



WELSH BACCALAUREATE

Individual Research Project

Abstract

Write this after I'm done

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Introduction

The aim of this project will be to create a simple but enjoyable mobile game. I have chosen to create a mobile game as they tend to be relatively simple games compared to the more complex games available on consoles and PCs. In this research project I will learn how to develop games using a game engine and how to code in C#. I will then use what I have learned to create a mobile game that will have the potential to be expanded on and released.

After taking my GCSE in computer science I became quite interested in programming, this lead to wanting to learn a more practical programming language than the one we learned (python) which is mostly used for creating algorithms rather than applications. I am going to continue computer science in university. This project will therefore, help develop my programming and theoretical computer science skills prior to starting a course at university. It will also help me develop my research, presentation and, writing skills as I will be documenting the process in this document.

I have a specific interest in games development and have already made some simple games in python despite the language being poorly adapted to having graphical user interfaces (GUI). In this project I intend to use a game engine to create a game as it will have many built in systems that I can utilise rather than programming everything from scratch. I will make the game using the Unity as the game engine as it is used in industry, is accessible for free, and has lots of learning materials and tutorials on YouTube.

Aims and Objectives

		Aim 1	Aim 2	Aim 3
Aim		Use tutorials to make a basic game.	Improve the game by adding more complex features.	Gather & collate opinions on the game.
Objectives	1	Learn how download & install unity with the correct settings, and how to create a new project.	Design & Implement extra features, menus, levels, and assets of the game.	Create a survey for people who will have tested the game.
	2	Find or Create assets for the game.	Create a changelog for each new version of the game to summarise additions, changes and bug fixes.	Get people from the target audience to test the game.
	3	Follow an in depth tutorial to learn how to program the basics of the game.	Conduct a closed tests in-between versions of the game to find bugs and help balance future versions.	Collate the survey data to create diagrams and a list of feature requests.

Rationale

Aim 1 – Use tutorials to make a basic game.

In this aim I will be following tutorials to make a basic framework for the game that I will be able to iteratively improve in Aim 2. I will need to find tutorial(s) that are relevant, useful, reliable, and up-to-date. To ensure that the tutorial(s) are useful I will chose a single video/series so that I will be able to follow a single tutorial from start to finish ending up with a basic framework for the game that I understand how to make changes too.

I will only be using tutorials that are for beginners, and use the unity engine to ensure that they are relevant to the skills that I want to learn. Unity does have support for two programming languages (C#, and a version of JavaScript) but I only be considering videos that use C# as the version of JavaScript used in unity doesn't have anywhere near as many applications outside of Unity game development as C#.

To ensure reliability I will use a video(s) that have a relatively high number of views with a decent number of comments so that if any mistakes are made in the video they will be pointed out by other people that have followed the tutorial before me.

Aim 2 – Improve the game by adding more complex features.

In this aim, I will be improving the game by adding more game mechanics, features, levels, and improving the particle effects. I will also add at least one extra set of world assets in a new theme.

To achieve this aim I will make a copy of the game to improve so that the base game made in Aim 1 can still be played. I will also create copies after updates so that if any game breaking mistakes are made I will be able to revert to an earlier version. I will also use these copies to track changes that I make in this document. By the end of this aim I hope that the game will be good enough to show the potential of the game to others if it was to be developed into a full mobile game.

To help me improve the game beyond the basic version made in Aim 1 I will use the programming skills I learned while making that version to make my own original code. I will use sources such as stack overflow, and YouTube to understand error messages and to learn some additional coding skills to use features of the Unity Engine that were not covered in the tutorial I use in Aim 1.

The other part of this aim will be to make the game playable on android devices. I will follow a tutorial on how this can be done to an existing unity project. I will find sources that has a relatively high view count, and a reasonable number of comments so that any errors in the video will be pointed out by others that have already used the tutorial.

Aim 3 – Gather & collate opinions on the game.

In this aim, I will be gathering the opinions of the target audience on my game. To achieve the largest audience possible for my game my target audience will be anyone who owns a phone regardless of age and gender. As the game will not be released on any appstores at the time of testing, I will have to meet the testers in person so they can use my phone. Due to Coronavirus, I cannot see many people in person so I will be mostly asking people in my year to test the game as it is the only group of people I currently have access to.

I will gather opinions using a questionnaire using a questionnaire on Google forms. I will be using Google Forms, as it is a fast and convenient way of gathering the replies that I can then export to excel to create diagrams. I also know how to use Google Forms as I have used it before.

I will analyse the opinions I have gathered by creating various diagrams, graphs, and lists. I will then analyse these results to make a plan of how the game would be further developed taking into account the most common feature requests and changes. I will also be asking people to report bugs and parts of the game that they do not like. These disliked aspects can then be modified/removed to make the game better.

Aim 1 - Use tutorials to make a basic game.

Comments

I will be documenting the process of finding, evaluating and using sources to get started with unity, and make a framework for me to improve in Aim 2. I will be using YouTube to find video tutorials to use. I will then evaluate the relevance, usefulness, reliability and up-to-dateness of the tutorials to ensure that it is a good source. I will also comment on how the source has helped me learn the skills required to develop games.

