



# SOFTWARE PROJECTS

## GROUP 10

pixelRun

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## Introduction

pixelRun is an augmented reality web application intended for motivating individuals to commit to more exercise in the form of running. This app idea was developed due to articles related to the rapidly increasing rates of obesity in the UK—such as ones found in [bupa.com<sup>1</sup>](#)—and lack of commitment individuals have for exercise—as seen in articles found in [livestrong.com<sup>2</sup>](#)—which highlight these issues.

pixelRun, therefore, combines exercise and the exciting new technology of augmented reality. Augmented reality<sup>3</sup>—which may now be referred to as ‘AR’—is a modified interactive experience of the real-life world whereby the objects that are in the real world are enhanced by digital information. The design included the idea that when runners would take a break, instead of standing still they would be able to use this app to collect coins—which would be displayed using AR technology alongside physical objects such as trees and the ground—before returning to their run. After collecting a predetermined amount, the user would receive trophies. This is a tool of motivation used in many successful apps as its rewards users for their hard work. This point and reward system would be used to motivate our stakeholders to use our application more frequently.

The market research showed ages from 17 - 28, with the mode age being 23, were the most interested to try out our app and confirmed it would motivate them to run. This was especially due to the AR feature which makes our app unique to other competitors, such as ‘Pokémon Go’ or ‘Zombies, Run!’. Understanding our target demographic and competition in the fitness market helped evolve our application to meet the needs of our stakeholders.

This report will include the design and implementation of our application and a development record that will show how our team handled the development process. The quality assurance section will reveal all the testing that was carried out and any results from these tests, there will be a formative evaluation that shows the whole process of our application, it will show the evolution of our project, the many different sprints created and the challenges our team faced with as well as any solutions to those challenges.

The summative evaluation will provide an overview of the methods used and the results gained that finally concluded our project. Next steps is a section that will explain what the future of our project is and the next steps our team would take to create a functional and marketable application for our stakeholders. There will be a bibliography to list our sources and a user guide that will show a rundown on how to use our application. Finally, the appendices will contain any additional material.

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<sup>1</sup> Bupa.co.uk. (2019). *Obesity in adults / Health Information / Bupa UK*. [online] Available at: <https://www.bupa.co.uk/health-information/nutrition-diet/obesity-in-adults> [Accessed 18 Oct. 2019].

Bupa.co.uk. (2019). *Obesity in children / Health Information / Bupa UK*. [online] Available at: <https://www.bupa.co.uk/health-information/childrens-health/obesity-children> [Accessed 18 Oct. 2019].

