Faculty of Technology, Design and Environment

Oxford Brookes University

School of Engineering Computing and Mathematics

BSc (Single Honours) Degree Project

Programme Name:……Computer Science…….,……

Module No. ……COMP6013: BSc Computing Project…..…..

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Project Title: …….. 'Lemonade Stand' Android Game……...

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(if applicable)

Date submitted……15th of October 2021……..……

A report submitted as part of the requirements for the degree of BSc (Hons) in Computer Science

At

Oxford Brookes University

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Computer Science Dissertation: Project Proposal

Chapter 1: Introduction

1.1. Background

In the era of innovation and creation, projects, solutions, and research ideas are promoted to improve quality of life or inquire compelling applications/topics. In the final year of Computer Science, a Computing Project module, COMP6013, has assigned a task to investigate, and document the process involving a study of a solution to a practical problem. The intention of the solution is represented to be a culmination of knowledge gained through the course.

A tactical method to encompass a highly populated demographic is to develop and design for a product that everyone has: a smart phone. Everyone in this century will have a smartphone in their pockets which promotes creating mobile applications as everyone will be able to access the product anywhere and use it.

An issue that is concerned in this project is money. Everyone needs money, everyone should understand how to generate revenue. Understanding and teaching economics is tough when studies are done through learning theories and applying case studies. Whereas practical application is a good way to convey how assets and capital are affected.

'Lemonade Stand' (Wikipedia, 2021). is a classic game that involves a player purchasing lemonade stock: sugar, lemons, water; then moving into a selling state where the player sells lemonade using their stock and recipe. The first commercial lemonade stand game was developed in 1973 by Bob Jamison of the Minnesota Educational Computing Consortium which was developed for the Apple I and ported to the Apple II. These types of game genres are defined as Business simulation games. Depending on the state of the day such as the weather or temperature, sales and demand of lemonade will fluctuate, and the player will have varying profits per day. The objective of the game is generally to generate profits and upgrade the virtual assets within the game. For instance, a player may be saving up to buy higher quality lemons or a nicer lemonade stall.

A virtual economy-based game is a game that involves the players exchanging virtual goods. Building an economy-based game will involve understanding economics and how it will be used within the application. The four aspects of an economy involves:

scarcity, supply and demand cost & benefits and incentives. In the lemonade stand, creating a scarcity of the stock will allow a virtual economy to exist as it creates a supply and demand for the available lemonade stock. Multiplayer implementation will create a demand for the scarce lemonade stock and players will create a market of trading commodities amongst themselves. To build on this, different types of lemons create competing commodities with different demands. For example, a special 'Alien lemon' will introduce 'Alien customers' that will pay in an 'Alien currency'. Furthermore, to get a unique lemon will require a system of lemon breeding, where 'lemon a' + 'lemon b' may generate an 'Alien lemon' or any other unique lemon. This project involves several interesting topics as it entertains the idea of a generic mobile game with a unique multiplayer economy feature.

1.2. Aim

The aim in this project is to improve the issues of money mentioned. Targeting a large demographic with time to learn and provide them with the ability to play with a virtual economy. As a result, the idea requires to develop a mobile application game that involves a multiplayer implementation and a virtual economy based on lemons and lemonade.

1.3. Measurable Objectives

Objective	Task and Deliverable(s)	Goal/Due date(s)
Ob.1.	Complete a full background review and analysis of existing/similar products.	End of Semester 1, Week 4.
Ob.2.	Review ethics and legal aspects of developing this project.	
Ob.3.	Design a 'Project Proposal' form of intentions.	
Ob.4.	Immediate development of the product.	

Ob.5.	Establish UML planning, and artefact creation.	Start of Semester 1, Week 5.
Ob.6.	Review and analyze formal due dates to complete the project.	Start of Semester 1, Week 6.
Ob.7.	Develop a minimum viable product application.	End of Semester 1, Week 11.
Ob.8.	Design a 'Progress Report' for intentions and reference.	End of Semester 1, Week 12.
Ob.9.	Develop servers and a database for the application.	Start of Semester 2, Week 2.
Ob.10.	Design and develop an algorithm for the virtual economy.	
Ob.11.	Virtual economy algorithm implementation in application and database servers.	End of Semester 2, Week 3.
Ob.12.	Begin writing Dissertation.	
Ob.13.	Iterate features, innovate on the product and submit a beta.	Start of Semester 2, Week 4.
Ob.14.	Testing and evaluation.	
Ob.15.	Release, plans for release and maintenance.	End of Semester 2, Week 7.
Ob.16.	Final Report & Present the work.	End of Semester 2 Week 8.