Unity Beginner Tutorial by Jason Weimann

Link to tutorial: <https://www.youtube.com/watch?v=Lu76c85LhGY>

Link to channel page: https://www.youtube.com/channel/UCX_b3NNQN5bzExm-22-NVVg

Relevance:

This video is perfect for what I am looking to achieve as it goes through developing a simple game from start to finish with no prior experience or programs. It has sections covering installing unity, creating a new unity project, and teaches all of the required programming skills required to follow the tutorial.

Usefulness:

This tutorial will be very useful as it will help me to make the framework for me to improve upon without requiring prior programming skills or knowledge of how to use unity. It will also be especially useful at it covers everything I need to learn in one place by a single person which means it will be easier to follow than having to use multiple tutorials from different YouTubers.

Reliability:

This video has been made by an established YouTuber with several other courses, tutorials, and other game development content. The video itself has over 200,000 views, over 5 thousand likes, under 100 dislikes, and over 700 comments, which are very positive. This means that the tutorial has been watched and followed by thousands of other people who have found it useful; there are also some comments about a minor mistake made in the video, which will help me if I am stuck on something. This tutorial is also a remake of an older video from February 2020 which has almost 1 million views, which shows that care has been taken to ensure that people who find the tutorial can follow a clear and up-to-date tutorial.

Up-to-dateness:

This video was published on the 29th of October 2020 which means the unity interface should be exactly the same as the most current version of unity. In terms of programming this tutorial is very recent as as programming languages and software do not tend to change much over time or become dated.

Comments after using:

This tutorial has thought me everything I need to know to follow more advanced tutorials and continue development of the game. I did come across a small mistake where one line of

code was skipped accidentally in the video but several people in the comments pointed it out and included solutions so I managed to find the additional code required to make the game work.

Why did I choose this tutorial over others?

After looking through several tutorials (best contenders in the table below) and comparing how many views, likes, comments, and the descriptions, I concluded that this tutorial was the most relevant, useful, reliable, and up-to-date.

Title	Views	Likes	Comments	Length	Uploaded	Notes
Unity Mobile Game Development For Beginners Create A Simple 2D Game	70k	1.5k	153	35mins (Installing unity not shown)	May 2019	Too short with a small number of views and comments compared to other videos.
How to Make a Game - Unity Beginner Tutorial	950k	25k	3.3k	3 hours (In depth, shows how to install unity)	Feb 2020 (new version available see below)	
How to Make a Game - Unity Beginner Tutorial - 2021 Version!	200k	5.6k	800	2hrs40mins(In depth, shows how to install unity)	October 2020 (new version of the previous entry)	This is the tutorial I chose
Making an IOS/Android game in UNITY - Beginner Tutorial - #4	50k	1.1k	120	35mins over 4 episodes	June 2019	Number of views likes and comments are taken from the last video as that is how many people completed the tutorial

Aim 2 - Improve the game by adding more complex features.

Comments

I will document the process of further developing the game in a changelog below. It will contain photos or videos of the new version of the game along with a list of changes, additions and bug fixes. I may also add comments or a description of changes if necessary. I will only include the latest unity project file with this document as the file size so that it is easier to download this project.

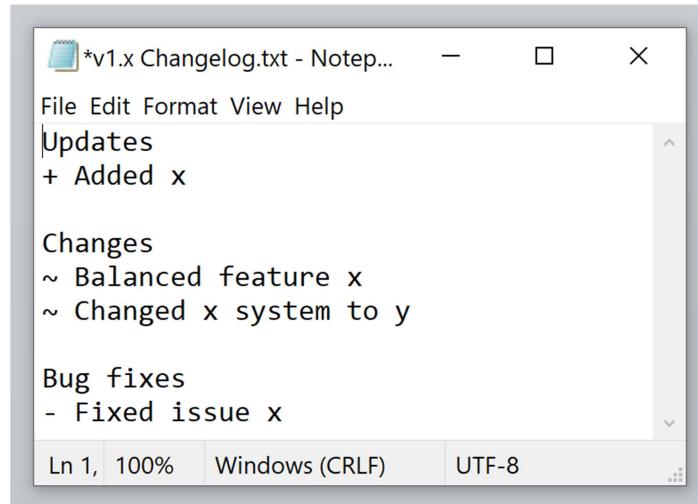
I will create a table in this document summarise all the changelogs that can be found in a changelog.txt file in the files for that version.

Changelog format

File title: v1.x Changelog

File format: I will use .txt as the file format as it is a universal way to save text that can be read by any computer without the need for installing a word processor

File Contents:



*v1.x Changelog.txt - Notep... — □ X

File Edit Format View Help

Updates
+ Added x

Changes
~ Balanced feature x
~ Changed x system to y

Bug fixes
- Fixed issue x

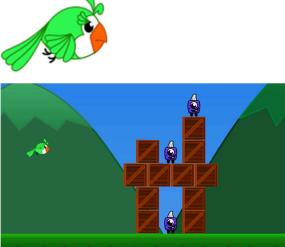
Ln 1, 100% Windows (CRLF) UTF-8

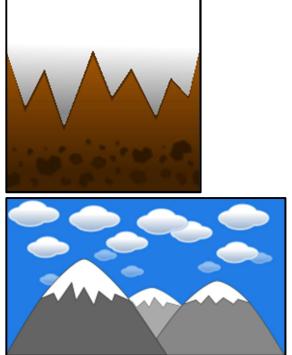
```
*v1.x Changelog.txt
Updates
+ Added x

Changes
~ Balanced feature x
~ Changed x system to y

Bug fixes
- Fixed issue x
```

Changelogs Summary.