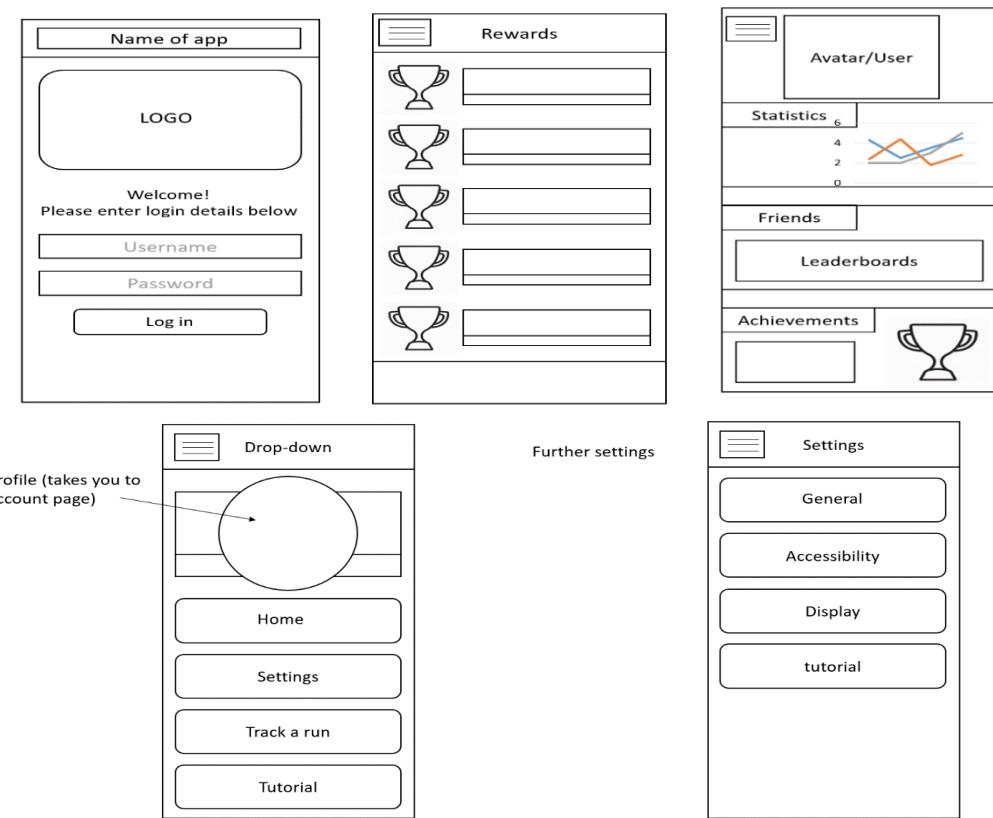
<sup>2</sup> LIVESTRONG.COM. (2019). *Ten Reasons People Do Not Exercise / Livestrong.com*. [online] Available at: <https://www.livestrong.com/article/370670-ten-reasons-people-do-not-exercise/> [Accessed 20 Oct. 2019].

<sup>3</sup> Contributor, J., 2020. *What Is Augmented Reality?* [online] livescience.com. Available at: <https://www.livescience.com/34843-augmented-reality.html> [Accessed 9 May 2020].

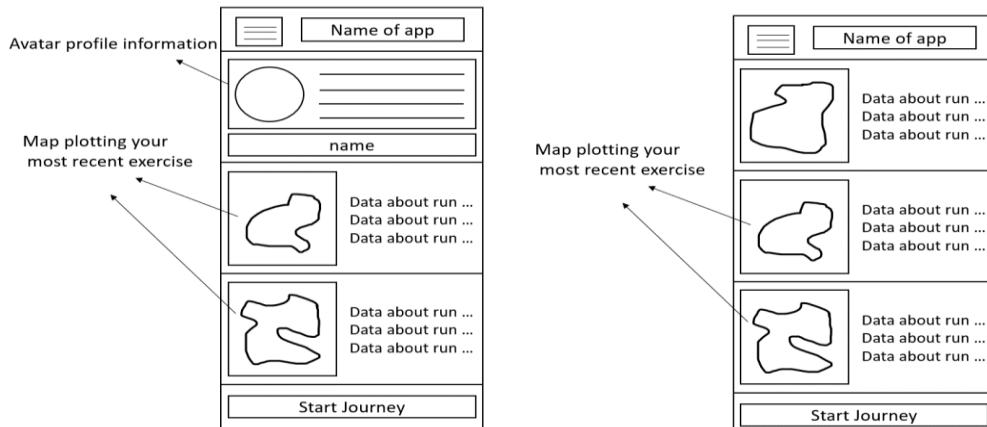
## Design and Implementation

When designing the product concept, development was not started immediately. A prototype was vital, and so interviews were conducted with stakeholders on their opinion on what they would want the overall design of the application to look like. Low-Fidelity Prototypes (LDP) and High-Fidelity Prototypes (HDP) were essential to determine the accuracy of what the target market required. This meant that they were necessary for narrowing down which design would make it on the final concept. Below are a series of pictures showing the low-fidelity designs for the various pages.