1.4. Product Overview

Nesta (Nesta, 2021) is an innovation foundation charity that develops techniques and exercises that efficiently and rapidly identify plans for the project and tries to stretch it into a different identity.

Nesta Evidence Planning:
Identifies what the aims of the project is and defines why it has value.

Key focus of the project

- Profit.
- develop a working application of a lemonade stand game.
- Working virtual economy.

Enhance: What does it bring new value to?	**Replace:** What does it make less desirable?	**Re-use:** What does it build upon?	**Limit:** What could be the negative effect when pushed to extremes?
It provides people with a way to play with a virtual economy to be able to gain a sense of accomplishment and learning.	When a player must pay real money to enhance their gameplay or there are incentives to do so.	Other games with virtual economies; Cryptocurrency coin breeding; mobile application development;	Legal and ethical issues when real money is involved.

Nesta Fast Idea Generator: A viable method of developing new ideas by thinking differently and opening new perspectives.	
Inversion: Turn common practice upside down.	Product placement found within a game is highly beneficial if it is done well and not seen as 'selling out'.
Extension: Extend the offer.	Players cannot directly purchase lemonade stock but trade a bond for in-game currency.
Differentiation: Segment the offer.	The game can implement bonds into the game economy.
Addition: Add a new element.	The game will trade out lemons for a portion of a crypto currency.
Subtraction: Take something away.	Players cannot trade between themselves therefore no economy.
Translation: Translate a practice associated with another field.	Creating an economy and using policies to define game rules that will keep the economy running translates to Politics and Economics.
Grafting: Graft on an element of practice from another field.	Players can define the policies that will run the game.
Exaggeration: Push something to its most extreme expression.	Player-run policies and economy (Player-driven development and gameplay). Players must pay real money for lemons or in game currency.

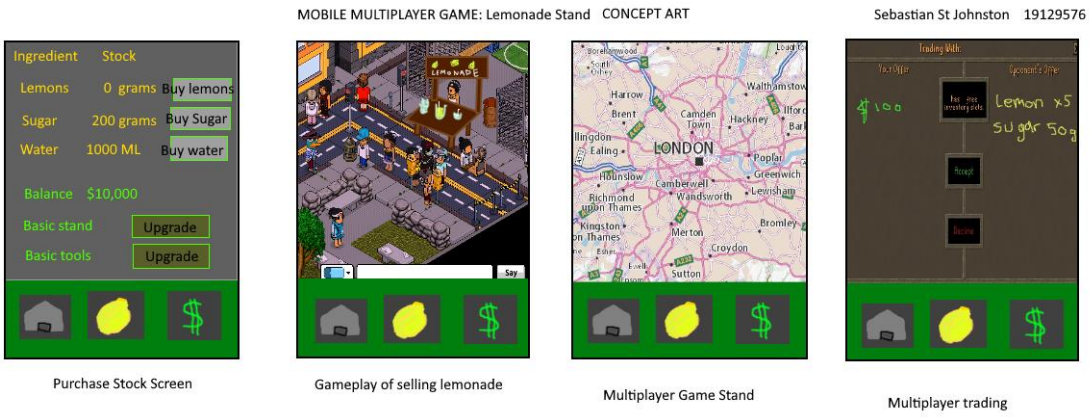
Problem Definition: Defines the main problems by exploring underlying factors which allows a greater overview understanding of the product.	
What is the key issue you are trying to address and why is it important?	This solution is aimed towards solving problems of lack of entertainment and having a potential ability to create a virtual economy. Teaching economics and running a business to understand assets and money. Applies to all real-world applications and is the basis of how our life works.
Who is it a problem for?	This solution to the problem is aimed towards people who want to learn more about economics in a practical way and people who want to play a virtual economy-based game. Therefore, it is important to design for both parties so that the target audience can invest their time into this game.
What social/cultural factors shape this problem?	Ethics of creating a virtual-based economy and the money that is involved with it. Game addiction and mobile-game addiction. Furthermore, not properly teaching economics in a practical fashion or having many virtual economies.
What evidence do you have that this is worth the investment?	Mobile app development is saturated but calls for niche apps. A large population for the target audience means that the investment will turn out to be worth it and potentially profitable.
Can you think of this problem in a different way? And can you reframe it?	Creating a project that involves multiple features of computer science to show evidence of developing a performing product. Open-source code that involves the process and discussion of building a mobile multiplayer economy game.

