Developing a free-to-play mobile game and evaluating the economic potential of the genre

Aiden Barrett

A project report submitted in partial fulfilment for the degree of

Bachelor of Science in Computing (Mobile Applications)

School of Physical Sciences and Computing
University of Central Lancashire

Abstract

This report contains both detailed documentation for the design of a mobile game and a research project alongside. The mobile game ‘Snippet Kings’ is a game in which the user has to correctly guess a song from a short audio clip played in a game room environment. The research aspect comes from the genre in which the game exists, the free-to-play genre: This is a genre that relies heavily on adverts and micro-transactions.

The research detailed further on will analyse the business model of free-to-play and a decision will l be made on whether this model is suitable for the project at hand. The documentation for the application development stems from the planning stages right through to the testing and implementation stages and conclusions are drawn on the viability of the research and the overall deliverables upon finishing the implementation.

Attestation

I understand the nature of plagiarism, and I am aware of the University's policy on this.
I certify that this document reports original work by me during my University project.

Signature **Date**

Acknowledgements

I would like to thank my tutors, Eddie Lee and Elly Foran for all their help and guidance throughout my time working on this project. I would also like to acknowledge my peers on my course as they were essential for the research and testing stages of the application.

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Introduction

According to Alha et al. (2014) the free to play model is increasingly becoming one of the most popular development and revenue models within the games industry. The abundant popularity of the free to play medium is evident by the revenue and active players of the relevant games within the category; Statista (2018) states that League of Legends, the free to play multiplayer online battle arena(MOBA), is currently the most played game globally, making up 22.92% share of playing time amongst all games and as reported by Unranked Smurfs(2018) the revenue model proves competent with " $964 million between January and September in 2014 putting them number one on the highest grossing game list"(Unranked Smurfs, 2018). To further emphasize the popularity of the free to play genre, the same study by Statista (2018) shows that 4 out of the top ten top played games follow the same free-to-play model.

To gain a further knowledge of the genre and understand the implications alongside this project will also contain the development of a free to play mobile game. The objective of the game is to correctly guess songs based on a short snippet played. The development will seek to design the game to entice the users to purchase items within an enclosed marketplace of the application in the way of micro-transactions. As the game is based around guessing songs the relevant ethical and legal implications will also be researched alongside the appropriate approaches to dissolve these problems.

Background and Context

Aim:
The aim of this project is to develop a mobile game with the objective of guessing songs based on a short snippet that is played. To further the deliverables on this project the economic viability of the game will be explored through the medium of the free to play model.

Research questions(s):
In order to achieve the above aim, the relevant algorithms, software development and design techniques will be identified and implemented to achieve a fully functioning application designed to entice the user to indulge in the micro-transactions within the application. This project will identify current mobile games with similar techniques implemented and define appropriate data of success alongside.

This project will look to emulate the success of similar mobile projects with free to play mechanics like Candy Crush or Clash of Clans. These games are one hundred percent free to play however the experience can be enhanced using the micro-transactions available. These games also focus on a simple yet addictive style of play that beguiles the audience into further play time and a larger spenditure.

Scope and Objectives

- Develop a mobile game
- Establish an internal social platform within the application
- Investigate and analyse the free-to-play model and its viability for this project

Achievements

The achievements of this project are a working mobile game that implements most of the game mechanics intended to be applied to the game. This is alongside a research project that determines the viable route that the application will take in terms of business model.

Literature Review

Introduction

In this section various literature surrounding the project concepts will be explored to further the knowledge on the topic and apply findings to the development of the final product. The focus of investigation will be the surrounding aspects of the free to play model and the viability of producing a game of that nature. To gain a further knowledge of the medium on a whole the reasons behind why gaming is such a big aspect of today's society will also be researched and analysed by examining literature behind the phycological and social reasoning.

Free-to-play market

The free to play market investigation is at the forefront of this project as the potential for success is dependent on the product fitting into the market well enough to overturn the costs of production and in turn increase revenue. In this section the current and past market will be investigated, along with data and figures of the current games within the genre, the practises used in these games will be stacked up and compared to relate to this project and see which can be implemented.

Multi-sided market and connective game platforms

According to Nieborg (2015) the success of the free-to-play genre within the 'multi-sided' market is highly dependent on the connective game platforms integrated within the projects. Nieborg described a connective game platform as "constituting a range of devices (e.g. iPhone, Kindle Fire), operating systems (e.g. iOS and Android), and applications stores (e.g. Apple's App Store)." and suggests that "Being tethered to these platforms has far-reaching implications for how games as apps are played, for their mode of development and distribution, and how they are marketed". The ideology consistently iterated throughout this journal is that the economic and social forthcomings of an application are largely dependent on interconnectivity between different platforms. Nieborg suggests that to exclude a platform is to reduce the potential of the project; the more social the application the more it will be shared and used amongst said social groups.

To further the research on this document and advance the findings of this project the economic and triumphs of the Candy Crush Saga series both economically and socially are delved into in the later parts of Nieborg's investigative report. The findings stipulate an economic growth of $1.8 Billion in 2013 from $63 million in 2011 with more than half of this revenue stemming from Candy Crush.

The overall findings within this journal further the argument that the free to play model is a viable option going forward in terms of social popularity and economic benefits alongside. It also suggests the reasoning to further research the connective game platform and seek to implement a similar system in some way through one of the many options.

Comparing Free-To-Play and Paid Games

To enhance the knowledge on the viability of he free to play market extensive research has been carried out into the current standings of both the free -to-play market and the paid

market. To broaden the knowledge the data found consists of both mobile games and games designed for PC and consoles.

According to Luton (2013) “the free to play business model has changed the video games industry completely and irrevocably”, he continues “free-to-play is a success because it allows you to make money from huge audiences created from giving your game away for free” (Luton, 2013). Throughout this literature it is emphasised that the success of free-to-play games are reliant on audience engagement which then transfers to profit by utilising advertisement opportunities and offering premium services that enhance the user’s experience.

The ideology iterated throughout this literature can be directly linked to the thriving revenue of a series of multiple games within the free-to-play genre. According to Newzoo (2018) the most played game of March 2018 is League of Legends, a free to play game that consistently ranks amongst the highest in terms of global playtime since its popularisation in early 2012. Reports from League of Legends Smurfs (LOL-Smurfs, 2017) state that in the fiscal year of 2015 $1.6 billion dollars revenue was made from this title alone in the ways of micro-transactions.

To gain a fair comparison and understanding of how these figures stack up against pay to play games the game Overwatch will be used to compare to League of Legends as the two are both the same genre of game with a high player base. According to Sarkar (2017) of Polygon: as of May 2017 Overwatch had made more than $1 billion in sales, taking into consideration both sales and micro transactions. These statistics alone are sufficient evidence of the viability of the free-to-play model, this however is taken upon games with a large audience and amount of users, to gain a further knowledge the free-to-play market will be explored within the mobile gaming medium.

The perspective of the revenue made from mobile games both free-to-play and premium games on mobile will be established by comparing the most downloaded free-to-play mobile game Candy Crush and the premium game Minecraft, which currently stands as the most downloaded mobile game that is not free. The price of Minecraft currently stands at £6.99 with a download amount exceeding 2,238,000 on Android. This leaves the revenue from downloads at approximately £15,643,620 from Android alone. Compared to Candy Crush Saga this revenue is substantially less, as stated earlier Candy crush was making upwards of $230 million annually according to data from Boone (2013).

Phycology behind Free-to-play

A study by Mackiewicz (2013) seeks to find the links behind the human psyche and the drive to spend money on microtransactions. In this report microtransactions are described as an entity that will enable “a game developer to sell additional content or services for their product within the game itself”. Mackiewicz discusses the negative perspective upon the microtransaction system on full games as they take away from the original product in most of cases and leave the customer missing out on portions of a game that they have already payed for if the additional content is not purchased; this ideology is skewed however when the original product is free.

Mackiewicz heavily links a study by Kahneman (1990) to his findings, suggesting that the compliance towards microtransactions stems from the “endowment effect”. Kahneman

defines the endowment effect as "[the] measures of willingness to accept greatly exceed the measures to pay", Mackiewicz expands and simplifies this, linking it to the topic: "we would value an item (game) we possess higher. Therefore, if a person was to download a free game which offered IAPs and spent x hours playing it, the game would be his. Due to the dedicated time, the feeling of ownership would grow. Thus, due to the endowment effect he would start to value the game higher" (Mackiewicz, 2013). This theory is summarised perfectly as "Free to play works because it doesn't ask you to value the game until you already feel you own it" (Harris, 2013).

The next theory Mackiewicz links to his study is the "Ego Depletion" theory by Dr. Baumiester (1998) which suggests the it is more likely that somebody will give in to impulses if they have had their mental resets diminished by certain tasks, in this case the related task is the monotonous tasks that come with a game that can often be skipped by purchasing a 'boost' micro transaction. It is suggested that the 'ego depletion' theory and the 'endowment effect' work well amongst one another as they both raise the value of the product as well as lowering the user's inhibitions stopping them from making impulse purchases.

Methods and techniques in modern game design

The quality of games has been at a constant rise since their dawn due to a correlative improvement in the surrounding technologies and software design methods. In this subsection the methods used in modern gaming used to entice users to play high amounts of playtime and continue to indulge in the games industry.

Designed for Repetition

A common method used within game design is for the user to repeat certain tasks in a monotonous manner. This can lead into opportunities for micro transactions or just drive up the playtime for the game. According to a study by Harrigan (2015) these behaviours need to be strongly supported by a reward system that positively reinforces certain behaviours by the user. By manipulating the cognitive behaviours distilled within the human psyche the potential of output in terms of playtime and how much the user spends can be exponential.

These behaviours are shunned by a large portion of game designers and the gaming community as they take away from the potential of a game, and the fun that can be experienced during playtime. According to Desurvire and Wiberg (2009) a game can enticing and promote enduring play if "the player finds the game fun, with no repetitive or boring tasks" (Desurvire and Wiberg, 2009).

Repetitive gameplay does not simply consist of one repetitive section of a game but can stem from alternative perspectives, like the artificial intelligence (AI) within the game using the same attack cycle in fighting game or a button combination that is used frequently throughout gameplay. Lindley disagrees with Desurvire and Wiberg, claiming that a game's repetitive functions are acceptable within a game if "the development of a game state to the point where a specific repetitive pattern emerges and remains stable" (Lindley, 2002).

To apply this to the project at hand the extractable from the literature explored would be the dividing line between a game being overly repetitive and implementing a system that engages with the cognitive and psychological behaviours that translates well to humans and how they play and interact with a game.