Version	Picture(s)	Changelog			Comments
		Updates	Changes	Bug fixes	
1.0		N/A	N/A	N/A	
1.1		<ul style="list-style-type: none">Added a heavier green bird	<ul style="list-style-type: none">Changed red bird in level 3 to the new green bird	<ul style="list-style-type: none">Fixed issue where a bird would reset to the start position without colliding with anything	

1.2		<ul style="list-style-type: none"> • Boxes can now be broken • Level 4 to show off the new box breaking system 	<ul style="list-style-type: none"> • Balanced weight and initial velocity of green bird 	none	Green bird's weight used to break through all boxes with almost no effort, changed so that it is less overpowered
1.3		<ul style="list-style-type: none"> • Changed various settings so that the game can be built to run on android devices 	none	none	The app will now run on any touchscreen or mouse controlled android device, I will not be building the app to run on IOS as I do not have a device to test on.
1.4		<ul style="list-style-type: none"> • Added a long, thin crate • Level 5 to demonstrate the new crate 	<ul style="list-style-type: none"> • Crate particles disappear faster • Crates and Monsters can break/die from colliding with other objects or the ground at a high speed 	<ul style="list-style-type: none"> • Disabled portrait mode as the game is intended to be played in landscape 	
1.5		<ul style="list-style-type: none"> • Added Main Menu • Added Splash Screen • Added UI to display the current level name 	none	none	The logo and title designs are from https://www.logomaker.com/ and https://cooltext.com/
1.6		<ul style="list-style-type: none"> • Created new winter themed ground and background 	<ul style="list-style-type: none"> • Created new winter themed ground and background • Changed app icon to the red bird from the default unity logo 	none	I edited the summer assets using paint.net to replace the grass with snow and rock. I also added more clouds to the winter background.

Aim 3 - Gather & collate opinions on the game.

Comments

In order to catch any bugs (problems) in games external testing is used in combination with testing from the developers to make sure that less obvious bugs are found, this external testing also help balance the gameplay so that the difficulty is hard enough to be fun but not frustrating. On top of this, it also allows the target audience to give their opinions on what they would like to see in the finished game or next version.

I will be doing my own external testing by asking people in my school (my target audience) to play the game on my phone as it is not on the Google Play Store and not everyone has a compatible android device. I will then ask the testers to fill in a questionnaire on Google Forms to gather their opinions on the game, and what they would most like to see included in a fully developed version.

Questionnaire

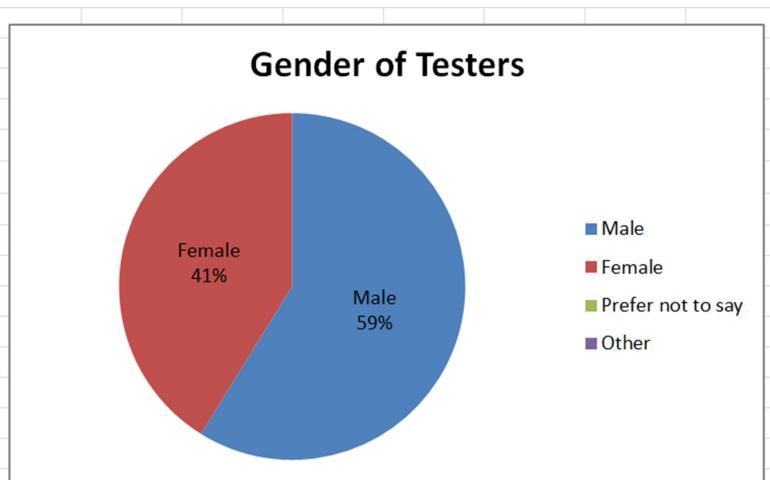
I have broken up the questionnaire into two sections. The first will gather information on the tester including their age group, gender, whether they currently own a smartphone, and roughly how many games they have installed (if applicable). The second will ask for their opinions on aspects of the game, and what they would like to see in the game.

Results

I will be analysing these results by exporting the numerical results excel and by creating tables of the text results here.