Theory of change (Key assumptions): Involves the future and defining the goals and how to achieve them.	
What is the problem you are trying to solve?	Teaching economics and business, gaming, mobile-app development.
Who is your key audience?	People with phones and have time to invest in a virtual economy game.
What is your entry point to reaching your audience?	Having a phone, in this case, Android. People with internet and time to play the game and the willingness to have a basic understanding of the game and economics.
What is the measurable effect of your work?	If the product produced meets the objectives and performs properly.
What are the wider benefits of your work?	Players may be able to earn money through the game.
Measurable effect?	Performance in each feature implementation.
Wider benefits?	Working and running game economy.
What is the long-term change you see as your goal? (Stakeholders)	Further implementation of features for profits and maintenance. Release and port to PC, iOS. Developers and investors will create this goal into a reality. Create a brand and develop more games. Players gets to have more content for their game.

1.4.1. Scope

The product overview of the application will involve a mobile-based, multiplayer economy, game based on 'Lemonade Stand'. The game will feature a virtual economy developed by an algorithm that will establish a supply and demand for the different items and commodities found in the game. The application system will involve a database implementation to be able to have a personal account system and multiplayer gameplay and trading. The game will be built in Android Studio (Google, 2021), using Java. Figure 1 showcases the concept art designed for the lemonade stand game and displays the essential states found within the game.

Figure 1: Concept Art for Lemonade Stand



1.4.2. Audience

The target audience is aimed towards people who have time to invest into a simple game with very minimal input and time cost. These people enjoy long term 'grinding' (a term to describe long-term, repetitive gains) to earn benefits as they play the game and build their wealth. Furthermore, any person that wants to play a mobile application game and learn about virtual economies.

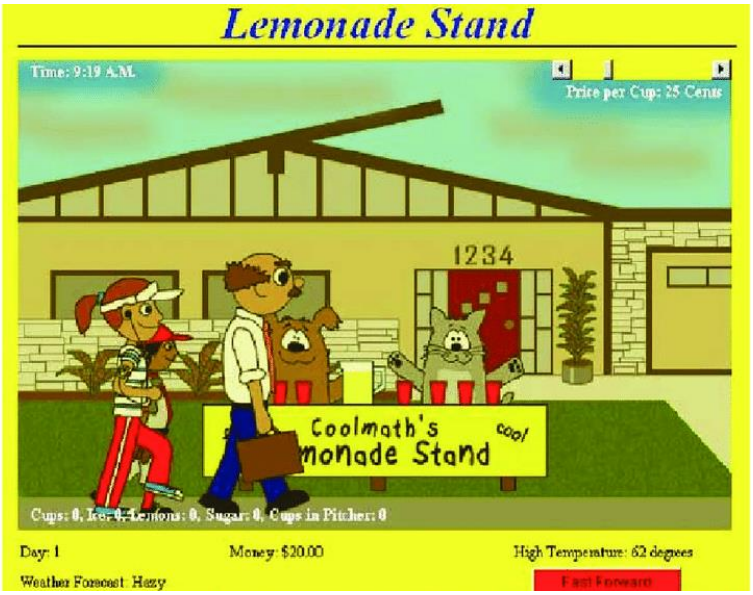
Chapter 2: Background Review

2.1. Summary of Existing Approaches

When creating a project, it is important to explore inspirations and state of the art solutions that already exist. The research must be essential and effective in helping to design and developing the final product. Being able to obtain the research would be achieved through a way of systematic searching. Systematic searching, defined as organising and performing the search process in a structured and pre-planned way. Comparing and critically analysing literature, software and papers that correspond to the main concepts in this project. Therefore, the search protocol must be defined precisely. Identifying a 'Table of Features' allows a clearer understanding of what is involved with the project.