Social Gaming

A key aspect for games in the modern gaming economy is to engage the players with one another to enabling the users to progress at a rate with players amongst them, applying a competitive value to the game and boosting the social aspects of the community of the game. Throughout this subsection the social aspects of modern gaming will be explored, including the methods used by developers to enable the platform to function.

"The average person is looking to socialize – not win. Although achievements are nice to earn (and make players feel great), they are not the principal driver. If designers begin by thinking the game is about achievement, they will at some point realise they are excluding a big chunk of the audience" (Zichermann and Cunningham, 2011). Zicherman and Cunningham claim that the drive to socialize is higher than the drive to win at the games they are playing, this is challenged by Hunicke, LeBlanc and Zubek who state "It's easy to see that supporting adversarial play and clear feedback about who is winning are essential to competitive games. If the player doesn't see a clear winning condition, or feels like they can't possibly win, the game is suddenly a lot less interesting." (Hunicke, LeBlanc and Zubec, 2004).

It is important to acknowledge what social interactions the players within the game are going to be using and designing the game and creating mechanics around these necessities. Zicherman and Cunningham (2011) list some of the possible expressions of a user as follows:

- Advocate
- Argue
- Comment
- Compare
- Compete
- Curare
- Explore
- Express
- Flirt
- Give
- Greet
- Harass
- Help
- Join
- Like
- Poke
- Rate
- Read
- Recommend
- Share
- Show off
- Taunt
- View
- Vote

Applying this to the application at hand the following expressions will be relevant for development:

- Express
- Greet
- Harass
- Join
- Poke
- Share
- Show off
- Taunt

These interactions will allow the users to communicate and create the sense of a community within the application and ensure the users will be able to communicate in a sufficient manner that relates to the original context and purpose of the application.

Summary

Many conclusions can be drawn from all of the information and data found in the various literature explored throughout this chapter. Whilst exploring the free-to-play market and the surrounding statistics, it found to be a viable option in terms of revenue potential and player base to design the application to be a free-to-play game.

To ensure the most money will be made from the project, the various techniques found above including the endowment effect and ego depletion theory will be implemented, whilst still pleasing the user by focusing on the overall gamification of the application and ensuring they can engage and create a relationship with the application.

Project Planning

Objective and Scope

In this chapter all the technical decisions made throughout development and in the stages leading to will be discussed, with reasoning why certain methods have been used to ensure the production has a low risk factor.

To ensure the options chosen are best for the project the perspective throughout this chapter will be undergone from an unbiased position and the pros and cons of each decision will be explored thoroughly.

Methodology

There are numerous options for the methodology used throughout the development of the application however the list has been shortened as some of the originals deemed too inefficient for the requirements.

For a project based around the development of a piece of software a feasible option is the Agile Development process. Emerging in 2001 the Agile Development process seeks to offer an “alternative to documentation driven, heavyweight software development processes convened” (Beedle Et Al, 2001). The agile development process works of a manifesto of 12 principles to separate itself from existing methodologies, listed below:

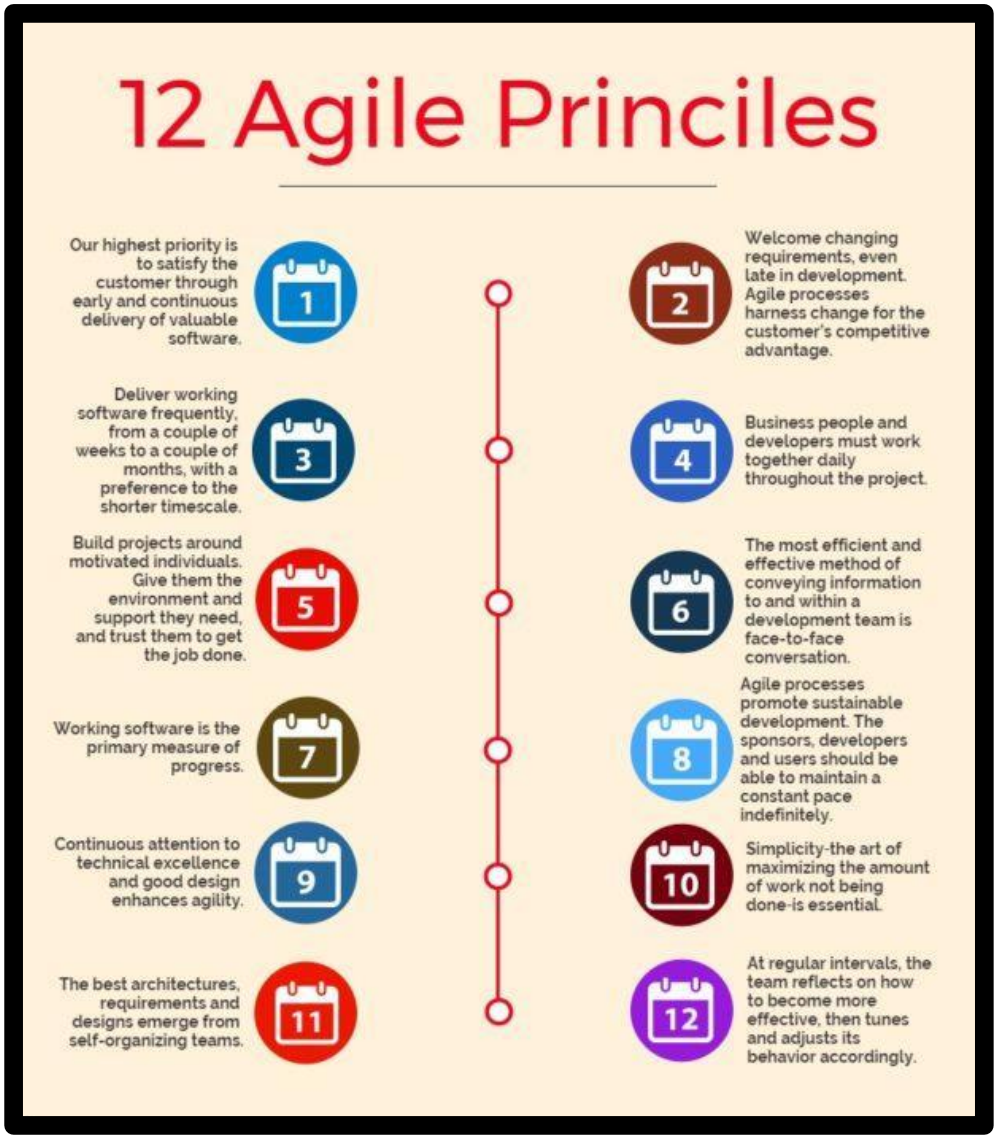

Figure 1 -1 12 Agile Development Principles

The other main alternative to the Agile Development Methodology is the Waterfall Model, unlike the agile methodology the waterfall method stems from a perspective of impeccable planning and procedure instead of focusing on a systematic development process. The waterfall method works well because it keeps a clear lineage for both developers and the client to follow to know where the project stands. In its simplest terms the waterfall model is "a sequence of stages I which the output of each stage becomes the input for the next" (Balaji and Sundararajan Muragaiyan, 2012). The waterfall is one of the oldest and most recognised and implemented software design life cycles (SDLC) but the methods within are so sequential that they can cause hindrance to the development process, one example being the lack of testing until a late stage in the project. For this reason, the agile development process will be used throughout this project.

Requirements

The requirements of this project stem from the production of the application to the research and analysis of the free to play model to identify the best design strategies for the project. To

achieve a fully functioning application there are many requirements that are found before the project can be completed.

Sufficient research and studying will have to be undergone into the desired techniques that will be used throughout development; this includes the chosen language that will be used. As a series of languages are used in conjunction the research stage took longer than expected and stemmed into the development stages.

The project heavily relies on the assets used within the game, this includes the music used for the game and the images and icons throughout within the aesthetics of the application. For the music in the application 6 songs will be downloaded to test the game and make sure pit works. The images will be acquired from the internet with no copyright if not designed personally.

One of the final requirements to enable the functionality of the application is a database that holds both all of the information about the songs and furthermore a table pertaining all of the user's information and login details to allow the social aspects of the game.

Potential Solutions

The potential solutions for the requirements listed above are as follows, following the same order as the previous section:

To gain a sufficient knowledge on the languages and software development methods related to the tasks ahead a series of books, journals and websites will be used to both learn methods and get a good grasp on the implementation using the available training software online.

To enable the database to function correctly within the use of an external server which would be a large cost point for the project, the project will be ran on a WAMP stack, which creates a virtual server on a private server. This creates several problems within the development section because the usual methods used to create multiplayer games will be null as the techniques are different on a virtual server. To tackle this IP addresses will be used to communicate between different devices on the application. The database will be created using PHPMyAdmin, a database development tool provided within the WAMP stack XAMPP.

Tools and Techniques

The tools and techniques connected to the production of the application are plentiful. Throughout this section the appropriate techniques that will be used throughout development will be explored and analysed as to whether they are an avid fit for the proposed approach.

Database Management

For the application to be fully functional and be able to hit all of the criteria it set out to in the plan a database is to be constructed and maintained. The database will hold all of the relevant information on a user, this will allow the user to be able to log in, manage their profile and will allow the user to participate within the social thresholds of the application. A further table will be needed to house all of the data on the music within the database, from this the application should be able to pool songs and retrieve information on specific songs to allow the game to function.

To create and manage the database the PHPMyAdmin database tool will be used, this is provided with the WAMP stack XAMPP and is a relatively simple tool to use that offers a wide functionality in terms of database management. Using a WAMP stack can be viewed as a downfall of the project as the application is not being tested on a full server, instead a virtual server set up on a local network.

Development software

To ease the errors within the code a feasible option is to use an integrated development environment, "An integrated development environment (IDE) is a software suite that consolidates the basic tools developers need to write and test software" (Rouse, 2018). Throughout the development of this product the Dreamweaver package will be used to assemble all of the code and write the application. Dreamweaver is a development environment focused around web development. It is a comprehensive tool to aid in terms of HTML, CSS, JavaScript and PHP which are the languages set out to be used for the project ahead.

Framework & Language

Choosing the correct programming language for the project at hand is an essential portion of the planning stage that dictates the next stages of development. "JQuery was released in January 2006 by John Resig as an Open Source JavaScript library to make it easier to add complex interactivity to your web applications using JavaScript"(David, 2011). JQuery Mobile is an extension of the existing JQuery library directed towards design of mobile based websites.

Using a conversion software called "PhoneGap" developed by Adobe Studios the web application will be manipulated into a mobile application format, in this case an .APK file as the application will be tested on an Android device.

To enable the back end processes involves with the running of the application and multiplayer aspects PHP will be used alongside alternative back end programming frameworks like AJAX. Darie describes AJAX in its simplest terms as a mix of technologies that let you be rid of the loading page, thus reducing the dead time during the navigation between pages (Darie, 2006). Within this application AJAX will be employed for processes such as the login function for the user and obtaining the song selections and data from the database to make the flow of data smoother and reduce the time the users will spend viewing the application loading.