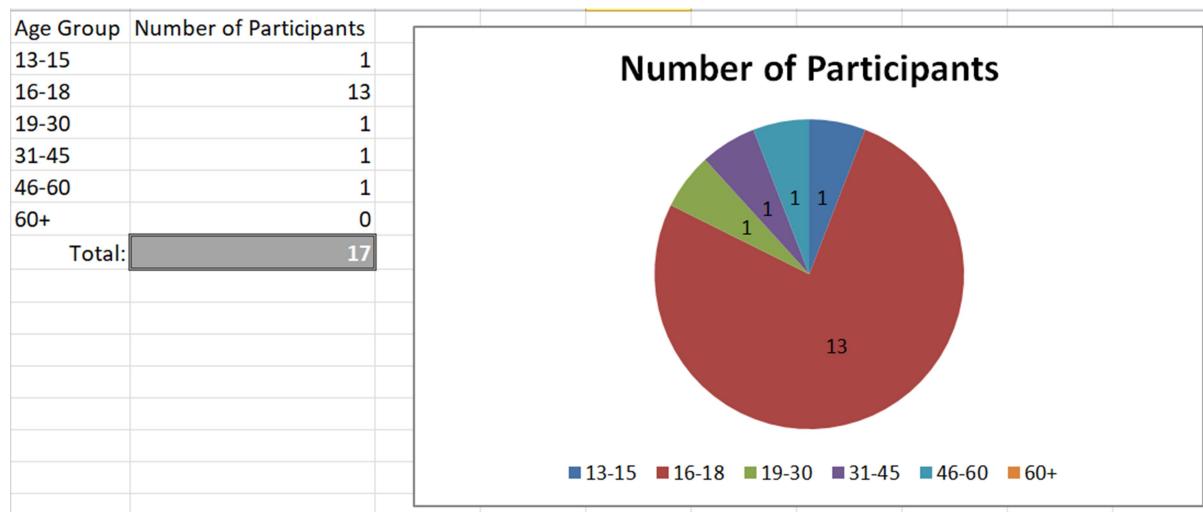
Gender

Gender	Number of Testers
Male	10
Female	7
Prefer not to say	0
Other	0
Total:	17



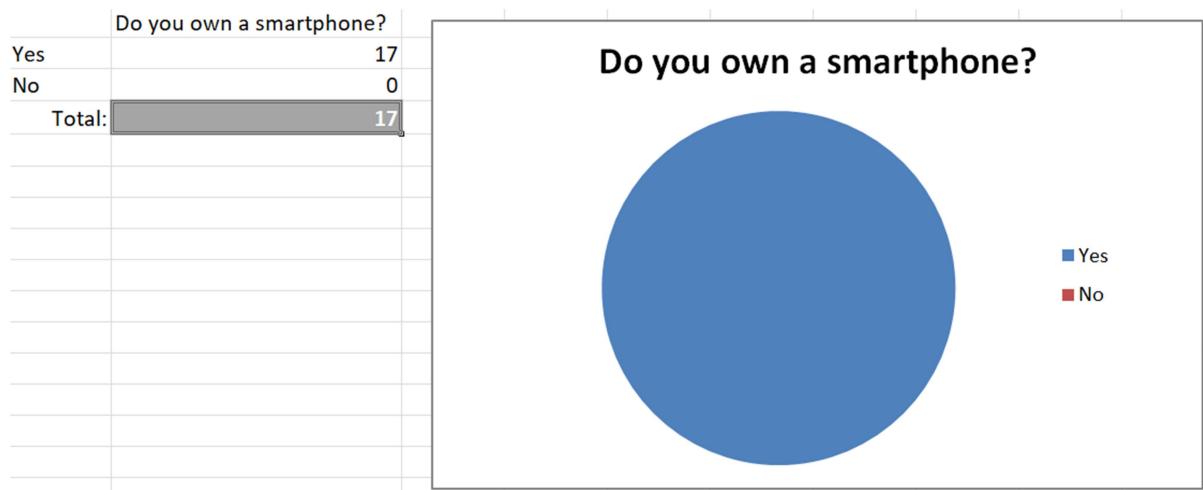
For this question, I have decided to use a pie chart as it is a good way to show how a population is split, in this case the gender of the testers. This chart shows that 41% of testers were female and 59% were male, a slightly higher number of either gender is normal in a questionnaire of this size as the participants had been chosen randomly.