There are some games that already exist on the market and that can be applied to the inspiration of this game. Firstly, the concept of 'Lemonade Stand' is a very common game that has seen many different interpretations over the decades of gaming development and how technology has evolved.

Figure 2: coolmathgames' Lemonade Stand



Shown in Figure 2, coolmathgames.com (Coolmathgames.com, 2021), a very popular practical Mathematics learning website, demonstrated their interpretations that are time-limited and very simple. However, the game features all the core elements

found within a 'Lemonade Stand' game; containing; an inventory state, stock purchasing state, recipe state, selling state, and profits state.

Other great interpretations of Lemonade Stand developed by Electronic Arts (EA) called, 'Lemonade Tycoon' (EA Mobile, 2002). This game's features were more advanced, designed very well and is more of the direction that will inspire how this interpretation of Lemonade Stand will turn out. The design and art of this game has a nice cliche design although it is very cluttered as information on the screen remained static and redundant after many playthroughs. Figures 3 and 4 display the essential and iconic game states found within the game.

Figure 3: EA's Lemonade Tycoon, Recipe & Pricing

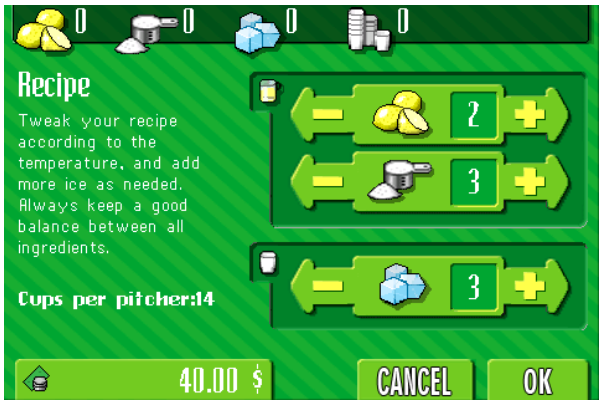


Figure 4: EA's Lemonade Tycoon, Selling

Other business simulation game interpretations such as 'Roller Coaster Tycoon' (Chris Sawyer Productions, 1999) or generic Café or Restaurant games. In these sorts of games, the business involved is swapped for a different real-world commodity. Although sometimes, in the case for 'RollerCoaster Tycoon', the gameplay is different, but the objective is the same. Figures 5 displays 'RollerCoaster Tycoon'. Figure 6 displays Armor Games', Coffee Shop game (Armor Games, 2007).

Figure 5: Popular Unique Business Simulation Interpretation, Roller Coaster Tycoon

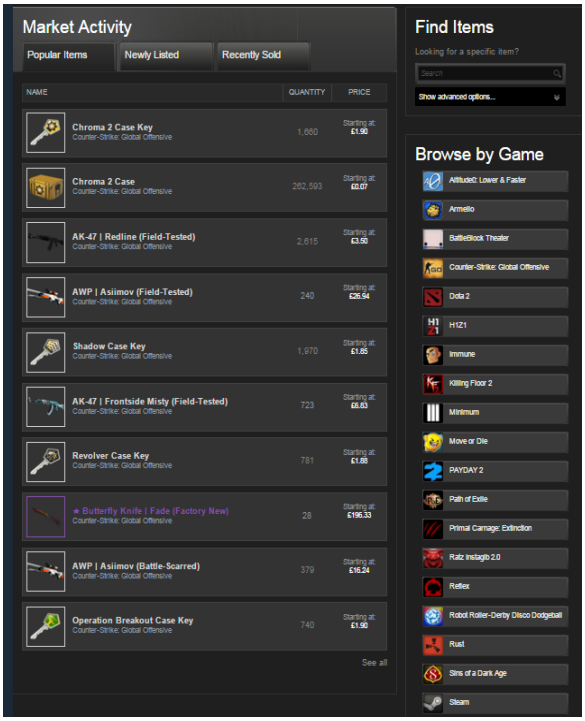
Figure 6: Café Krazy, Business Simulation Example

Games that feature virtual economies is a rare game genre to come by as normally, these games would be massive, multiplayer online (MMO) games and have very high scale production. One of the biggest inspirations is RuneScape (Jagex, 2001), which is one of the most popular virtual economies that is active to this day.