### Low fidelity Prototypes:



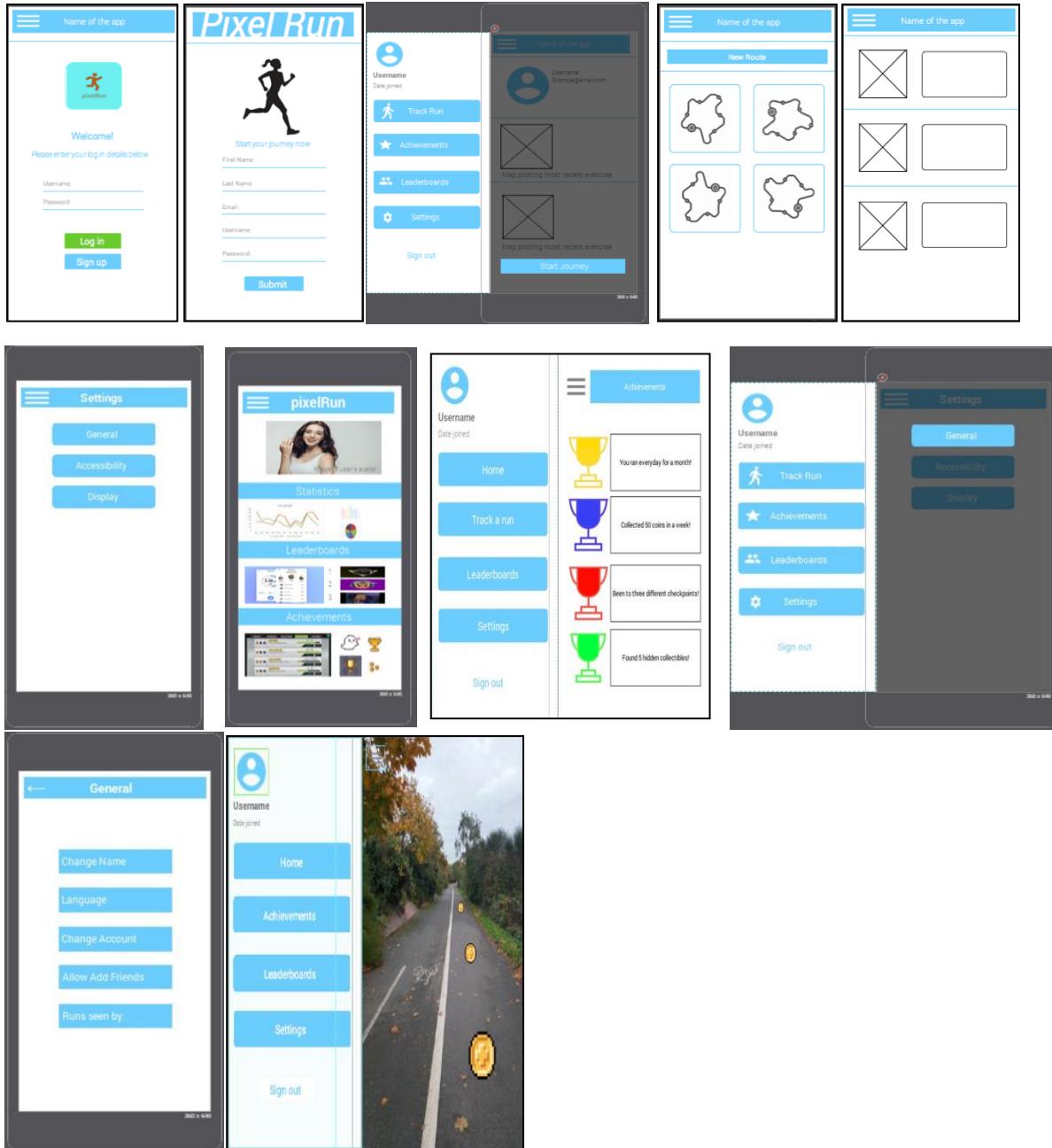
These Low Fidelity Prototypes were rough designs of what the final design implementation of the concept would look like in the early stages of its development. Once the team interviewed the stakeholders' questions such as, which colour themes they would prefer and other UI related questions, the high-fidelity prototypes were developed based on feedback. A good example would be the panel below:



This was provided to the stakeholder to see which colour scheme was most favourable. A wide selection was offered to get a clear overview of the colour scheme users were more drawn towards—warmer toned colours or colder toned ones—and which colour ultimately was the most popular. Each stakeholder was allowed 2 votes instead of just choosing one scheme, to allow for clearer evaluation. This was implemented especially due to most users being conflicted between 2 schemes, there was also the option of voting for the same scheme twice if it was the most attractive design to that stakeholder.

## High Fidelity Prototypes:

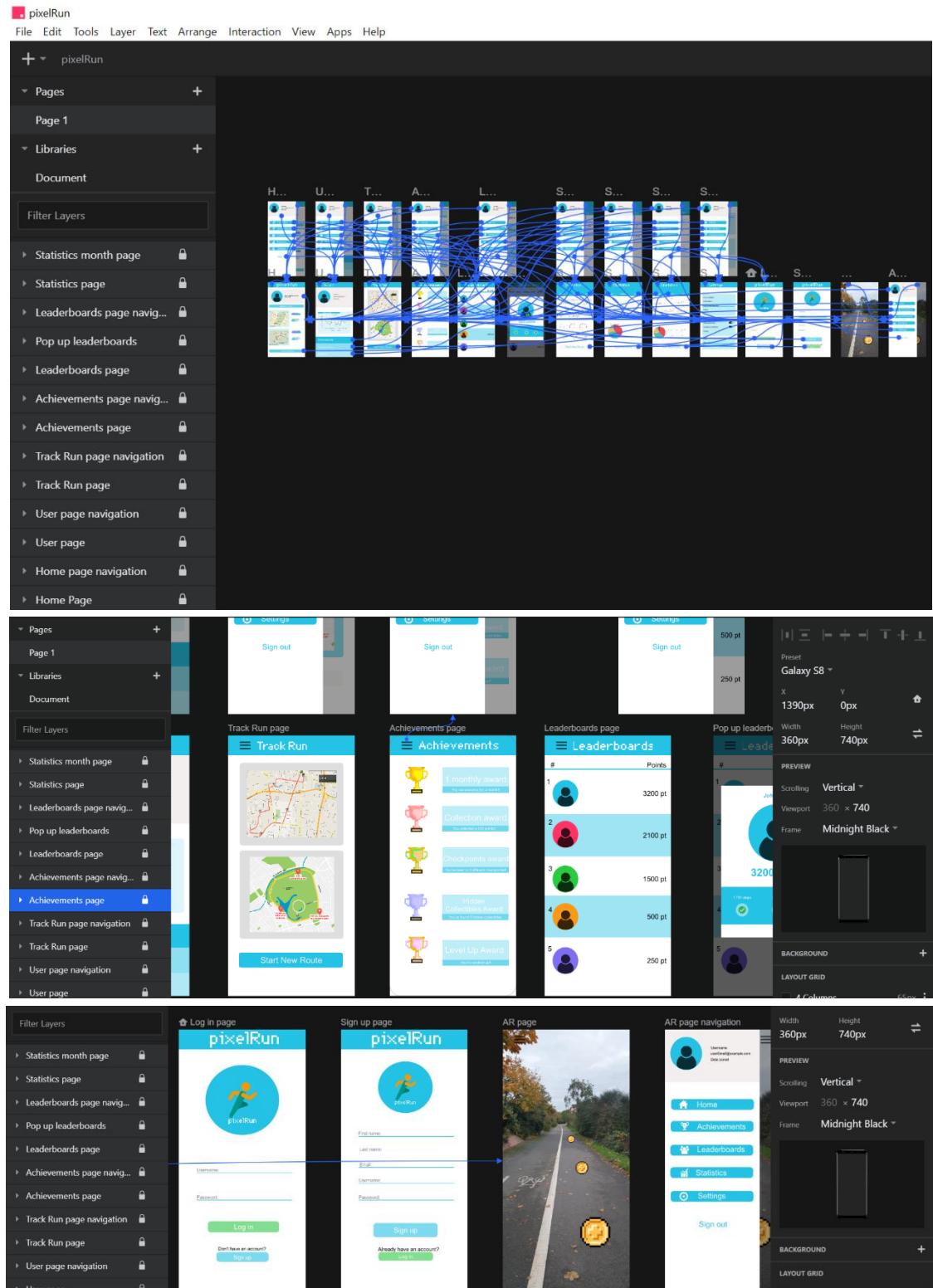
The high-fidelity prototypes were first created using JustInMind<sup>4</sup> which is a prototyping tool used to create high and low fidelity prototypes. Our team used this tool to create the high-fidelity prototypes shown below. These designs did not seem professional due to the system used, thus the team using the main colour schemes (identified with the low fidelity prototypes) and navigation system of this prototype- created a more refined version using another prototyping tool called InVision<sup>5</sup>.