Age



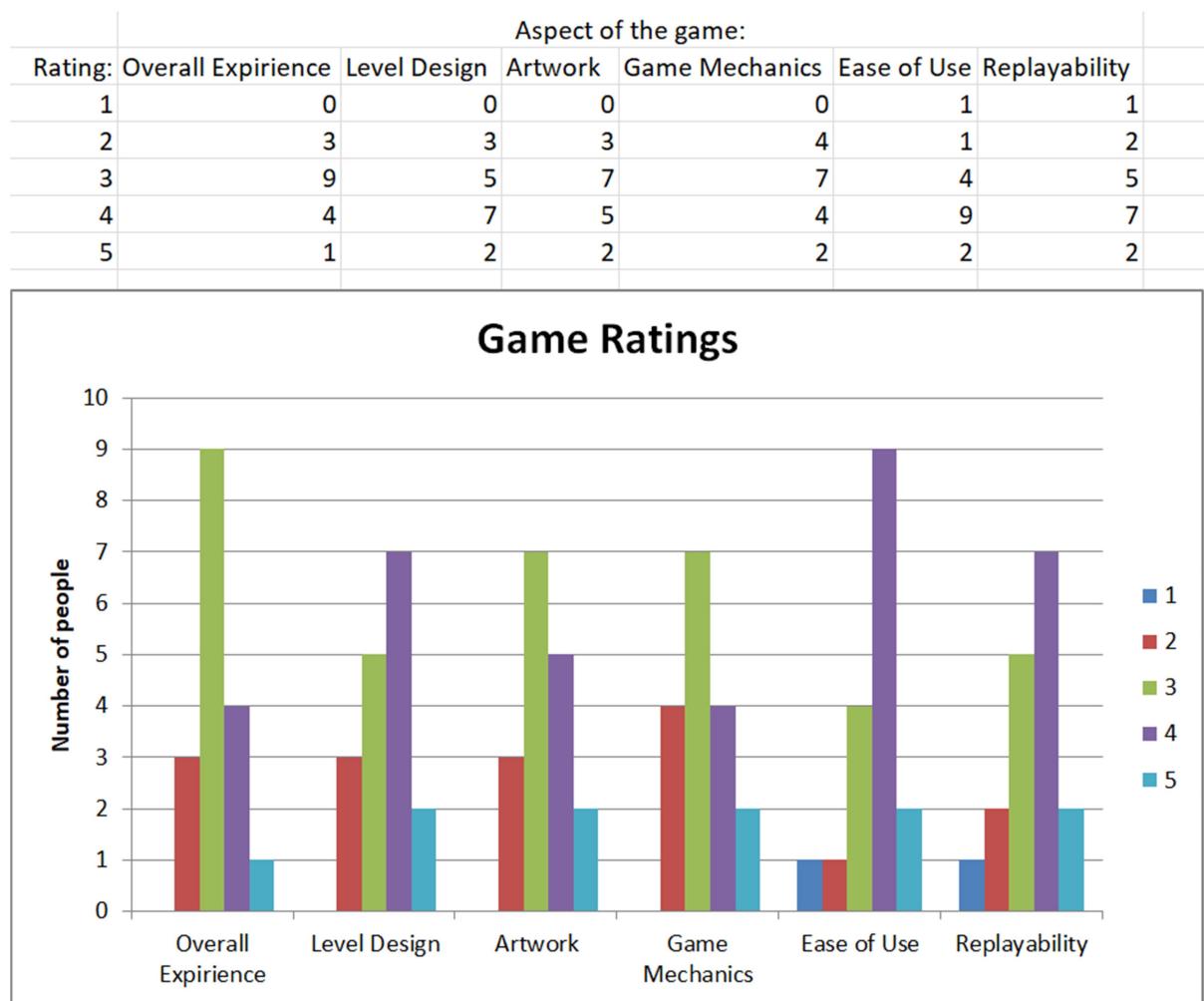
For this question, I have decided to use a pie chart as it is a good way to show how a population is split, in this case the age group of the testers. This chart shows that most of testers were between 16 and 18 with a few from other age groups. This is due to the limited number of people that I can see in person so that they can test the game, most of the testers are people in the 6th form from my school which all come under the same group.

Smartphone Ownership



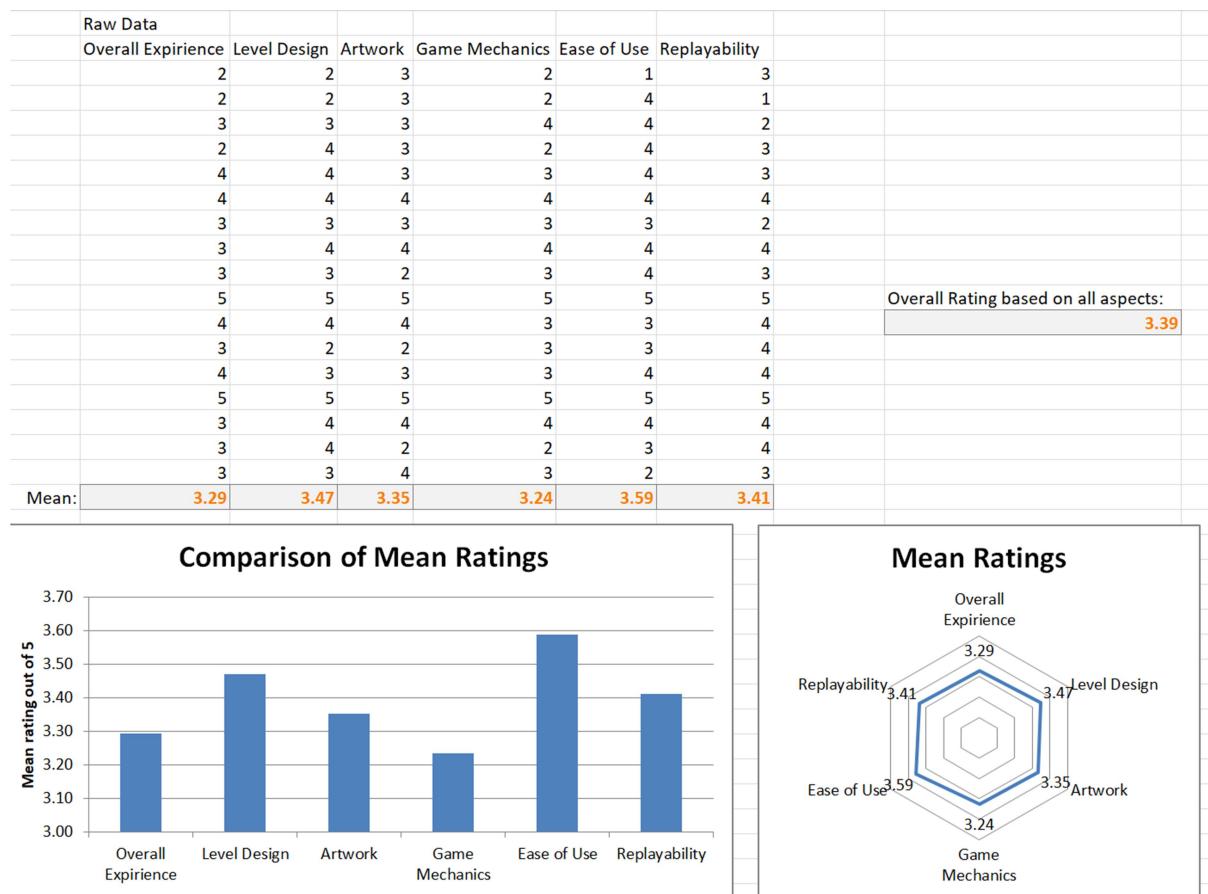
For this question, I have decided to use a pie chart as it is a good way to show how a population is split, in this case whether or not the tester owns a smartphone. In reflection this question is irrelevant as I don't know anyone who could have tested the game that does not have a smartphone.