Figure 7: RuneScape Trading Interface

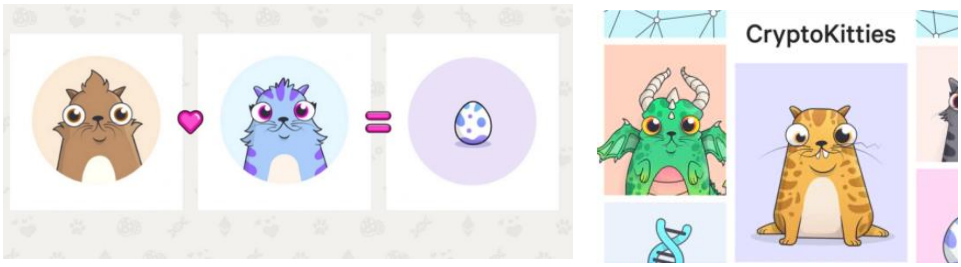
Furthermore, a whole system can embed a virtual economy within such as Steam (Valve, 2003). Steam is a video game digital distribution service by Valve and their games have unique, tradable virtual luxury items and people buy, sell and trade with these virtual items on the official steam community market or through a peer-to-peer trading system.

Figure 8: Steam Community Market



Cryptocurrency has been huge over the last decade. People, huge amounts of money and very influential companies have been involved with Crypto and born from it is 'CryptoKitties' (Dapper Labs, 2017). A generation-based crypto currency that breeds tokens into other tokens. This may inspire how the lemon token may retain a unique value based on the attributes of the unique attribute. The attribute is then able to be bred to create a more valuable token.

Figure 9: 'CryptoKitties' Breeding and Variations



2.2. Summary of Literature

There are several papers and discussions that are involved when developing this project. Furthermore, there are several contrasting topics that are related to this project that are not normally related when approaching developing a mobile application. This topic does involve ethics, laws, virtual economies in economics, smartphone addiction, game design. Several databases that have resources and research literature from the Institute of Electrical and Electronic Engineers (IEEE.org, 2021), Association of Computing Machinery (ACM.org, 2021), Social Science Research Network (SSRN.org, 2021). The search terms that were included when researching this project: Android, Java, Game development, Project Management, Java Database Server Implementation, Lemonade stand.

The first paper, 'On Virtual Economies' (Castronova, 2002) discusses the topic of virtual economies and their macro effect on this Earth. It begins with describing the popularity of virtual economy games and the lifestyle of that player. There is a discussion to define the game theory with games markets and the impact of these virtual items and commodities in these games. It covers an essential topic of 'Real-world trading' where these virtual items are described as digital capital goods. It then discusses the government regulation of these virtual goods and how legislation of these virtual goods can affect the game developers. It calls for research into this field of virtual economies macro effect which is now a very noteworthy topic within Economics and Technology.

'On Virtual Economies' is a great discussion of very relevant topics but it was very dated, exaggerated and sometimes far-fetched. This paper can infer that it is directly written for economists that aren't aware of the impact of virtual economies, and to shine more light of some of the futures of virtual economies. The strengths include a great description and flow of argument that demonstrates impacts very well. The weaknesses is that over the time, legislation has begun to regulate and control these markets, although it still has the reputation as described. This paper is relevant as it proves why the project is worthy of development. It also allows a greater understanding of this project's impact and what it stand behind.

The next paper, 'Development Informatics' (Heeks, 2008) uncovers the controversial impact of virtual economies known as 'gold farming' and the effect on third-world countries. Players trading real world money for these in game virtual goods tracing

back since 1987. It discusses the demand for these virtual goods and what poor countries can do to exploit these demands by obtaining the virtual items, in mass.