<sup>4</sup> Justinmind.com. 2020. *Free Prototyping Tool For Web & Mobile Apps - Justinmind*. [online] Available at: <https://www.justinmind.com/> [Accessed 9 May 2020].

<sup>5</sup> InVision. 2020. *Invision | Digital Product Design, Workflow & Collaboration*. [online] Available at: <https://www.invisionapp.com/> [Accessed 9 May 2020].

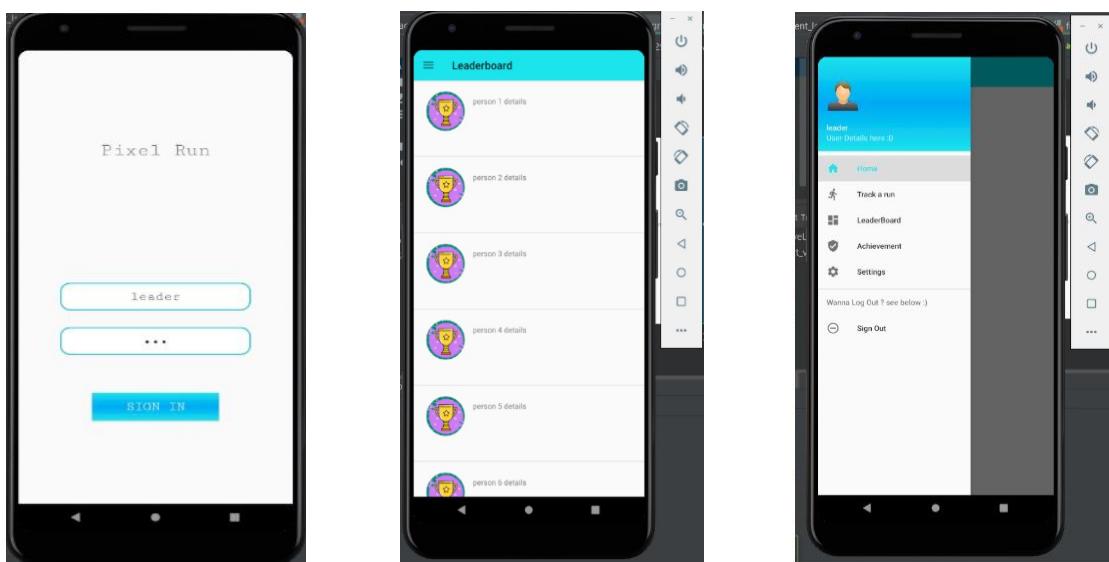
With InVision our team was able to see links between pages therefore, being able to create user-friendly navigation throughout the app prototype. There would be links to each page through the navigation bar moreover, the user would also be able to navigate to different pages using links embedded in photos or buttons. The whole application design using this tool looked cleaner, more professional, and stakeholders found the design more appealing and easier to understand.