Ratings



This part of the questionnaire is probably the most important as it shows how good people thought various aspects of the game were which will allow me to decide which aspects are in more need of improvement than others for example most people seem to have rated game mechanics lower than ease of use. To better demonstrate this data I will work out the mean rating for each aspect.

Mean Rating

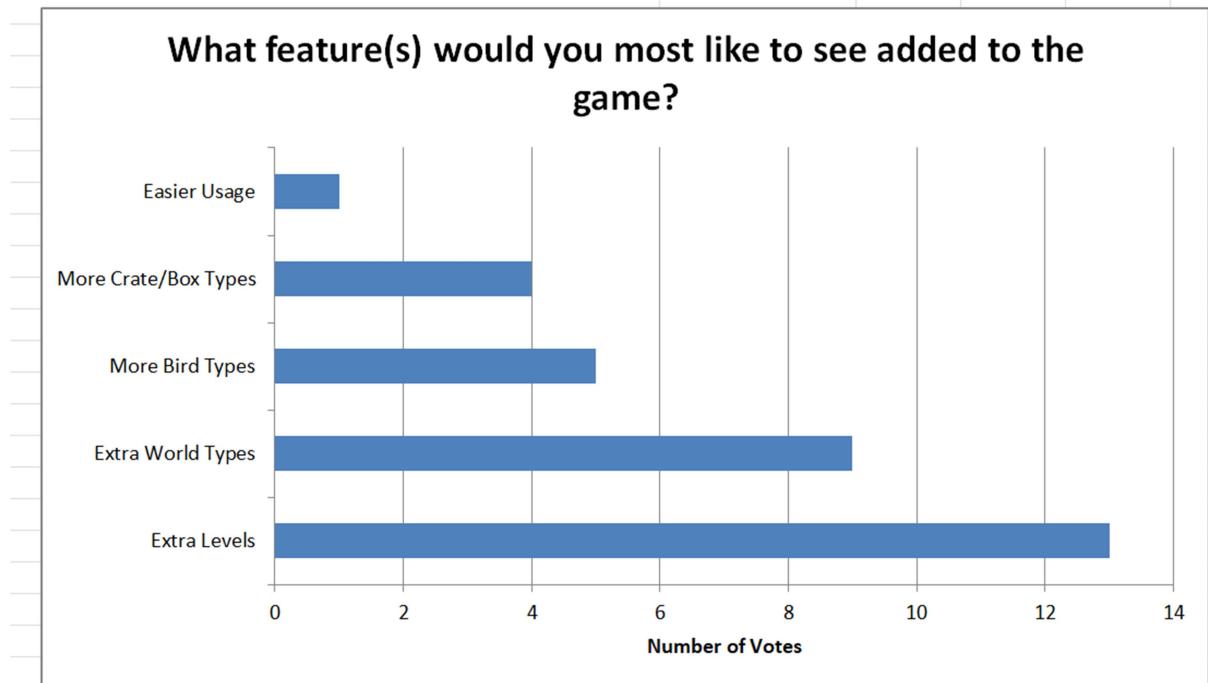


I have used two different charts to show this data, the radar chart on the right helps show that all the aspects of the game are actually average out to be roughly the same whereas the column chart on the right gives more insight as to how the mean of each aspect is different. From this data, we can see that mean rating for game mechanics is the lowest and ease of use is the highest.