'Development Informatics' great discussion that cover complex topics of 'gold farming' and its impact to the game and its players. It uncovers the reality behind these methods and why it should be policed. It is relevant in providing the externalities of these virtual economies and what should be enforced.

The next paper 'Policy Questions Raised By Virtual Economies' (Castronova, Knowles and Ross, 2014), discusses the regulation of virtual economies by developers and governments. It uncovers the several unresolved legal disputes and the legislation made by policy makers.

'Policy Question Raised By Virtual Economies', is an essential paper in discussing regulations and issues made externally by virtual economies. It also lays out the main point that these virtual economies behave similarly to any other economy which shows that economic policies and learning may be applied here.

'Design User Experience for Mobile Game-Based Learning' (Shiratuddin and Zaibon, 2011), layouts the fundamental design for mobile-based learning. The theories to approach the most efficient way of teaching mobile-based learning and the methods to apply them. This paper will be effective when applying in requirements modelling as it describes the needs and how the design of the application should be.

'Computers in Human Behaviour' (Balakrishnan and Griffiths, 2018), is a paper on Mobile phone addiction and addictive design. It discusses the methods on how mobile phone game applications use addictive design to generate profits and keep you playing. It uses the human reward system by awarding pointless digital points for keeping virtual tasks.

'Computers in Human Behaviour' is an important paper in today aspect of mobile phone application design as designing for and against these features difficult approaches. It calls upon ethics, the affects loyalty between the customer and business. This study will help evaluating the design methods used to make the application's profits, 'fun' and manipulative techniques.

'Analysis of the Scope of Copyright Protection for Application Programs'(Menell, 2021) helps the project understand copyright infringement of applications and programs. It discusses why design and copyright infringement is an important aspect as similar features can suggest copied work. It covers the legal protection of software ownership and the pros and cons against it. This is a relevant study paper as 'Lemonade Stand' is

a generic and common business simulation game that may fall under copyright infringement. However, for this project purposes, it will not undergo or plan for any profits during this development.

The discussion of the general computer ethics of acts. The Data Protection Act 2018 (GOV.UK, 2021) allows data subjects to have a greater control of their data and enforces data controllers to highly secure that data. The General Data Protection Regulation (GDPR, 2021) ensures that companies will follow the regulations of the policies as they would face severe punishment. The Institute of Electrical and Electronics Engineers (IEEE.org, 2021), has defined several ethical laws and procedures that companies must abide by.

In conclusion, this vast number of discussions about the existing product and literature is due to the number of topics that are involved in this project. It is essential in providing a great understanding of goals of this project and what this project has been inspired and must stand by. The studies and research will be used to answer questions in evaluating design approaches in development.

Chapter 3: Methodology

3.1. Approach

The first approach to smoothly developing an application is applying all the software engineering techniques to allow uncertainties to be limited and known. This involves developing proper planning documents, requirements criteria and plenty of research to understand the scope and what the end-product will be. This project will aim to follow Agile Software Development Methodologies as it flows and pushes the project for accelerated and priority-driven development.

The project will initially begin in the planning stage where outlines/structuring of the project and the requirements are established. Next, moving onto designing the project using Unified Modelling Language (UML) techniques and building prototypes to understand limitations. Moreover, developing the project further using the essential planning documents and specifications. In addition, testing against the application using the documents, analysing, and evaluating further development. Implementing all features into the project and deploying it. Then, reviewing the state of the project and continue maintaining or increasing development and feature implementation.

3.2. Technology

Developing the project will be done using Java, in Android Studio using the Android API. Java Database Connectivity will allow databases to interface with Java. Version control is maintained by GitHub (Friedman, 2008).

The project will be developed on Windows 10 (Microsoft, 2015), on a computer with a 7th gen. i7 processor and a Nvidia (Nvidia, 1993) GTX 1050 graphics card. The test development environment will be done on a 10th gen. i7 processor with Intel (Intel, 1968) Iris Plus graphics. The minimum requirements of running the Android app will need to be Android 10 and later, nothing intensive. The server that will be used to run the server won't need to be intensive either, requiring 4-8 gigabytes of RAM. The ideal requirements would include any smartphone made within the recent 5 years.