Our team chose to create an android application because it would be coded in Java, this is a programming language that everyone in the team is familiar with as it is a language the team is learning in our computer science degree. This would allow the team to quickly recreate our high-fidelity prototype in android studio, creating a skeleton for the application that could be distributed to the team members and each team member would be able to individually add functionality to the application without running into the issue of the final application looking disjointed. It would also save time and be more efficient than learning a new programming language entirely. This was especially since Unity<sup>6</sup> was the platform decided on for the augmented reality aspect of the application, and it was a new platform for all team members.

This choice was made due to Unity being a well-known games development platform, especially for augmented reality. Therefore, it was known that there would be a wealth of resources online to provide help. Furthermore, Unity is programmed in C#, which is very similar to Java.

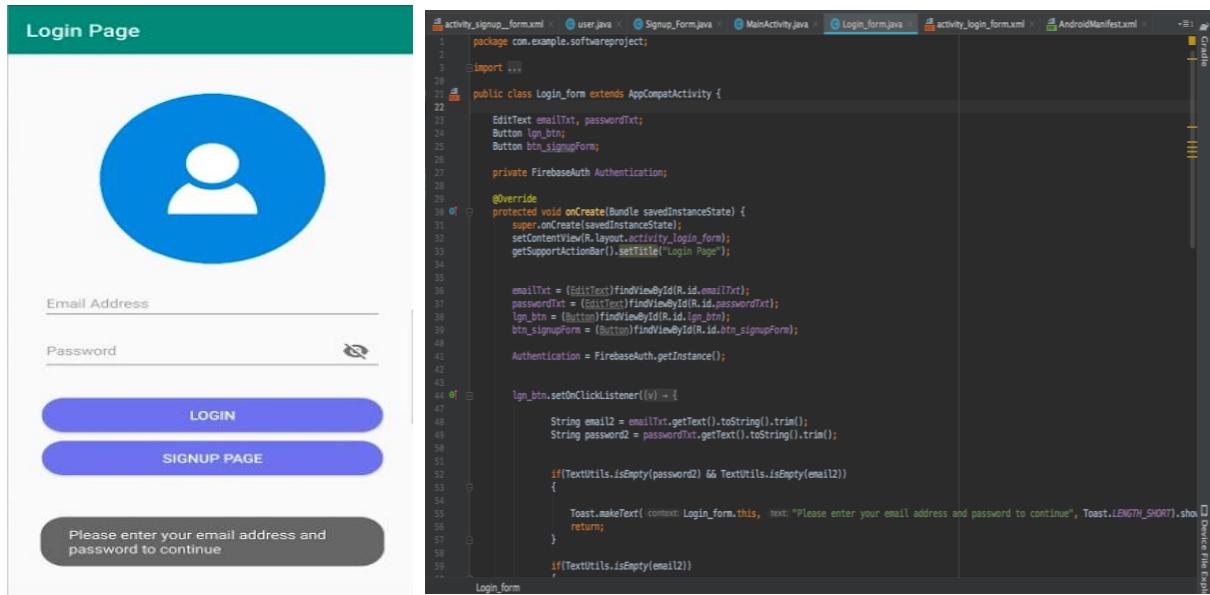
Below are the app skeleton and the design layout of the High Fidelity Prototypes that were followed.



Initially, it was decided that the UI part of the application would be completed using Java via Android Studio, with the login and registration pages being completed to function properly by the team. Firebase was used to provide security and validation. Firebase also provides a live database to store form data, so that functionality could be possible. Firebase is a platform for building mobile and web applications. Data is stored in the database in JSON format. The advantage of NoSQL databases such as Firebase is the scalability and the ability to handle large volumes of data. These were some of the key reasons for choosing Firebase as a database. Originally, the plan was to use MySQL however, it was later decided that a NoSQL database was more appropriate.

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<sup>6</sup> Concept Art Empire. 2020. *What Is Unity 3D & What Is It Used For?* [online] Available at: <https://conceptartempire.com/what-is-unity/> [Accessed 9 May 2020].