Using these two charts, I can see that no aspects are in much need of improving compared to the rest although I will keep in mind that game mechanics and overall experience are rated the lowest.

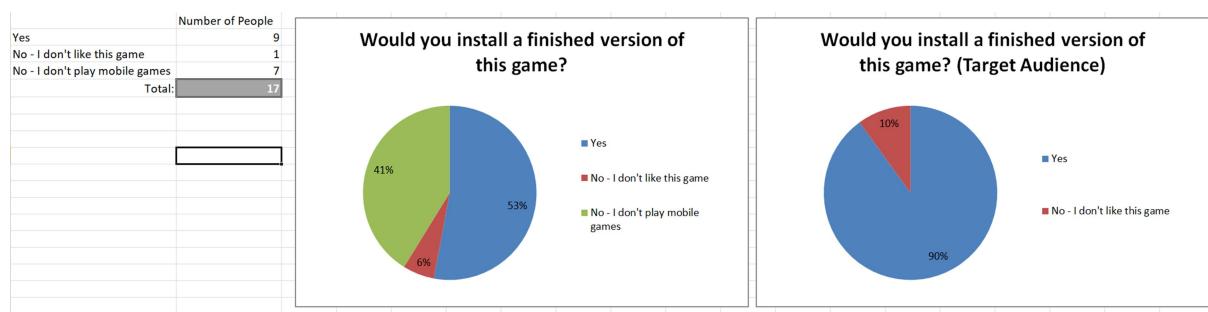
Features

What feature(s) would you most like to see added to the game?	Number of people
Extra Levels	13
Extra World Types	9
More Bird Types	5
More Crate/Box Types	4
Easier Usage	1



In this question I have asked people to vote for the features they would most like to see, using this information you can see that the most requested feature is extra levels. Following extra levels there are also a lot of votes for extra world types. This will help me come to a conclusion on what should be prioritised as the next thing to be worked on for another update.

Installing



This question's aim is to find out how many people would install the finished version of the game. The results to this question shows that of all tester 53% would, and that 90% of testers in the target audience would.

Likes and Dislikes

As this question in the questionnaire had a written response I will be compiling some of the replies here. This will help give insights into what exactly people like and dislike about the game rather than just a numerical ratings.

Like or Dislike	Summary of comment	Occurrences	Notes
Like	The background	1	
Like	Fun	1	
Like	Simplicity / ease of use	4	
Like	Addictive	1	
Dislike	Difficult to use / Frustrating	2	Comment is likely due to a bug where some people find it difficult to drag the bird
Dislike	Not enough levels	1	
Dislike	Graphics don't match	1	
Dislike	Repetitive	1	

Development Plan

Taking into account the information gathered by the questionnaire, I will now create a plan for development.

Key

Red = required before release

Orange = recommended before full release

Yellow = optional / post release

Green = post release

Priority	Feature / Change	Comments
Highest	Fix bug with touchscreen	Makes the game almost unplayable of a small number of people
	More levels	At least 100 levels
	Better UI w/ score system to encourage using less birds	Makes the game less repetitive and requires the player to find the fastest most efficient way to clear the level
	More crate types	
	More bird types	Would be useful on other level types with harder / different crates
	More level themes	Will make levels look different, aesthetic only but makes the visuals better
	New logo with higher resolution	Current logo is extremely low resolution, needs to be fixed

	New icons for in more resolutions to resolve problem with icons across different devices	Bug on some android devices which require different resolution of icons
	Improved graphics	Particles from crates are basic and ugly
Lowest	Menu redesign	Menu only has a start button; a level selector could be useful.
Post-Release	Sandbox Mode	Allows players to create and share their own levels, would have to be post release as it is such a huge feature that would be difficult to code.
	Reverse Mode	Allows players to design a level for an AI to beat. Same problem as above.
	Multiplayer Mode	Players design and then defeat each others level designs, the winner is the one who beats the other's level first.
	Tournament Mode	Same as above but the loser is eliminated from the tournament.
	Player Rankings	Use multiplayer games to influence a ranking system for players.

Section 1:

Bird Game Questionnaire

Please fill in this questionnaire after testing the game.

* Required

Are you... *

- Male
- Female
- Prefer not to say
- Other: _____

What age group are you in? *

- 13 - 15
- 16 - 18
- 19 - 30
- 30 - 45
- 46 - 60
- 60+

Do you own a smartphone? *

- Yes
- No

Roughly how many games do you have installed on your phone? *

- 0 - 10
- 10 - 25
- 25 - 50
- 50+
- Not applicable

[Next](#)

Section 2:

Bird Game Questionnaire

* Required

Bird Game - Feedback

Please rate the following parts of the game: *

1 - Poor 2 3 - Average 4 5 - Excellent

Overall Experience	<input type="radio"/>				
Level Design	<input type="radio"/>				
Artwork	<input type="radio"/>				
Game Mechanics	<input type="radio"/>				
Ease of use	<input type="radio"/>				
Replayability	<input type="radio"/>				

What did you like about this game?

Your answer

What did you dislike about this game?

Your answer

What feature(s) would you most like to see added to the game?