3.3. Version Management Plan

Version control management is an important aspect when ensuring a safe and high-quality application development in any project. It begins with ensuring backups and version management of the project in all stages of development. This creates a clear understanding of the different repositories and the development timeline. Version control will be achieved using GitHub, a very popular software and project management tool.

Cloud storage and physical storage management is also very important. All artefacts and documents will be shared on a Google Drive (Google, 2012) folder and backed up to physical drives. This allows sharing documents between important project stakeholders and developers and the security that the project will not be lost.

Chapter 4: Project Management

Project management is formally understanding and defining how to achieve progress within the project. Conveying the objectives into small tasks, that needs to be completed for the objective to be achieved. It also allocates the efforts for the tasks and layouts the deadlines for the project.

4.1. Activities

Objective 1 - 3: Ethics forms & Project Proposal

A1.1	Conduct a systematic search of similar software
A1.2	Create a feature comparison table
A1.3	Complete a literature search
A1.4	Perform a literature review
A1.5	Submit proposal

Objective 4-8: Designing & Development and Progress Report

A2.1	Develop a prototype
A2.2	Establish version control management
A2.3	Design State transition structure
A2.4	Design UML documents and artefacts
A2.5	Create Software Artefacts and User Stories
A2.6	Define formal dates, goals and back log.
A2.7	Submit a progress report

Objective 9-11: Product Post-development

A3.1	Create a minimum viable product application.
A3.2	Design the interface of the Java code with the servers.
A3.3	Develop database code and implement it.
A3.4	Develop an algorithm for the virtual economy and implement it.
A3.5	Create a shippable viable application.
A3.6	Start documenting the final report.

Objective 12-14: Testing Analysis and Evaluation

A4.1	Test the application and analyse.
A4.2	Iterate features or innovate the product
A4.3	Submit a beta or working product.
A4.4	Evaluate the progression and timeline.