The idea of using 3D printed objects, that individuals could collect whilst on a run (meaning the figures would replace the original coin collectable shape) was experimented with. Users could scan a QR or bar code to then be able to collect the said object. This is an additional feature that was decided would be nice to potentially or would be a future step for our application, and the implementation of a NoSQL database allows for such expansion.

### Technology implemented:

The plan was to link the app from the android studio with the augmented reality feature using middleware, however, after many trials with trying to implement augmented reality in Unity and create a coin collection feature our team realised that it was not in our ability to, given the time restraint and our unfamiliarity with the engine and C#.

Therefore, there was a need to adjust our project accordingly. It was realised that augmented reality could also be achieved using different JavaScript libraries as opposed to using Unity and Java. Three.js and A-frame would handle the design of the coins as well as accessing the camera.

A-frame is a web framework for building virtual and augmented reality experiences and Three.js is a JavaScript library commonly used to create and display animated 3D computer graphics. However, the use of JavaScript meant the team had to divert from the idea of a mobile application available on the app store and develop a web application instead. JavaScript, HTML5 and CSS3 could be used in combination to create the website.

Users would still be able to see coins on the street through the phone; however, this would be through a website. Ionic framework, an open-source SDK, was experimented with to change this. This would make it possible to make an application using HTML5, CSS3 and JavaScript that can be downloaded instead of being on the web. Unfortunately, it was found that the augmented reality part would crash when the implementation of three.js was attempted. So, a web application was decided as the focus, rather than a mobile application.



Figure 1 Augmented reality with Three.js

Even though the initial plan was to develop a mobile application that can be downloaded from the app store, which can be seen from the low and high fidelity prototypes, it was ultimately decided that a web application would be designed, due to the aforementioned reasons and the team's adaptation to the issues faced. This means that the user can access the augmented feature of the website via a camera on their phones, however many of the design research would still be relevant to the new app. The following picture shows the page users are greeted with when visiting the web app.