Legal and Ethical Issues

There are numerous legal issues that require addressing throughout this project, and many ethical issues that require preventative actions and potential solutions to problems that could arise. Throughout this section the legal and ethical implications connected to the development and distribution of this application will be explored and the solutions and preventions that can be applied will be drafted into the current plan.

Management of Music Rights

The most prominent legal issue is the rights and usage problems for all the music that will be used for the application; this is pivotal to the project to solve as the music is linked with the main task of the game. The solution to this problem lies within the Digital rights Management (DRM) which manages client's use of digital licenses. DRM works in different ways for different clients depending on the needs of the client, for example, some clients require the rights for personal use whereas some require them for distribution. "Usage rules can be defined by a range of criteria, such as frequency of access, expiration date, restriction of transfer to other devices, copy permission etc" (Liu, 2003). Below is an example of a typical model used within current DRM implementations provided by Lui:

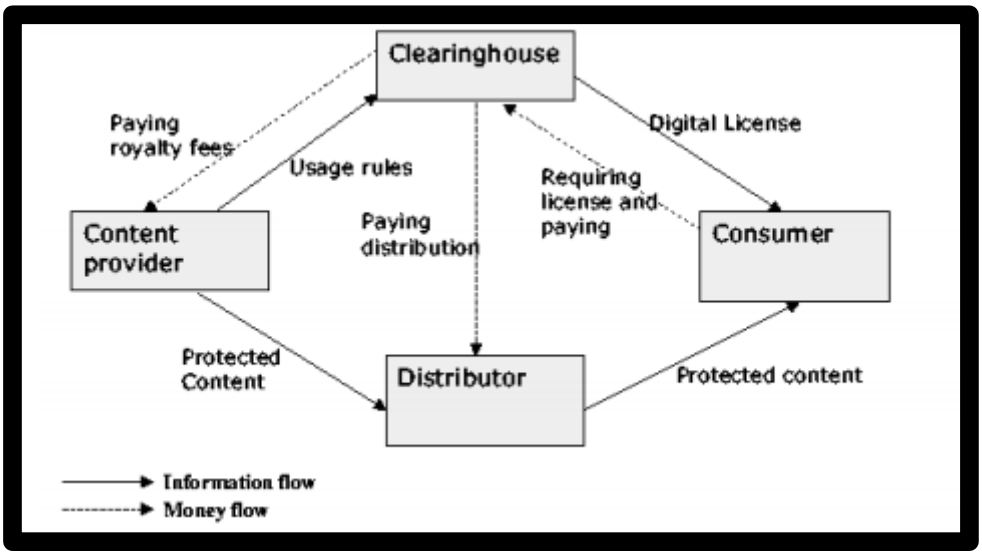

Figure 2 - DRM Model of Implementation

Victimisation, Discrimination and Offensive Behaviour

A prominent ethical problem often risen when creating a mobile application is the possibility of victimisation and bullying, on a digital scale the possibilities differ from the physical possibilities in terms of physical harm inflicted upon the victim, instead it is inflicted in ways of discrimination, harsh words and other victimisation methods. "Cyberbullying, or eCRIME as we call it, is any form of on-line abuse. By this we mean simply 'bullying using technology' (any electronic device), as the tool with which to target someone and deliberately upset, humiliate or threaten them" (National Bullying Helpline, 2018).

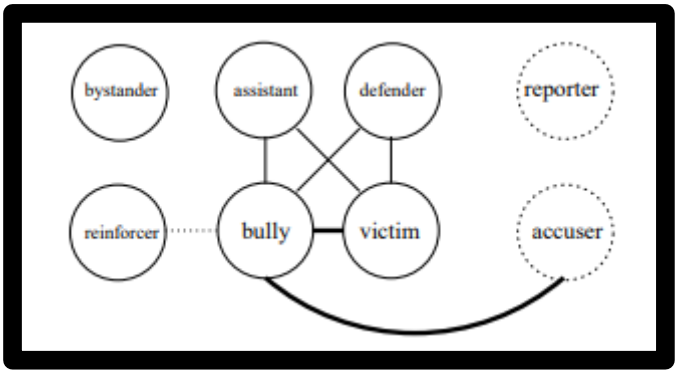

Figure 3 - "The roles in a bullying episode. Solid circles represent traditional roles in social science, while dotted circles are new roles we augmented for social media. The width of the edges represents interaction strength." (xu, zhu and Jun, 2012)

To combat these behaviours within the final application the chat and social aspects of the application will be restricted to pre-made quick chat while in games, and outside in other social spaces there will be a general chat but sufficient means to file reports on users. Reports will be able to be files on profiles for other reasons, including their image and name. To prevent harmful and offensive language in the chat there will be sanctions in place that prevent users from being able to type certain words.

Security Barriers & Privacy Protection

The security of information and network should be equipped with properties such as identification, confidentiality, integrality and undeniability (Suo and Wan, 2012). Considering the current class-action lawsuit on the popular social platform Facebook for violating state laws concerning personal privacy, security and privacy are at the forefront of the system design.

Langheinrich speaks of the common perspective taken upon by the general public where they believe that their privacy and their online presence fall into the same bracket, when in fact, now more than ever, the need for privacy should be the one of the leading priorities for users to evaluate (Langheinrich, 2007). From the same study there are six main principles to abide by when designing around user privacy, they will be listed below with a brief explanation of the context and procedures involved.

Notice

It is a fundamental priority to give the user notice of the goings-on with the personal information held within the data acquired within the website/ application.

Choice and Consent

No activity should take place with the data of the user if no consent has been personally provided.

Anonymity and Pseudonymity

The user should be able to stay anonymous in terms of data held about them if they choose, and the information held around themselves should not be able to identify the specific user.

Proximity and Locality

The user should be aware of the scale that their data is being shared, to tackle this and gain privacy establishment easier the data will only be shared on a much lower scale.

Adequate Security

Having a secure platform that does not allow infiltration and compromise of users data offers confidence to the users and reduces the risk of reducing their privacy.

Access and Recourse

The user should be able to gain access to the data that is held about themselves and recourse and review the information within.

User Needs Analysis

It is essential in before beginning development to have a clear grasp of the needs of the user and how they will be best delivered to the client. Within this section the needs of the potential users of the application will be analysed, assessing what content is appropriate and how to best deliver the content.

This game will not be restricted to a certain age group but will be harder for a user of young age to immediately grasp and find enjoyment. The expected age group of users is expected to be between sixteen and fifty.

The first problem to analyse toward the user is the aesthetics of the application. The application is to be designed in a cartoon fashion but still laid out in an organised and sophisticated manner, this is to ensure that the users do not feel condescended by the simplicity of the application but are still able to view it as a game and not a formal entity.

A further problem to overcome is the variety of music; as the user base is so diverse the need for various music types increases. To deprive a portion of the user base of the music that they are interested would cause an underlying dislike toward the app and result in the discontinuation of use. The option to choose certain genres in the game will also benefit the crowd that would like to stick to the music that they know.

One of the highest priorities for the user that is often overlooked by the audience themselves is the need for high security on the personal information they provide. As the user has a profile they have sensitive data submitted to the back end that will be stored within the database. Furthermore, the application will rely on micro-transactions to enable special items and other ‘boosts’ and the credentials of the user mustn’t be compromised.

Risk Analysis & Stakeholder Analysis

MOSCOW

Figure 4 - Moscow Analysis

SWOT Analysis

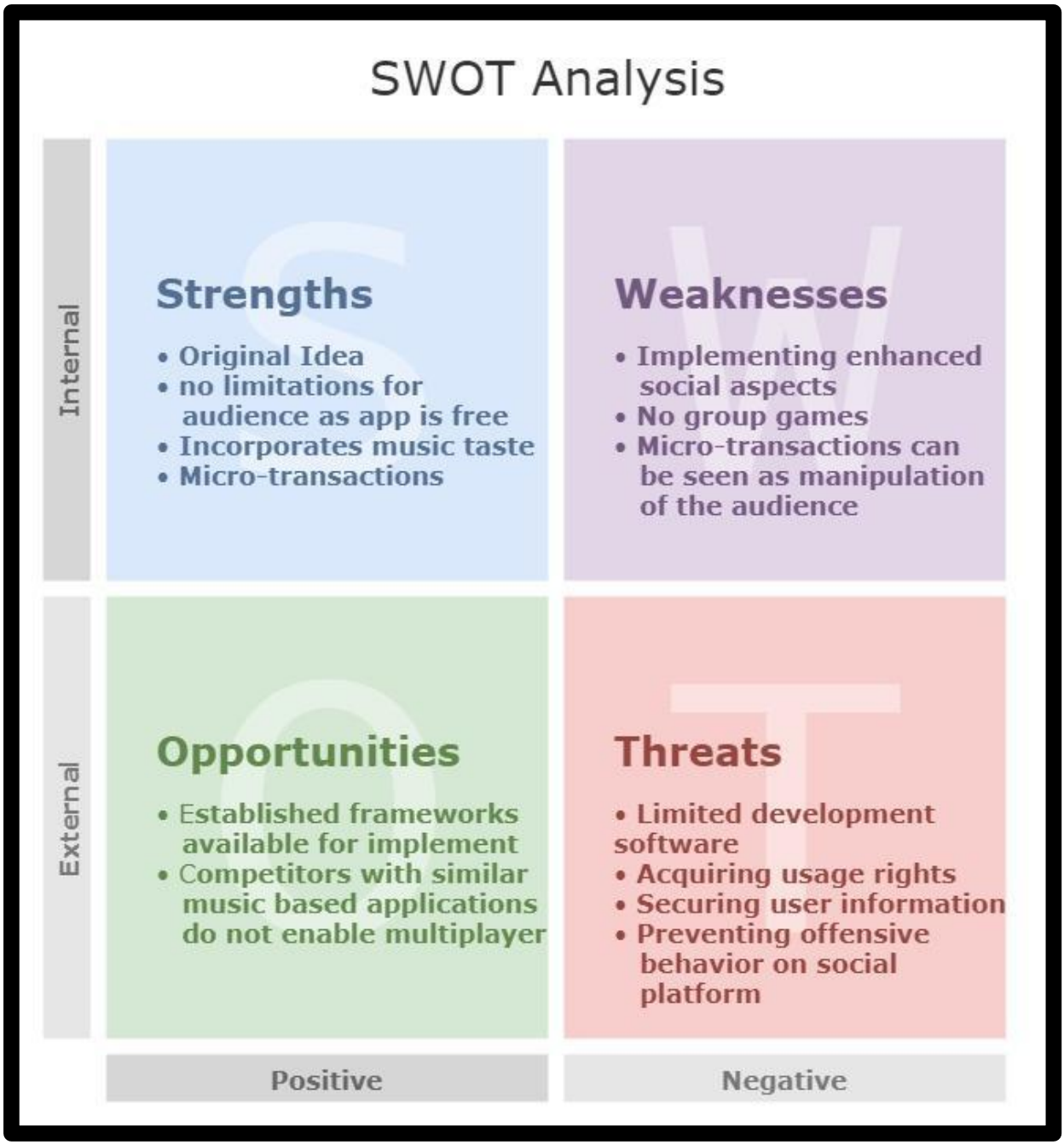

Figure 5 - SWOT Analysis

Design

Objective and Scope

The purpose is the following section is to describe the design choices and processes in place, giving the corresponding reasoning for chosen methods as well as drawn out plans for any material requiring so.

