, known as the International Federation of the Phonographic Industry. From 1999 to 2014, recorded music sales declined while digital music sales increased exponentially. With the advent and development of digital music, there is a fear of music piracy, and it is feared that most people will choose to pirate music instead of buying licensed music. Therefore, it reduces music revenue and, in turn, eliminates the incentive to create innovative music. An analysis of 16,500 clickstream activities of internet users in 2011 showed no evidence of unauthorized music downloads on digital music purchases.

On the contrary, it was found that there is a positive relationship between them. From their statistics, it can be understood that digital music purchases would drop by 2% if pirated music websites did not exist. It also shows that different countries are affected by pirated music differently. In addition, they need to consider that the music industry continues and will continue to grow [4]. Several people assume that the digitization of music would cause the music industry to lose intermediation between music producers and consumers. However, P. Galuszka argues against this, as the music industry is exceedingly complex, and intermediation provides several benefits to both producers and consumers. Music aggregators such as iTunes or Spotify allow major record company, independent labels, and artists to put their products on digital music stores for consumption [5]. Several hypotheses test the interaction order by Brewer and Goldsmith by J.F. Popham and C. Volpe, where correlated with action in terms of piracy in terms of digital music. This provides an argument that the hypothesis obtained in the study is that the internet is used to commit cybercrimes. Especially in terms of piracy in digital music without the owner's permission, either on YouTube or in the form of music videos.

For this paper, five theories and five forms of measurements were used:

• The encounter: The first proposed idea is the ‘encounter.’ It is the process people use to gain non-conformist knowledge on the Internet. Popham and Volpe use an adapted version of the Computer Self Efficacy Scale to test this.

• Shielding: The Internet is a shield for the perpetrators, hiding people's negative behaviors. The scale of the measure was derived from a questionnaire by Lwin and Williams. • Imitation The Internet enables the formation of custom networks for digital gatherings focused on counterhegemonic exchange.

• Affect: ‘effect’ concerns the person’s assessment of their behavior. A singular measure of effect was used based on the procedures used by Panas & Ninni.