- Extra Levels
- Extra World Types (currently summer and winter)
- More Bird Types
- More Crate/Block Types (currently only wood type)
- Other: _____

Would you install a finished version of this game on your phone? *

- Yes
- No - I don't like this game.
- No - I don't play mobile games
- Other: _____

Do you have any other comments about the game?

Your answer

[Back](#)

[Submit](#)

Conclusion

To conclude on the project I will be looking back at each stage of the process of making a prototype mobile game. Looking back at my first aim, which was to learn and make a basic framework for the game, I believe that I have completed all of the objectives that I had set out for myself. I completed these objectives by following a great beginner tutorial on making games in unity, this source was exactly what I had aimed to find and went through all of the programming and design aspects thoroughly.

In the second aim, I used the skills that I had learned to improve the basic game I had made from the tutorials. By the end of the aim, I had taken the game to a point where it could be tested and reviewed externally in aim 3. In the process of developing this game, I added more levels, another bird type, a new winter themed level type, a menu screen, and a user interface. I also improved the boxes so that the bird could break them. In the course of developing the game, I also made it compatible with android devices so that it would work outside of the development environment on my computer. Although the game would still need a lot of development to reach a fully released version, I think that I have improved it to a state where I or another person could continue development by using my plan outlined in aim 3.

In the third aim of the project, I conducted a questionnaire to find others opinions on the game, this also served as a pre-release testing phase that most games would go through before release and helped me find a serious bug in the game. The analysis of the data gathered by the questionnaire has also helped me create a plan for how the game could be further developed to create a fully released version.

Taking all of these individual conclusions on each aim into account, I believe that this project was a success as I have learned the basics of how to make games and have made my own prototype game using the skills that I have learned.

Self-Evaluation

Literacy

By documenting the process of completing this individual research project, I believe that I have significantly improved my writing skills as I have had to write about every aim I hoped to complete, a full development log tracking what I was doing. At the start of the project I had also found it difficult to concentrate on the project without being distracted, I have found that listening to music significantly reduces the risk of being distracted. This has allowed me to get large amounts of the project done in a much faster time than I normally would have while retaining the same quality.

Numeracy

In the project I have had to use many numeracy skills while programming and analysing the results of my questionnaire, this has helped me to improve my numeracy skills. I have also learned how to use excel more effectively to create useful diagrams. If I were to do this project, again though I would learn how use more advanced charts and diagrams to analyse my questionnaire data.



Example of a sheet from my excel document. Full document should be included with this document.

Digital Literacy

Out of all of the skills I have had to improve in the project I would say that my digital literacy has improved the most as I have learned how to use Unity to make games, the basics how to code in a new programming language (C#), how to create better forms in Google forms. I have also learned more about how to use Excel to create charts.

Below is a level controller script written in C#, all the other scripts can be found in the unity project files included with this document.

```
using System;
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class LevelController : MonoBehaviour
{
    Monster[] _monsters;

    [SerializeField] string nextLevelName;

    void OnEnable()
    {
        _monsters = FindObjectsOfType<Monster>();
    }

    // Update is called once per frame
    void Update()
    {
        if (MonstersAreAllDead())
        {
            GoToNextLevel();
        }
    }

    bool MonstersAreAllDead()
    {
        foreach (var monster in _monsters)
        {
            if (monster.gameObject.activeSelf)
                return false;
        }

        return true;
    }

    void GoToNextLevel()
    {
        Debug.Log("Go to level " + nextLevelName);
        SceneManager.LoadScene(nextLevelName);
    }
}
```

Critical Thinking and Problem Solving

One of the most critical skills to write effective code is to be able to think critically and solve problems as they arise, this is because the slightest mistake can cause large sections of code to stop working or introduce a bug which requires it to be found and removed or fixed. Programming also requires a lot of critical thinking as it is possible to get the same outcome from different code, finding the fastest, and clearest code requires the code to be written clearly and efficiently.

Creativity and Innovation

As this project was an artefact one, I have created a game, which has required a lot of creativity and innovation. My development of the basic game has required me to come up with, implement new features, and create new assets. Although this game is admittedly not very innovative as it is similar to angry birds, I have managed to make a game, which looks different. To create a new theme based on the one featured in the tutorial I flowed I used Paint.net to edit the environment assets to be in a winter theme. A video of me playing through the game on my computer using an android emulator can be found included with this document.

Planning and Organisation

I believe that this project has helped me improve my planning skills as I have split my project into aims and objectives which has helped break down the project and allowed me to start working easier as it is less overwhelming. In the process of writing the code for the game I have learned to organise my code better and more consistently which makes it easier to read than my previous coding projects. This clarity in the code would help me with understanding it if I continue development, It would also help someone else understand what my code does if they were to use it, or develop it.

Personal Effectiveness

I have bettered my personal effectiveness throughout the course of this project. I have done this by bettering my concentration by listening to music, and by managing my time better by splitting up a large project into aims. By splitting my project into aims, I have found it easier to get started on working on the project rather than procrastinating. I have also been able to analyse my skills in this section on self-evaluation.