This section will not contain any of the code or implementations within the document but instead house all the design plans needed to carry out all the practical implementations.

System Design

Within this section the plans for the design of the functionality as well as the overall game mechanics, to provide a solid structure for the workload the code will be drawn up into a pseudo design and a flow diagram showing the inputs and outputs of the system. The design specifications for the database will also be provided to give perspective on the systems in place.

Database Design

As mentioned above the database for this project needs to contain both the user's information and the data of the music inside the game. To initialise the design process for the database the first step is to plan the tables and fields.

Data Dictionary

To plan an efficient database, it is important to have all of the necessary fields in the correct table; the goal is to have all of the information stored in an efficient manner and to stray away from repetition. The first table is the user table and follows the structure below:

Table Name: User Table				
Field name	**Data Type**	**Size**	**Required (Y/N)**	**Description**
User ID	Number (AUTONUMBER)	8	Y	The unique identifier for each field in the table
Username	Varchar	18	Y	The username chosen by the user
Password	Varchar	18	Y	The password chosen by the user, ran through the MD5 hash to secure the information.
Email	Varchar	30	Y	The email

				address of the user.
Level	Number	3	Y	The current level of the user.
XP	The current amount of XP the user has.	5	Y	The current amount of XP a user has.

The next table is the music details table which holds all the information on the songs within the application.

Table name: Song Details				
Field name	Data type	Size	Required (Y/N)	Description
Song ID	number	8	Y	The unique identifier for each field
Title	Varchar	20	Y	The title of the song
Artist	Varchar	20	Y	The name of the artist of the song
Album	Varchar	20	N	The name of the album containing the song
Lyric	Varchar	50	N	A memorable lyric from the song
Genre	Varchar	20	N	The genre of the song
Snippet start	Double	5	Y	The start of the snippet that will play for the game
Snippet finish	Double	5	Y	The end of the snippet that will play for the game

Data flow Diagram

“In describing a dataflow diagram, we take the perspective of the organization that will use the information system. Hence, all the activities that contribute to manipulating information within the organization are modelled through processes” (Navathe, 1992). A data flow diagram can be good to visualise the necessary processes taking place within the database and between the users before beginning the development.

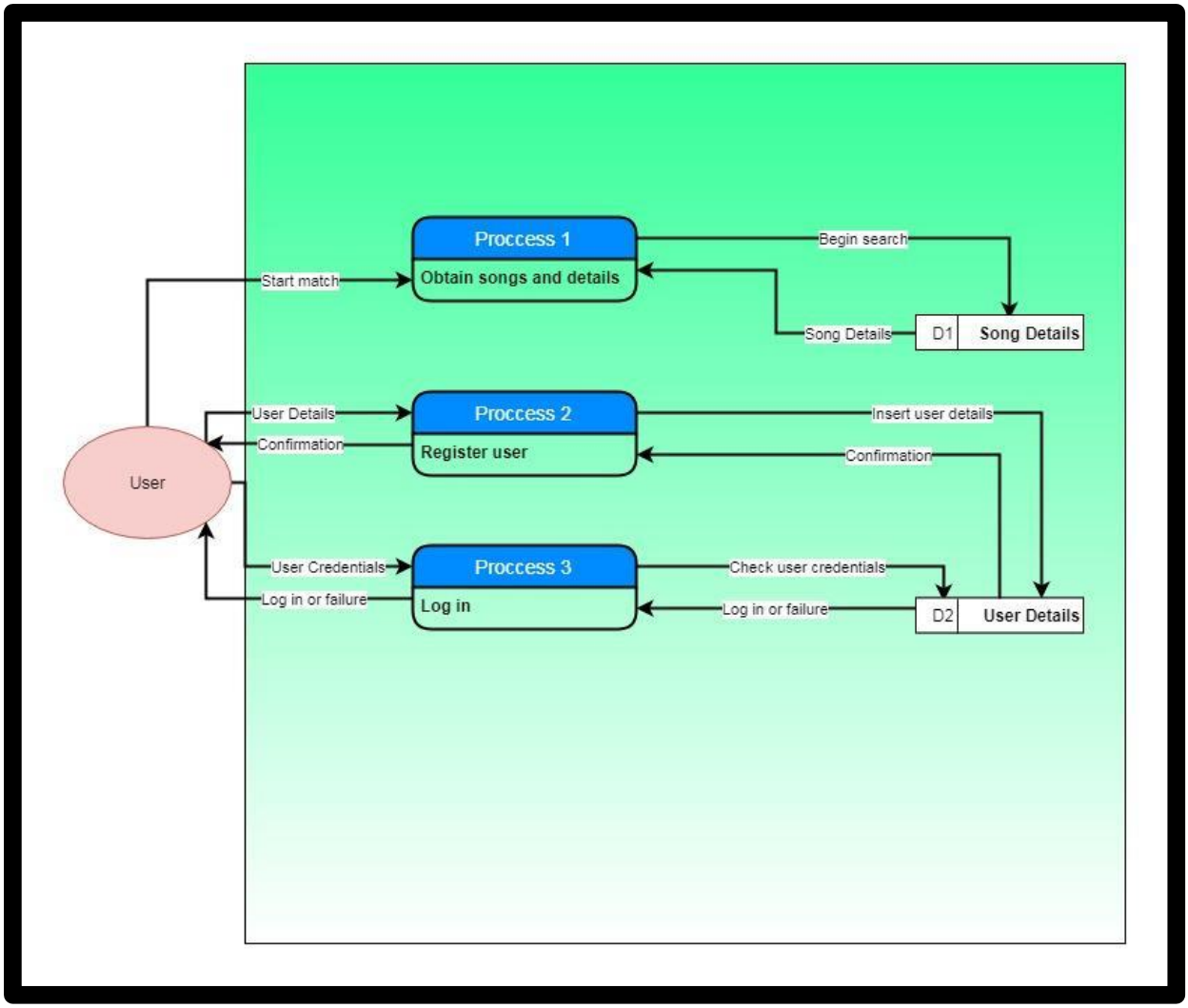

Figure 6 - Data Flow Diagram

Further Database Theories

There are a multitude of database theories that can further the design of the entity and ensure that upon the development the risks are much lower, and the finished product is often a higher quality.

Normalisation

"Database normalization is the process of refining a database schema in order to ensure that all tables in a relational database are of high quality" (Mitrovic, 2002). In most cases Normalisation takes place to reduce repetition within a database and save space, as well as keeping errors at bay. For this project in particular, no normalisation will be implemented upon the fields as the two tables as separate and have no correspondence.

Entity Relationship Model

According to Techopedia "An entity-relationship model (ERM) is a theoretical and conceptual way of showing data relationships in software development" (Techopedia, 2018).

An ERM is essential for large databases with allot of tables linking data in between. In this case an ERM will not be created as the two tables do not relate.

Advanced Coding Methods

In the development of the project many advanced programming methods are required to enable the functionality of the application. In this section a series of design methods connected with software development theories.

Pseudo Code

Pseudo Code is an English alternative to the programming languages used, it presents the technically savvy language into basic English that can be interpreted by viewers of any skill set. “This is done to identify top level flow errors and understand the programming data flows that the final program is going to use” (Economic Times, 2018).Various methods in the project will be translated into Pseudo Code to gain a further knowledge on the flow of the program and how the inputs and outputs will be taking place.

Shuffling Songs

The processes involved in shuffling and delivering the songs are vital to the gameplay of the application, below is a pseudo code interpretation of this process:

```
START
IF user starts a match
        IF user specifies GENRE
        GET songs within chosen GENRE from SONG TABLE
        END IF

        IF no GENRE is specified
        GET all songs from SONG TABLE
        END IF

SHUFFLE songs in the retrieved list

ADD first five songs to shortened list
END
```

Checking Answer

To check that the answer is correct when in a match the answer given by the user has to be checked against the correct answer, the code is represented in pseudo code below:

```
START
        IF user has submitted an answer
        CHECK song title provided against SONG TITLE in the SONG TABLE
                IF song title provided matches SONG TITLE in the SONG TABLE
                        MARK song title provided as CORRECT
                END IF

        CHECK song artist provided against SONG ARTIST in SONG TABLE
```

IF song artist provided matches SONG ARTIST in SONG TABLE
Mark song artist as CORRECT
END IF

IF both submissions are CORRECT
SHOW answer as CORRECT
END IF

END

Finding opponent

When searching for an online match the user has to search to find an opponent, below is a pseudo code interpretation of what is going on in the background:

START
IF user searched for a game
SEARCH for open match room with a HOST
IF match room found with a HOST
START match with user and HOST
END IF

IF no open match rooms are found with a HOST
START match room and HOST the game
WAIT one minute for OPPONENT
IF no OPPONENT found
GIVE error report of no OPPONENT find found
END IF
END IF
END IF
END

Flow Diagrams

User Model Diagram

User Interface Design

The interface design procedure is a pivotal step in the development, if the interface is not properly designed the overall product will be visually unorganised and will be lacking in structure. “The design of computer interfaces that are usable and easily learned by humans is a nontrivial problem for software developers. As information technologies mediate many of the activities we now perform routinely as part of our lives, the attention paid to the process of human-computer interaction is enormous” (Dillon, 2003).

Hand drawn designs

The first step in the user interface (UI) design is to draft a sketch of the intended layout of the application on paper. This gives the developer a stage to stem from in terms of where to take the aesthetics of the application and helps to visualise how the functionality.