• Moral disengagement: The people feel that what they are doing is not too morally wrong. A cumulative and singular measure was used based on the methods from Bandura et al. In their paper, J. Waldfogel proposes the golden age of music as an elaboration on how digitalization where most people assume that digitization to the industry would cause a significant reduction in their revenue, which is especially true for the music industry. They concluded that the discontinuous nature of the Internet might cause people to do digital music piracy [6]. However, it was observed that the main effect of digitization was reducing the creation of new works for the market. Nevertheless, it would also seem that digitization has made music more widely accessible to people. Digitization has led to piracy, which in turn causes decreased revenue, and threats to reduce revenue result in reduced costs. It is unclear whether copyright is doing its function and needs further assessment. It is good to enforce rules against piracy, but it should not hinder creative output [7]. R. Fleischer and P. Snickars took software studies and digital humanities approach towards streaming media, where in 2017, Spotify was using almost 100 million users. In their time spent on the research project, they discovered that it was difficult for them to grasp the definition and the nature of Spotify. This is why they tried localizing and historicizing Spotify as a company. They attempted to localize Spotify as a company and found it difficult as there were a lot of grey areas. In 2012, Snickars discussed with Sophia Bendz, who was Spotify’s Head of Marketing. She was asked what type of company is Spotify classified as, and she replied that it was a tech company. However, after some analysis, Fleischer and Snickars stated that Spotify had become more of a media company. Aside from localizing Spotify, they also took a crack at historicizing Spotify. They felt that this was important because Spotify is constantly changing, so their research and findings should be based on historical information. Due to its immense number of users and growing valuation, Spotify is often considered a prosperous company. However, the researchers explored multiple other perspectives on how to view Spotify’s history and noticed that it was filled with unachieved visions and predictions [8]. Dai and Yu analyzed contestability in digital music players and hypothesize that the power of the firm’s market is held at bay due to threats from new entrants. Others argue against this point because they think a contestable market is rare. At the beginning of the digitization of music, the market for portable music players was dominated by Apple. Apple developed the iPod, a portable personal media player released in 2001. Since 2004, the iPod has been the dominant digital music player, with its sales being 90% of the market in the US. Quality-adjusted price index estimates as part of a study conducted by Dai and Yu, who used data between 2002 and 2010 in which they found that there was a decline of about 20% annually for the market price index. They consider this a supporting idea that proves their hypothesis correct [9]. Consumers of digital music usually keep their library of songs on their hard disks. One issue they may encounter is the duplication of music files. This is not optimal as they take unnecessary space in the hard disk. Existing applications detect duplicate music files but still leave something to be desired. H. I. Hamzah, T. J. Low, and A. A. Mutalib decide to tackle this problem. They propose the Cognitive and Constructive Learning (CCL) approach. They came up with the Digital Music Archiving Model (DMAM). To test the effectiveness of their model, they compare it to existing applications that detect duplicate music files. The analysis shows that the DMAM is better than the other applications [10]. The article by A. H. D. Crooke contextualizes music technology in Hip Hop. They start their paper by explaining the historical significance of music technology to the Hip Hop tradition of beat making. As time went on, the beat-making culture started to expand and diversify. This diversity extends to the equipment used. The article gives a typology of these beat-making equipment. It shows the varying music technology and states how they should be considered as instruments on their own. It also explains how these technologies are integrated into music therapy. Crooke expressed his research opinion in the hope of changing the way people view music technology in music therapy. On the one hand, music therapy can affect the development of the human psyche; besides that, there is a negative side where certain music can also damage the human psyche and morals with descriptions of invitations to violate the law and crime. What is more, Hip Hop music is also strongly associated with social justice acts because they are a product of minority cultures [11]. Throughout the continuous development of the digitization of music, one of the most notable applications regarding music is Shazam. Shazam is an application that can help people identify music that’s currently being played. A. L. Wang attempts to break down how Shazam functions. Shazam uses the microphone to take in a query containing the small and short ambient audio sample. The minor is as short as two seconds. Then, it searches through its extensive database containing around 40 million songs. There may be distortions in the query audio, and they may be filtered out. The algorithm Shazam utilizes is comparatively better than previously available algorithms. Firstly, it computes faster, processing time as fast as a millisecond. It is also more tolerant of distortion to the query audio by about 20 to 30 db SNR. When comparing the efficiency, It was found that Shazam is approximately 1e + 9 times more efficient [12]. Recording companies and music promoters use data from sales reports to make strategic decisions. In their paper, E. Kristiani et al. discuss data warehouse design techniques. To simulate accurate data, they use chinook, a data sample available to the masses. During the design process, they use Object Relational Mapping. The creation of the data warehouse design is to help relevant stakeholders in making essential decisions [13]. M. I. Fadhil, R. Magdalena, and I. N. Ramatryana wanted to make a database containing the reff and verses of songs. However, manually separating these reff and verses would be very work-intensive and time-consuming. To help overcome this, the research on ways to automatically do these separations. They achieved a way to do this by using correlation calculations between frames. The system receives an mp3 song as an input and converts it into small frames in the framing process. Each of the frames is transformed using the Harmonic Fast Fourier Transform method. The result determines the correlation pattern of the frames. Then, it can determine the location of the reff and verse. Lastly, the reff and verse are taken from the song depending on the previously determined location. The researchers conducted this process on 25 songs and analyzed the result. The study produces more than 50% accuracy in determining the location of the reff and verse. The best computation time produced in this final project is 86 seconds with a 1000ms frame to cut a single song mp3 file [14]. Ubimus, introduced in 1999 by Weiser, is a research focus that combines Ubiquitous (Ubicomp) computing and music, which literally means Ubicomp calculates anywhere, anytime, anything, and every day, including the definition of Invisible computing, Silent technology, or Pervasive computing. This Ubicomp examines the use of software and hardware in implementing its benefits in the music field, which uses special software to produce digital music following the selection of unique hardware that can produce variations of the musical art itself [36].

During this literature review, we learned about how the music industry experienced a change through digitization. Then arises the concern of piracy and revenue loss. The collected reviews have mixed results regarding this, some state that digitization shows no proof of a decrease in sales, while some say otherwise. However, most research found that the digitization of music has led to several positive things, such as music variety and quality improvements. As technology continues to advance, breakthroughs are found in the music industry. Several types of research were focused on learning the technology used by music teachers and their views on it. Outside of that, research was also concentrated on creating a recommendation system for course places. Another common use of computer science in music is to help create music. There are a large number of proposals for this, including, but not limited to, automatic music generation, interactive music composition workshops, or computer music languages. The most used apparatus is computer software or sophisticated devices to achieve this. This literature review gives more details on how these tools are technically achieved. Overall, music is something that is constantly changing and evolving. There are many directions that it can go, and we believe that it is possible for there to be further advancements in the music industry.

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