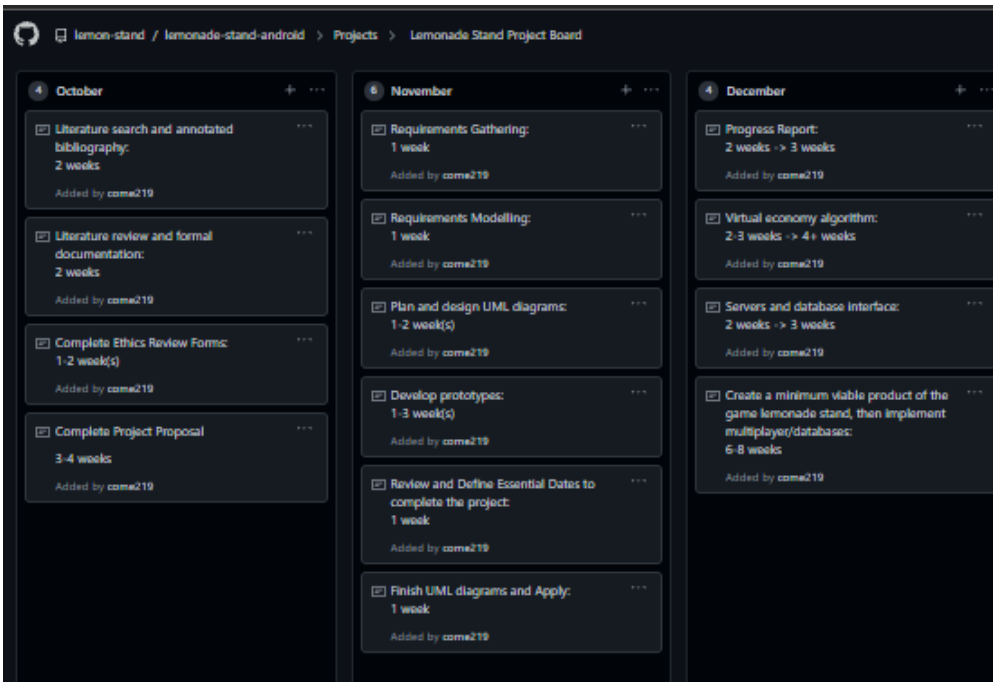
Objective 15-16: End of the Assignment

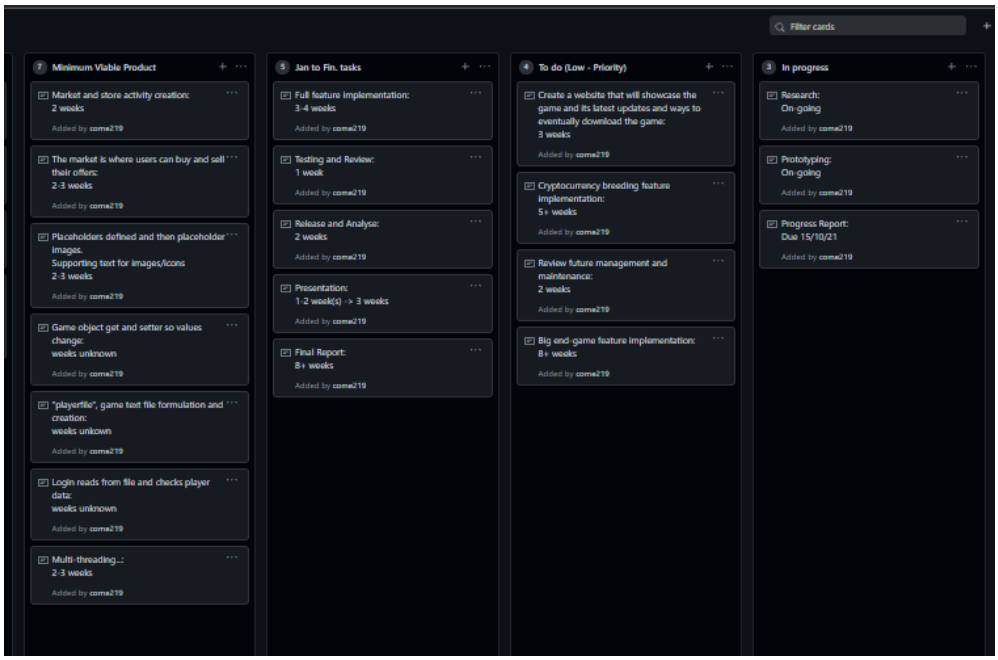
A5.1	See evaluation and review.
A5.2	See plans for release and maintenance.
A5.3	Final report.
A5.4	Present the work.

4.2. Schedule

An important method in ensuring that the project progresses is building a timetable with due dates. GitHub offers an effective project storyboard, which this project will be using to describe the tasks and effort needed for the project.

Figure 10: GitHub Project Story Board





Note: Several tasks can be done in the same week and may overlap each other and not be true to when the task is started.

Time allocation:

October:	4 to 5 Weeks.
November:	6 to 9 Weeks.
December:	12 to 15+ Weeks.
January to Finish:	7 to 11+ Weeks.

4.3. Data Management Plan

All things will practice heavy documentation and plan for it. The timeline of the project and when it was being processed. The meetings will be planned and logged and the comments during the meeting. This will allow an understanding of the progression during the timeline and the next steps. Google Drive and main physical drives will hold the software artefacts, project source code, sprint plans, ethics forms, literature and Unified Modelling Language documents. GitHub will also manage the repositories of the source code to allow easy version control management and testing.

4.4. Deliverables

Task/Deliverables	Due date
Project Proposal: Including a literature review and several project management methodologies.	Due Semester 1, Week 4.
Ethics Forms: Required forms for ethics review and evaluation.	
Finish designing **UML documents** and **software artefacts**.	Due Semester 1, Week 8.
Minimum viable product: A prototype that will be developed into the product.	
Progress Report:	Due Semester 1, Week 12.

Include requirements reports, UML specification and design documents, User stories, Sprint plans and Software artefacts with a **prototype**.	
A **working product**, with all features implemented.	Due Semester 2, Week 2.
Project log: Planned objectives and discussions with due dates.	Due Semester 2, Week 8.
Final Report: Final Product submission and a written report of the overview of the project development.	
Video: Project demonstration to illustrate the product features and what it does.	
Poster: Project visual and static demonstration and description.	

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