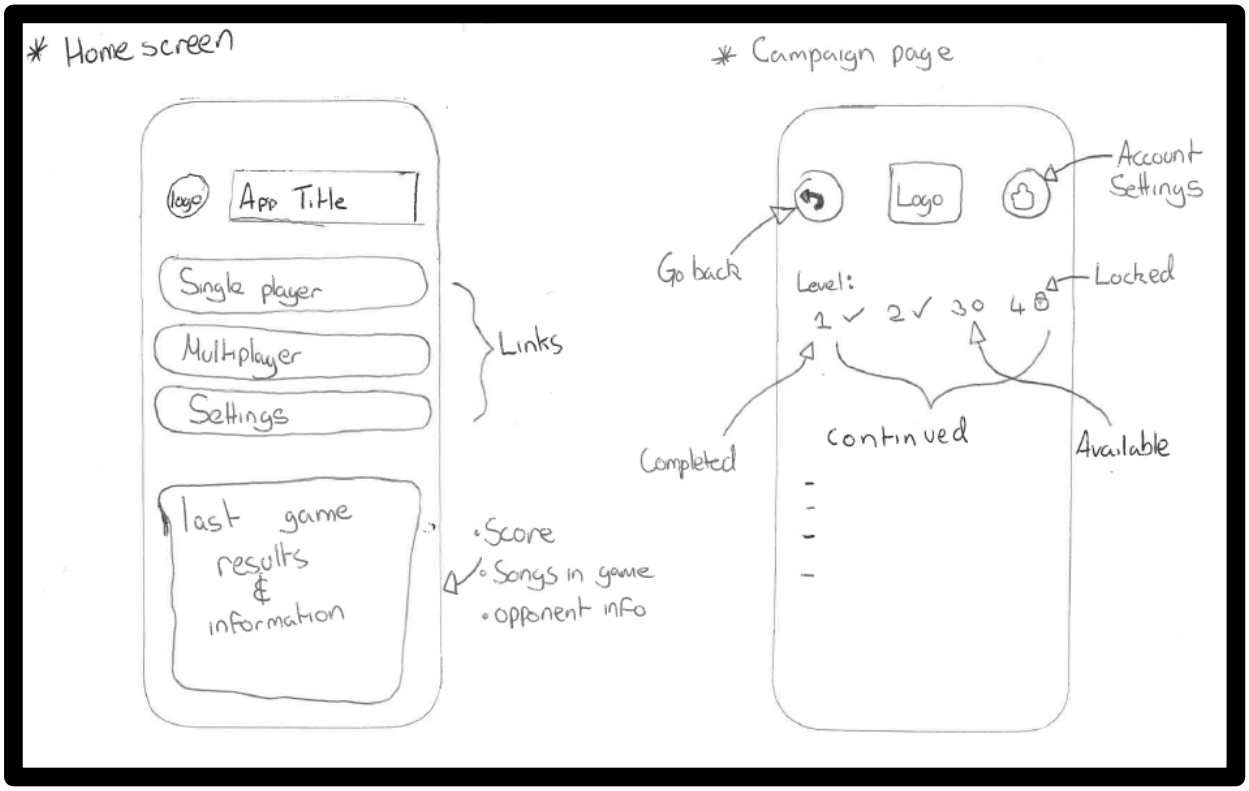

Figure 7 - Hand drawn design 1

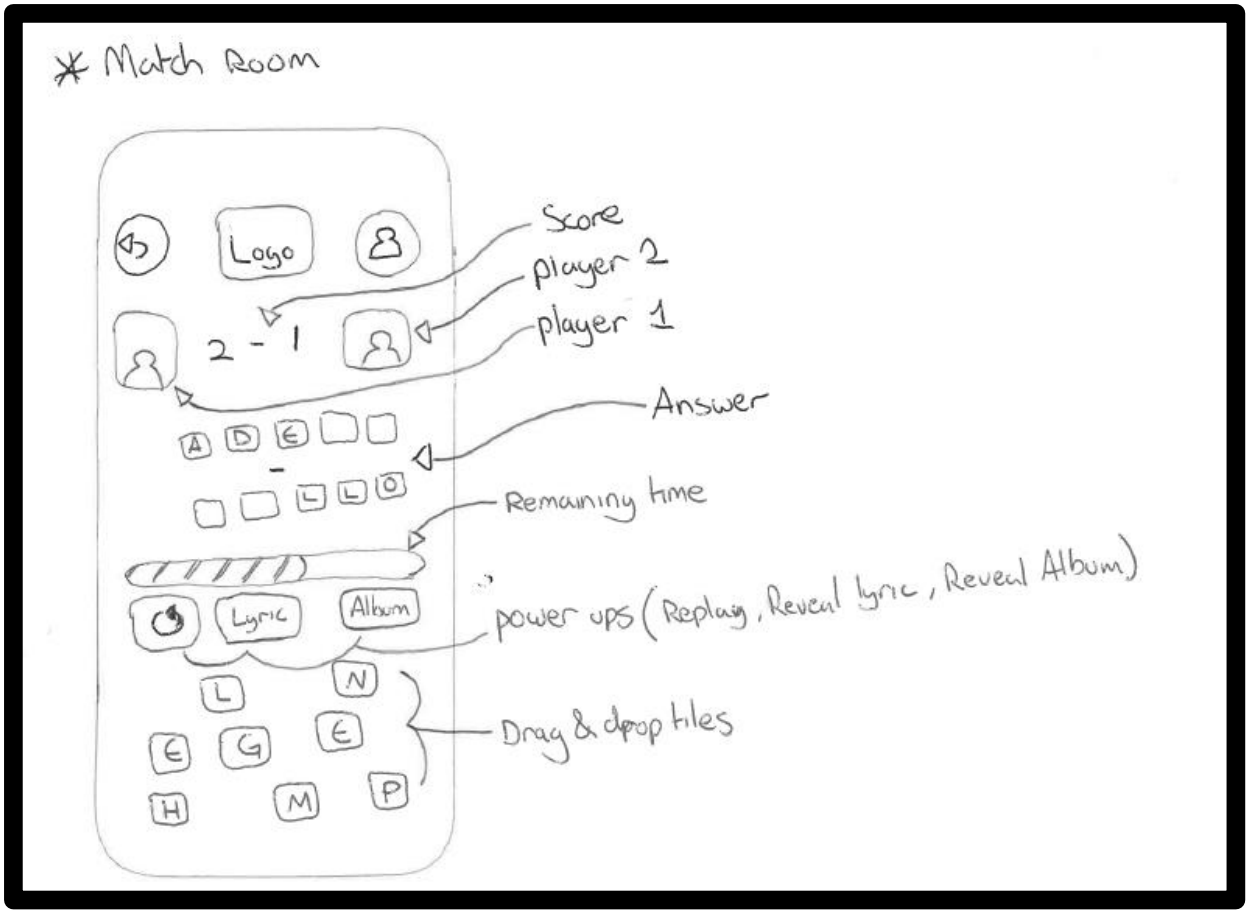

Figure 8 - Hand drawn design 2

Storyboard

The below storyboard shows the overall design and the lines of transition between the pages.

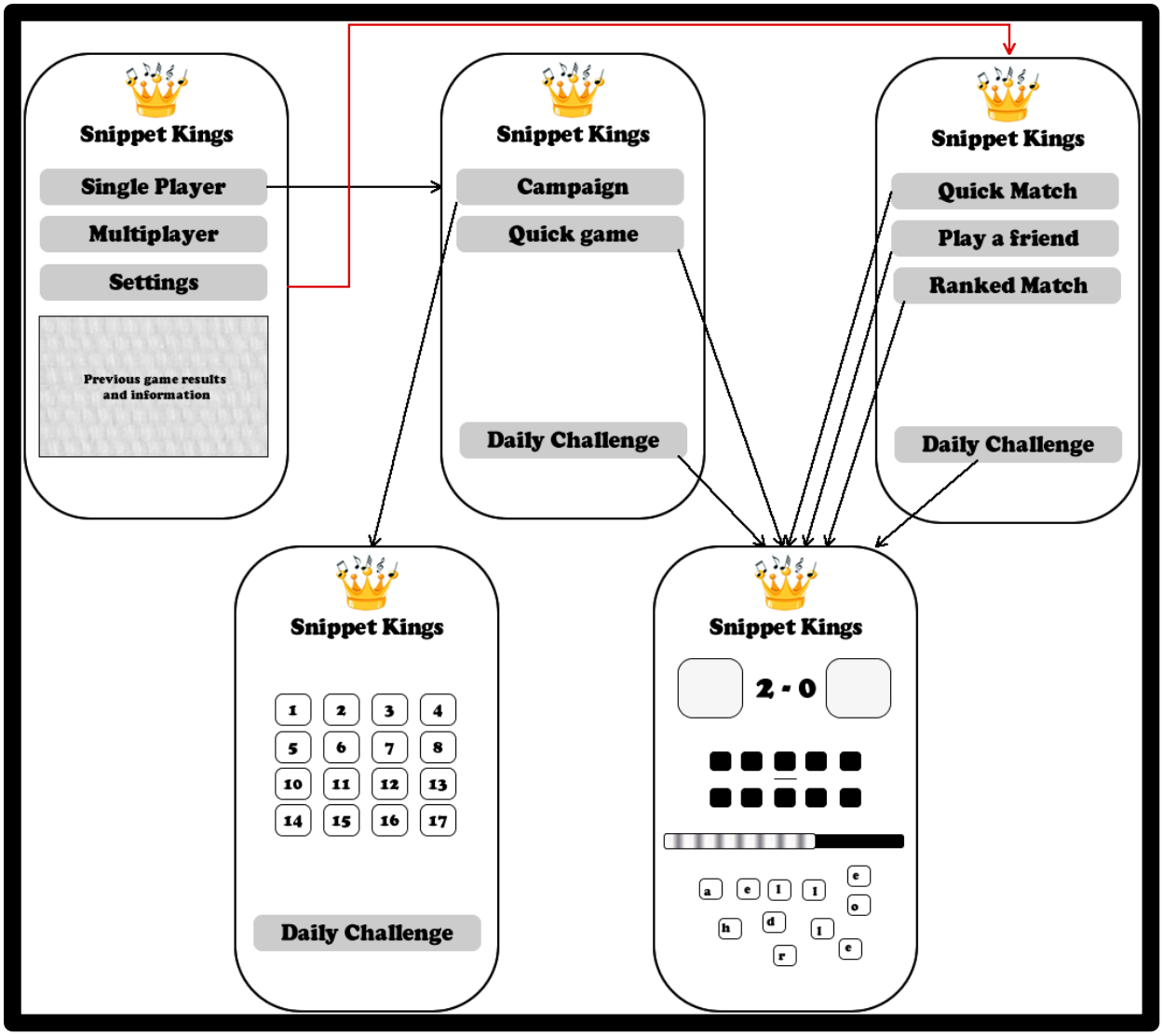

Figure 9 - Storyboard

Implementation

Introduction

The implementation stage held the largest portion of time consumption in terms of the project as it entailed all of the preparation and coding involved with the design of the final product.

This section contains the detailed steps undertook within each stage of development and the implementation processes related. As this is the implementation there will not be much description and reasoning behind the design choices as this has previously been mentioned, the only justification provided throughout this section will be for changes made during the implementation stage due to errors with development.

Preparation

in the months leading to the third year of study the time was utilized researching and practicing the necessary skills and knowledge that will be used throughout development. It was essential to find the medium between research and practice as the methods learned are quickly forgotten without real life application.

Rather than investing time in the broad amount of learnings to be found on the internet, the best method for learning came from revisiting previous personal projects and reconnecting with the techniques used throughout. From their it was easier to see how to adapt the code and other skills involved to adapt to the project at hand.

To prepare for the research involved with the report a series of literature was outlined ready to be read and analysed. To gain an upper hand at the practical side of the project books pertaining coding methods of jQuery and PHP were purchased.

Aesthetics

An important aspect of the project is the look at feel of the application, it is vital that the application looks sleek and professional and the transitions amongst the navigation needed to feel seamless.

To ensure the design fitted well on mobile devices with HTML design the framework jQuery Mobile, “jQuery Mobile is built on top of jQuery API and offers a JavaScript library of CSS and other components” (Dalmasso, 2013). The jQuery Mobile framework allows for an easy development process and the end product is a fully mobile optimised product across any mobile platform.

To develop the application, a series of jQuery Mobile classes methods were used. Unlike a regular webpage, all the pages have to be housed within the same document. To separate the pages are given the role of ‘page’ to the ‘data-role’ attribute. These pages act as alternate pages like any other website, but they are housed within one document. The CSS files that come with the jQuery Mobile package alter all of the HTML elements to suit a mobile device and the colour scheme can be controlled with a theme that was created using ThemeRoller.

Database

The database is vital for the user-based actions of the applications and for holding all of the information on the songs. The se4ver holding the database was ran through the Apache and MySQL services within the XAMPP local server. To create the database and make alterations the PHPMyAdmin tool was used. According to “it provides a complete web interface for administering MySQL databases, and is widely recognised as the leading application in this field” (Delisle, 2009).

Functionality

To achieve functionality within the application and enable all of the mechanics of the game a combination of languages was used in unison. Much of the application functionality was achieved through jQuery, an extension of JavaScript with adapted functionality. The numerous requirements that required enhanced functionality are listed below with a description of the implementation.

Obtaining songs:
To obtain the relevant song the data had to be pulled from the database to then be manipulated in a series of alternate functions. This function used AJAX to link to php file which can get the data. The jQuery can be seen below:

```
function getSongs(level) {

	if(level != "") {

		var dataString = "level=" +level;

		$.ajax({

		type: "POST",
		url: "ajax/getLevel.php",
	data:dataString,
	error: function(ts) {  },
	success: function(data) {

		divideWord(data.title);

	},
	dataType: "json"

 });
	}
```

Listing 1 - [Main.java] The main class of the program

The level parameter comes from the ID of the level that is clicked on the campaign page. The PHP file linked to this function can be seen below:

```
if(isset($_POST['level'])) {

 $level = $_POST['level']; //Retrieve username from POST data
```

```
$user = "root";
$pass = "";

$conn = new MySQLi("localhost", $user, $pass, "snippet_kings");
if($conn->connect_error) {
        die("Connection failed: " .$conn->connect_errno);
}
$sql = "SELECT * FROM song_details WHERE songID = ".$level;
$result = $conn->query($sql);
 $jsonReply = array();
if($result->num_rows > 0) {
        while($row = $result->fetch_assoc()) {
                $title = $row['title'];      $artist=$row['artist'];   $album=$row['album'];
        $lyric=$row['lyric'];      $start=$row['snippetStart'];     $finish=$row['snippetEnd'];
        }

         $jsonReply['title'] = $title;
         $jsonReply['artist'] = $artist;
         $jsonReply['album'] = $album;
         $jsonReply['lyric'] = $lyric;
         $jsonReply['start'] = $start;
         $jsonReply['finish'] = $finish;
         header('Content-Type:application/json;');
         echo json_encode($jsonReply); //Encode the array to JSON
}
 else {
        $jsonReply['error'] = "An error has occured. Please try again.";
        header('Content-Type:application/json;');
        echo json_encode($jsonReply); //Encode the array to JSON
 }
}
```

setting up the game room:

The game works by dragging and dropping thee relevant tiles into place to spell the correct artist and title of the song that has played. This function calls all of the necessary functions to shuffle the words and add the letters to the screen.

```
function testTiles() {
        var a = "pitbull";
        var t = "timber";


        divideWord(a + t , "letters");
        divideWord(a, "tile", "a");
        divideWord(t, "tile", "t");
        //$("#tileSpace").append(addLetters(shuffleArray(divideWord(a))));

                $( function (){
                        $(".letters").draggable({
                                snap: ".tile",
                                snapMode: "inner",
                        revert: function(event, ui) {

        $(this).data("uiDraggable").originalPosition = {
            top : 0,
            left : 0
         };
```

```
        return !event;
    }
            });
                $(".letterDrop").droppable({
                    drop: function(event, ui) {

                            checkWord(ui, this);
                    },
                    out: function(event, ui) {
                            removeLetter(ui,this);
                    },
                    });
            });
                $(".letters").addClass("h1");



}
```

In this instance the song Timber by Pitbull as been used as it was a good example that is easily recognisable.

Dividing the word into letters:
To be able to add the letters to the game room as separate entities the data pulled from the database has to be separated into letters. To keep the letters as one entity but separate they were added into an array:

```
function divideWord(word, type, e) {
     var letters = [];

     for (var i = 0; i < word.length; i++) {
    letters[i] = word.charAt(i);
     }

     if(type == "letters") {
     shuffleArray(letters);
     }

     if(type == "tile") {
           addTiles(letters, e);
           addTiles(letters, e);
     }
}
```

Shuffling the letters:
So the the answer isnt abundantly ohbvious the array needs to be shuffled so that the letters dont appear in the correct order. To achieve this the Fisher Yates Shuffle(FYS) was applied to the array of letters, According to Ibijola and Olu “FYS is regarded by many as an unbiased and optimal method for generating a truly random permutation of a finite set” (Ibijola and Olu, 2012).

```
function shuffleArray(array) {
    for (var i = array.length - 1; i > 0; i--) {
        var j = Math.floor(Math.random() * (i + 1));
        var temp = array[i];
        array[i] = array[j];
        array[j] = temp;
    }
addLetters(array);
}
```

Adding the letter tiles:
After the letters have been shuffled the next step is to append the HTML on the page to add the letter tiles. The HTML is added and the pre-made class for a tile is applied to the **letters to make them look appeasing.**

```
function addLetters(array) {

    var inputHTML;
     $("#tileSpace_letters").html("");
    var a = array.length ;
          for (var i = 0; i < a; i++) {
               $("#tileSpace_letters").append("<div class='letters
tile' id='letter"+i+"'>" + array[i].toUpperCase() + "</div>");
     $.mobile.changePage('#gameRoom_page');
     return inputHTML;
}
```

Adding the tiles to drop the letters:
Adding the tiles to drop the letters only requires to know the amount of characters in the word, for this reason it is called allot earlier when dividing the word.

```
function addTiles(array, e) {

    var answerHTML;
     var a = array.length ;

     if(e == "") {
          $("#tileSpace_artist").html("");
          for (var i = 0; i < a; i++) {
        $("#tileSpace_artist").append("<Div class='letterDrop tile'
id='tileArtist" + i + "'> </div>");
    }      }     if(e == "t") {
          $("#tileSpace_title").html("");
          for (var i = 0; i < a; i++) {
        $("#tileSpace_title").append("<Div class='letterDrop tile'
id='tileTitle" + i + "'> </div>");
    }      }
       }
```

Checking if the answer is correct:
To check if the answer is correct the answer has to be checked every time a tile is dropped, when a tile is dropped the letter that is dropped is added into a relevant array that will eventually equal the number of letters in the word, the word is then conjoined back to a string a compared to the actual answer, which is saved as a global variable during the getSongs function.

```
function checkWord(ui, e) {
           var letter = ui.draggable.html();

           if(~e.id.indexOf("Title")) {
                 var sub = parseInt(e.id.substring(9));
                 arrayTitle[sub] = letter;
                 answerTitle = arrayTitle.join("");
                 $("#titleSpace").html(answerTitle);

                       if(answerTitle == correctTitle){
                             $("#titleCorrect").html("Correct! <br><img
src='tick.png' class='levelSelectUnlocked'>");
                       }
           }
     if(~e.id.indexOf("Artist")) {
                 var sub = parseInt(e.id.substring(10));
                 arrayArtist[sub] = letter;
                 answerArtist = arrayArtist.join("");
                 $("#titleSpace").html(answerArtist);

                       if(answerArtist == correctArtist){
                             $("#artistCorrect").html("Correct!<br><img
src='tick.png' class='levelSelectUnlocked'>");
                       }
           }
}
```

Removing a letter from the answer:
It is important to have a function in place that will deal with the event of a letter being moved or removed from the answer otherwise the answer given will not be able to be manipulated and the smallest mistakes by a user could be catastrophic

```
function removeLetter(ui, e) {
     if(~e.id.indexOf("Title")) {
           var sub = parseInt(e.id.substring(9));

                 arrayTitle[sub] = "";
           }     if(~e.id.indexOf("Artist")) {
           var sub = parseInt(e.id.substring(9));

                 arrayArtist[sub] = "";
           }
}
```

Converting to an application

To convert the prototype to an application the Adobe PhoneGap service was used, this compiles all of the files linked with the application and converts them to an .APK file that can be ran on android devices.

Summary

The overall implementation of this project led to a functioning application, thanks to the design stages it came very easily as the plans were all laid out. Problems with the implementation arose when the development of the multiplayer aspects. These problems

arose for multiple reasons; because there was no remote server there was no way to test whether the multiplayer aspect would work.

Test Strategy

Introduction

As the development of this project was proceeded in an agile manner, the problems that were being tackled were very iterative, the problem at hand would be tackled until it is working in order then the next problem would be faced. For this reason, testing was running throughout on every problem faced. Throughout this section all the tests ran on the project will be listed, giving further actions and explaining if they could be fixed.

Table 1 - Test Results

Test Number	Test Name	Description	Did it work	Further Actions
1.	Testing the jQuery Mobile framework	testing whether the framework makes the page show like in a mobile design	Yes	None
2.	Links between pages	Can the user navigate through the pages using the links provided	Yes	None
3.	Transitions between pages	Does the page transition have an animation	Yes	None
4.	Collapsible set	Does the collapsible set open and close on clicking	Yes	None
5.	Collapsible set closing	Do the other collapsible sets close when a new section is opened	Yes	None
6.	Inputting text	Can text be entered into the text boxes	Yes	None
7.	Profile dialog box	Does the profile button open the profile page as a dialog box on top of the current page	Yes	None
8.	Logo showing	Does the logo show on the top of the page	No	The aspect of the logo changed the

				structure of this page, for this reason it was replaced with text
9.	Images showing on the campaign page	Do the tick, locked and unlocked images show on the campaign select page	Yes	The images were very large, so the CSS had to be altered to get them to the correct size
10.	Images Correct size	Are the images the correct size	Yes	The images were the correct size but were still below the numbers relating to the level. The images were floated to the right.
11.	Level images in line	Are the images in line with the level number	yes	None
12.	Font changed	Does the font match the downloaded font	No	Moved the CSS file to earlier than the new font as it overwrites the change.
13.	Font changed	Has the font changed	Yes	None
14.	Calling functions	Do the buttons on the campaign select page call the obtain songs function	Yes	None
15.	Level parameter	Is the parameter for the level passed to the function with no errors	Yes	None
16.	Ajax successful	Does the AJAX call the PHP function correctly	Yes	None
17.	Inserting data	Does data get entered into the database with no errors	Yes	None

18.	Obtaining song information	Does the PHP file obtain the relevant data on the selected song	Yes	None
19.	Passing information back	Does the PHP file successfully send the JSON encoded replies back to the jQuery file	Yes	None
20.	Calling Divide word function	Does the divide word function call correctly using the information provided by the JSON response	Yes	None
21.	Separating the letters	Does the function separate the words into separate letters within an array	Yes	None
22.	Calling shuffleArray	Does the function shuffleArray get called with the new array as a parameter	Yes	None
23.	Shuffling the array	Does the array get shuffled with no errors	Yes	None
24.	Calling the addLetters function	Does the function get called with the new shuffled array.	Yes	None
25.	letters added	Does he function append the HTML and add the letters to the game room page	Yes	None
26.	Tile Design	Do the letters have the design of a tile with the CSS class '.tile'	Yes	None
27.	Adding droppable tiles	Does the addTiles	Yes	None

		function add the empty tiles that the letters can be dropped onto		
28.	Making letters draggable	Are the letters draggable due to the code	Yes	None
29.	Making tiles droppable	Ca the letters be dropped onto the tiles	Yes	None
30.	calling check word function	is the check word function called when an item is dropped in the droppable tiles	Yes	None
31.	Adding letters to array	Are the letters added to an array when dropped	Yes	None
32.	Joining the letters to string	Are the letters joined as a string	No	The letters were separated by a comma, a parameter was added to the join function of " "
33.	Joining the letters to string	Are the letters joined as a string	Yes	None
34.	Removing a letter	Is a letter removed from the answer when the tile is removed	Yes	None
35.	Correct answer	Does the answer show as correct if the answer given matches the correct answer	Yes	None
36.	Song play	Does the song play and can it be repeated	Yes	None

Evaluation, Conclusions and Future Work

Objective and Scope

This section will entail the personal evaluation of my progress and an overall evaluation of the finished project. This section is written in a personal manner after the development has ceased.

Project Objectives

Due to hiccups n development the overall objectives of the project had to be changed to accommodate for what was achievable. One of the main objectives of the project was to develop a multiplayer application. With the resources available it was very hard to integrate the game mechanics into a multiplayer system. The multiplayer aspect of the application was abandoned to focus on the game mechanics and instead the focus was placed onto a campaign system.

The aim of the game was to challenge users to guess songs based off a snippet that is played for them, these mechanics were developed correctly and the game runs with little errors in that particular manner. To adapt the game and make it more immersive the option to drag and drop the letters was added. This brought a lot of unexpected problems as functions would be called when tiles were accidently brushed through other tiles as it was registered as a leave even. Upon trying to develop a solution to this problem more and more problems continued to arise. The problem was eventually solved by adding code that would not allow more than one tile to be dropped.

The research aspect of the project came with expected results and overall was more enjoyable than expected. As mentioned in the preparation section above the relevant materials were already obtained and ready to read and analyse. The internet was used to obtain the quantitative data on the subject which acted as the argument side of the final conclusions.

Self-Evaluation

In the early stages of the project the tasks involved with the project seemed daunting. The time management was a vital aspect on the ongoing development of the project as it was mostly developed in personal time around the other assignments. As the year went on the amount of work with alternative assignments continued to grow in size and effort required, for this reason the project continued to be pushed to the backburner.

When it came to the development stages I felt confident in my ability to implement the ideas i had and felt confident in my ability to solve the problems at hand. The problem again with the development was the time management, tasks that I had predicted to be small were amounting in large chunks of unpredicted time being spent fixing unforeseen problems. There was a certain enjoyment found in fixing and tinkering with the project and finally solving problems.

Conclusions

There are many conclusions that can be drawn from the research aspect of the project and the literature reviewed. The main goal of the research was to assess the free-to-play genre and analyse the prospect applying the methods of the genre to the application development.

The conclusion drawn from the research is that the free to play method is a viable option for the project depending on the method for revenue within the application. If a sufficient revenue system is in place, then the application does not require a onetime payment and can instead rely on an income stream. It was determined that the best way to make money on this application would be through advertisements schemes and at a later date the goal is to incorporate microtransactions to the gameplay that will propel the users experience and also add to the profits of the application.

Future Work

Although the project is drawn to a close it is certainly not final, with more time there were countless amounts of improvements and implementations that could have been added to the project.

Improvements:
A major flaw with the application at present is the stutters in the GUI and functional complications. The first improvements to be made in the future would be to ensure that the graphical aspects of the application all function correctly, the main aspect of the aesthetics that cause problems is the drag and drop aspect of the game. To fix these problems there will be more code added to ensure that functions are not called at the wrong time, which is causing the problems at present.

Currently there is only one level of the campaign to test the game mechanics are working correctly, the next step would be to add more levels. As there is only one level the function to mark the level as ‘complete’ and unlock the next level was never implemented, this will also be on the list for improvements within the application.

New Features:
This subsection is focused on aspects of the application that have not yet been started and will offer new experiences. The original plan for the application was to create a multiplayer game, with restrictions on the network and time restrictions this was delayed as it was causing too many unforeseen problems, instead the focus was put into the game mechanics and single player experience.

At a future date the focus would be placed back on the multiplayer experience and the social aspects surrounding. This will also open a window for micro-transactions to be implemented. The micro-transactions will be one of the main focuses for company revenue as this and the advertisements will be the main source of income.

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2 Appendix 1 – Project Proposal

Computing Degree Project Proposal

Name: Aiden Barrett Course: BSc Computing Size: double/single
Discussed with (lecturer): Eddy Lee

Current Modules (and previous modules if Computing or direct entrant)

Databases
Computer Fundamentals
Programming
Mobile Applications
Website Design
Work Based Learning
Wireless Networking
Object Oriented Programming
Graphic Design
Advanced Database
Academic Practice

The Project Title

Snippet Kings

Project Context

In this technological age in which most of the population own or have access to a mobile device I have decided to embrace this and try to tend to the large population of mobile device users by creating a mobile app; more specifically a mobile game. The overall objective of the game is to listen to small snippets of songs and try to guess the song title and artist. Furthermore I aim to make the game a multiplayer platform in which users will be able to compete against one another and create a social space in which the users can also interact with each other. To give a sense of accomplishment and keep the users playing I plan to incorporate a profile system and levelling system so progress can be tracked, as the users progress through the levels they will unlock new profile attributes.

Specific Objectives

1) Play single and multiplayer games to guess songs within a specified time limit.

2) Progress through the levelling system and track progress through XP.

3) Socialise and connect with other users.

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Potential Ethical or Legal Issues

Data protection

Comply with all legal trading laws

Copyright infringement

Resources

Limited to using College computers due to specific software contained on the devices for programming and application development.

Testing will take place on the Android S8, which is my personal mobile device.

Potential Commercial Considerations - Estimated costs and benefits

Taking into consideration the time scale in which this project can be completed and the level it will stand at upon completion, I believe that the product will not sell well if there is a price

tag attached to the initial download, instead I believe that the commercial benefits could come from advertisements and because of the nature of the game and the social aspects I believe that a micro-transaction system could be implemented for aesthetic items and if enough time remains for an in game currency in which the user can purchase ‘power ups’ to enhance their gaming experience and give them the edge over the opponent.

To weigh up the cost it is first important to analyse the user base and determine the traffic that the app will endure. In this case the traffic is expected to be low to begin with but is expected to grow exponentially with time as its popularity grows. The main cost comes from the server, this can come from as low as £10 per month for very low traffic, however as with the popularity of the application the traffic will grow and the server will need an upgrade which will cost more.

The other cost that needs to be planned for is the maintenance and staff that will be maintaining the application, this can be priced in different ways whether the employee is being played on a salary basis or hourly work, to maintain this app the suggested hourly rate in my opinion would be £10 per hour.

Proposed Approach

To enable a testing facility and run the app upon completion of the prototype I will be programming the application using the combination of JAVA and MySQL, which will allow for great functionality and also allow for the interpretation and manipulation of data within databases. The chosen SDK for the development of this prototype is Android Studio, a popular development kit used with android developers. This SDK comes with a highly functional framework that will be used for the overall design and aesthetic functionality.

I am proposing that all of the relevant details for the songs to be held within a database as well as creating a class for songs that will play host to these same attributes. To avoid data duplication I will not be making any of the songs details into an object in the source code, instead I will leave the options blank and gather the songs and their details from the database.

To ensure that the songs the users are guessing are randomly generated and do not appear more than once in one sitting I will be employing the method known as the Fisher-Yates shuffle; this function manipulates an array and shuffles the output in a random order, from here the it is as simple as creating a loop function for the songs that will cycle through the songs in the new shuffled order.

Once the songs have been shuffled the game space will then be created, whether single player or multiplayer, and the first song will be played for a selected amount of time, specified in the songs details (snippetStart and snippetEnd). The users then have to enter the artist name and song title within an allotted time, if neither manage to get any the snippet time is extended. Once the user has entered the details it will be checked against the details now held within the object of the song rather than the data within the database to heighten the speed of the processes, if the details are correct they receive a point for each correct details entered.

Below is a plan of development in steps:

Research – Conduct research on the available apps like my suggestion and the overall processes involved in app design.

Initial Design – Create plans and designs for the app (Hand drawn designs, user needs analysis, user case diagram)

Design Feedback – present designs and plans and receive feedback.

Development Stage – Begin Development of the application

Testing – Independently test application on personal device.

Feedback – again present prototype and receive feedback to implement further changes

Maintenance – Make changes to the application based on the feedback and fix any problems with application

3 **Review and innovate** – Review the project on a whole and continue to update the app

Appendix 2 – Technical Plan

Computing Project Technical Plan (V2)

Name: Aiden Barrett **Mode**: *full time*
Course: Computing (Mobile Applications) **Supervisor:** Eddie Lee

Title
Developing a free-to-play mobile game and evaluating the economic potential of the medium

Summary
Following from the preceding technical plan, the overall aim of the project remains unaltered in conjecture with the assets and software changed to accommodate for problems encountered during the early development stages of the former plan. The intention of the project is to construct a mobile game with an integrated social platform and micro-transaction system on a free-to-play platform and to evaluate the free to play genre in terms of revenue and player base potential. The objective of the game is to correctly guess songs based on a small snippet that is played.

Problems were encountered with the software outlined in the original technical plan due to unavailability and restrictions on the college network disabling the capability to update to the system or software. Due to this the programming language has been changed to from java to HTML5, Jquery Mobile, Jquery, CSS and PHP. The mobile app will be created with JQuery Mobile techniques and converted to an .apk file using the PhoneGap service.

Deliverables
- Mobile Application
- Work breakdown structure
- Development documentation
- Research and findings

Constraints
In the prior technical plan it was stated that the created mobile application would only be functional on android devices due to the software used to create the application and the languages used. As a result of the change in IDE and programming languages the constraints keeping the application to one mobile platform are no longer present and the application should be attainable from multiple platforms. A constraint with the new plan is with the functionality alongside with the programming languages is not as thoroughly progressed in terms of functionality.

One constraint that holds a bar on the progression of the project is the lack of a dedicated server that can be used to host the multiplayer aspects of the application, to emulate this a WAMP stack will be used and the code pertaining the structure of the online aspects will instead be sent directly to and from the devices using their IP addresses.

Key Problems

The first problem apparent from the context of the application is obtaining and maintaining the usage rights for all of the audio used in the app, and as it is based on guessing popular songs this could end up being a big cost point, this point will be expanded upon further on in the potential ethical and legal issues section.

The second key problem lies within the database and how the information is stored, as all of the user's personal information is going to be stored, one example being a password, there has to be a secure way to store this data so that the users data is safe amongst all else. One solution to this is to have the users data go through a hashing mechanic that will change the data that the user has entered using complex algorithms that cannot be reversed, the alternative solution which is also preferred in my opinion is to use the services provided through exterior companies like Facebook that offer a service that will store account details or better yet allow users to log in using existing Facebook credentials by linking their account to the application.

A large portion of project cost usually stems from the advertisement and distribution of the end product. The easiest form of distribution is to have it approved and hosted on one of the established app markets such as the Apple App Store and Google Play Store. This method requires a lot of perquisites, more so with the Apple version as the quality of the app and contents are all tested and investigated to ensure the product is suitable for the audience and adheres to all of the terms and conditions associated with the services.

Whilst many app distribution services offer a higher pay-out to the developer, which would result in a higher pay for each download, they do not gather the same scale of audience yield as the other main competitors as mentioned above do. This is where the choice becomes harder as the quantitate income can differ and the profit made is being based on the potential audience that is expected to use the app and how high the audience base is expected to get.

As this is only a small scale project the audience yield is not expected to be too high, for this reason I would use the service SlideMe. This service is better for smaller developers, According to Tim Mackenzie from TechRepublic "developers get as high as 91% of the app's sale price from SlideME." (Mackenzie, 2012) . As well as a larger pay out the service also manages to maintain a good reputation as all of the applications go through a strict vetting process and are reviewed to ensure the terms and conditions are met, "60% of the submissions are rejected so those who want to browse among quality apps have found the paradise" (Farago, 2015) .

System and Work Outline

The first primary task linked with this project is to research the software and languages that will be utilised throughout, this includes the JQuery Mobile API and all of the functionality that can be applied throughout development, to do this research the JQuery documentation will be used as well as studying software created by others and the techniques used.

The second point of research is the server side coding that consists of PHP and MySQLi, this research will be carried out online and using books acquired in preceding years. It is of the utmost importance that the server side code is secure as

user's personal information is going to be stored within the database and in the case of intrusion the data must not be compromised.

The third point of research will be around the free to play market; both the successes and failures within the genre and analysing the corresponding reasoning. To ensure the planned application has the highest potential for revenue the strategies behind micro-transactions will also be investigated to gain a further knowledge on the correct design for the application.

The final research to be undergone will be in accordance of the potential ethical and legal issues linked with the project, seen briefly later in this document, the correct procedures regarding copyright and monetization of the application and songs involved will be investigated and a proposal will be presented with the sufficient evidence.

After the research groundwork is concluded the development process will commence. The first point of development will be the aesthetic portion of the application, this being the menus, game rooms and alternative pages found within the application. The aesthetics of the application will be created by manipulating the JQuery Mobile framework. This framework allows the developer to create pages that are viewed separately but written on one document unlike a webpage, as well as offering a lot of functionality through its many alternative tools and methods. To stray from distraction and confusion the functionality of the application will be delayed until the preparation of the aesthetics are completed.

The next development step is the functionality of the game itself, the functionality of the app will be created using a combination of JQuery and PHP. The first hurdle for the game to overcome in functionality is for the songs to be selected at random from the database. The database will hold all of the information on the songs from the title to the duration and start and finish of the snippet. The most important field is the location of the song which hold the information where the song is stored so the song can be pulled and played when selected.

To acquire a random selection of songs a select query will be ran on the songs within the database proceed to be added into an array of the premade class object named 'Song', once the array is established the Fisher-Yates shuffle will be employed to shuffle the array and generate a random order for the songs. Once the array is shuffled the first five songs of the newly shuffled array will be pulled to easily keep track of the data on the songs and procedurally keep the songs shuffled but still in an organised order.

A further problem to be solved with the program is how the user will input and submit their answers. The chosen method for this particular application is to apply a tile based system in which the available letters will be shown as tiles as well as extra letters so to not allow the user to use the letters to guess the answer rather than the song itself. The tiles will be draggable using the jquery method 'Draggable' and they will be droppable using the jquery method 'Dropppable'. Once the letters are all in correct place the task will be completed and the next song will load.

The final implementation will be the social aspects of the application that will allow the users to communicate with one another and be able to establish a level system to allow for progression. The user details will be stored within a database, with the private information going through a hash and salting procedure of MD5 to secure their information. A separate login will be created for each user in which they will be able to create all of the user details like the username, icon and biography. Users will be able to track their own and other users information within the app.

Risk Analysis

Risk	Severity	Likelihood	Action
Project deadline not met	High	Low	Give adequate time to development
Copyright infringement	Medium	Medium	Ensure music is not being used without the license to use and monetize.
Bullying within community	Medium	High	Restrict the user's communication tools and implement a report user function.
Personal data taken maliciously.	High	Medium	Hash and salt the data within the database and keep the code strict to not allow for intrusion.
Songs are unrecognisable	Low	High	Change the time of the snippet playing or prolong the playtime.
Server crash	High	Medium	Have an according server considering the user base and upgrade if necessary.
Forgotten user details	Low	High	Have a system that allows for user credentials to be reset or obtained.
Account hacking	Medium	Medium	Don't store user's credentials in plain text.
Over paying for micro-transactions or unauthorised payments	Medium	High	Ensure that adequate security measures are in place to make sure it is the user who is paying for the product and add messages so the user is aware of what they are buying and the price.
Rapid user decrease	Medium	Low	Keep new content coming.

Options

Design Life Cycles

The first development cycle that is a viable option for the project is the waterfall model. This method works by completing the project section by section and not progressing in the development stage before the previous stage is complete. This model is good for time management and organisation if the developer is able to put all of the available time into the tasks required.

The latter development cycle and the one that will be used throughout this project is the Agile Development Cycle. This employs a more iterative design that tackles problems one by one. With this style of development it is easy to jump back and forth between sections of development but a portion of the organisation is lost and if not used correctly the developer can waste a lot of time and resources by getting carried away.

Development Tools

The development tools are limited as the cost is too substantial to attain for personal use and the college tools are limited to the software available, the available options are using java or C# in NetBeans, Android Studio or Eclipse or creating the application using web development tools and using a conversion application called PhoneGap.

The original plan was to use android studio and develop the application in Java, however the availability of Android Studio was skewed as the software was not up to date and network restrictions resulted in the IDE being rendered unusable.

The next best IDE in terms of personal experience was Dreamweaver due to the volume of work previously done using this software. The functionality is not as high as with Android Studio and there are not as many usable assets to attain however all of this can be gained by using external frameworks. In this instance the main frameworks I will be using are JQuery and JQuery mobile as they offer great functionality for mobile applications and mobile based designs.

Target Environment

During the span of this project the target environment has changed due to a change in the personal device used to test the product. Originally the testing environment was going to be on the apple software and the device used to test it on was the IPhone 6+. Shortly after the project begun this device was upgraded to the Samsung S8 which further cemented the programming language to java and reduced the complications involved in developing for mobile that subsequently arrived due to originally developing using Apples development tools.

Potential Ethical or Legal Issues

The main area of concern with the ethical and legal issues are the copyright issues that ensue with the use of the songs, as the songs are being used without correct usage rights it is both unethical and illegal to monetize the application, for this reason all of the costs shown are taken from a perspective of a future date in which the correct usage rights have been obtained.

A large ethical issue that comes with a social platform are the issues with bullying and overall bad community communication. To help prevent this the users will be able to report users using a system that will be made in the development of the application and certain words and phrases will not be allowed within the chat sections and when naming anything within the application. The application needs to be suitable for any users including age so the content within needs to be appropriate on all levels.

Commercial Analysis

To analyse the commercial aspects of development and the application on a whole it is important to have an estimation of users and be sure in the development options. For this project the estimates user base will be set at 50,000 as if the developers were well established.

Factor Name	**Description**	**Is this a cost or a benefit?**	**Estimated amount**	**Estimate of payment arrival**

Developer's time	The hourly price of the developer by the amount of hours planned on the project	Cost	£10 X 400hrs = £4,000	After project completion
Software used	The price that comes with leasing the appropriate software used throughout development	Cost	£300	Prior to start of development
Hosting services	The price of hosting the app on a server in order to allow others access.	Cost	The initial price will be around £10 but increase depending on traffic	Throughout development and onwards
Price of finished application	The price to purchase the app on the various app stores	Benefit	Free	N/A
Money from advertisements	The money gained from hosting advertisements from AdMob	Benefit	£50 per day	After application is released.
Money to advertise	The money spent on the advertising service from AdMob	Null	The cost of advertising is nullified by using the house ad campaign which allows you to advertise whilst advertising other applications	After application is released.

Employability Contribution

As this is the area I wish to proceed in after graduation this project should help me build my portfolio and hopefully the app is technically challenging enough that I both learn allot within the software development field and have a technically advanced application to offer as experience to future employers.

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Appendix 3 – Gantt Chart