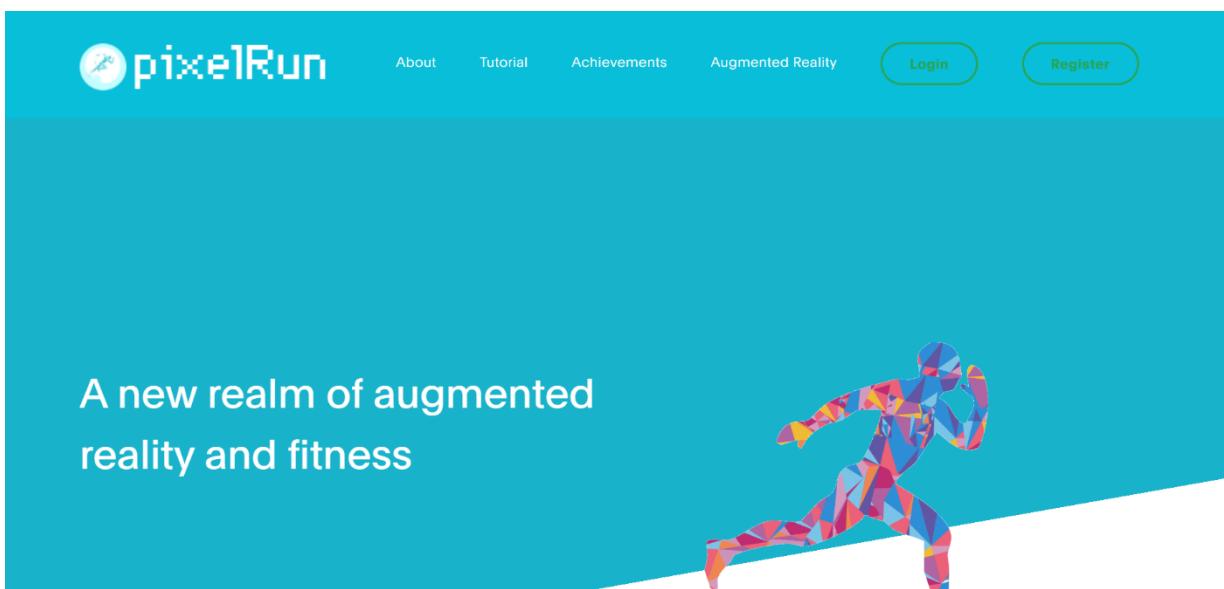


Figure 3 pixelRun web app home page

## Reflection:

Upon reflection, the choice of Unity was an educated choice. However, this was ultimately not in the team's favour. Unity is a great game developing platform. Nonetheless, the team had no prior experience with development on Unity and therefore, it was an ambitious task learning and then implementing augmented reality, especially being a fairly new technology, within the space of 8 weeks. The failure to acknowledge that our team could not simply learn how to use a complex game engine like Unity, as well as a new coding language C# was the downfall of using these tools and implementation techniques.

If it were possible to complete the implementation process again, the group would focus on developing the application using JavaScript with the assistance of libraries, from the beginning. Given the limited time available this would have been a more suitable approach as JavaScript, HTML5 and CSS3 is a familiar language to the whole team. The creation of a web application is a subject our team was also learning this year as part of our degree hence, it would have been a more practical option to start with this instead of something more ambitious, such as a whole new development platform.

## Development Record

### Group Meetings:

When developing the product concept, the team devised group meetings each week so that the group could come together and review each team member's progress. This ultimately facilitated to gaining feedback and cutting time on research as each team member was looking into their tasks that they were meant to be doing. Group meetings were organised and held every week and the time frame would be depending on the length of the task that was required to be completed. Many of the times more than one meeting were held a week, to be able to finalise research, organise the next tasks to complete, and complete the milestones in a concrete and clear fashion.

### Project management on Trello:

Each team members role was set up on this platform called Trello. Trello is a productivity and time management web application used in project management. It displays tasks that need to be completed and once finished, the task is checked off making it easier to see the broader aspect of the whole operation.

Our Trello is based on a list of functions created at the start of our project. This shows the family the function is in, the feature of that function, the level of complexity, its priority, its current state, the owner (meaning the person responsible for developing the feature) as well as the start and end date. This is a common technique to split up tasks into categories and have these labels, used in professional software development. Since it was the start of the project, the states were all set to design. The owners and the start and end dates are all empty, with the team going into more detail when our Trello page was created.

Family	Feature	Complexity	Priority	State	Owner	start Date	End Date	
3	Accessibility settings	Colour change for colour blindness, font change	1 P3	Design				P1 = Important P4 = not important
4	Achievements/Motivation	Rewards like point and badges for milestones reached (per 10 km a month), positive affirmation	3 P1	Design				
5	Security	For the first connection the user receives an email confirmation	2 P3	Design				
6	Display data	Visualizing data of the user and displaying it on the home screen	2 P1	Design				1 = not complex 4 = complex
7		Comparing it with others	4 P2	Design				
8		Share on social media	4 P4	Design				
9		A timer to show how long you've run	1 P1	Design				
10		Notification to drink water	2 P4	Design				
11		Use google maps to track runs	3 P1	Design				
12	General settings	Privacy, audio, location, units of measurements, bluetooth	2 P1	Design				
13		A tutorial for first time users on how to use the app, when this happens the tutorial will be available on settings	2 P2	Design				
14		QR code scanner	3 P1	Design				
15		Dark mode	2 P4	Design				
16	Interference	Make sure our app doesn't interfere with bluetooth device	P1	Design				
17		Our app should be able to run in conjunction with other apps	P1	Design				
18	Physical objects	Objects outside the AR app that are in real life	2 P2	Design				
19		3D objects	2 P2	Design				
20		QR codes stickers	2 P1	Design				
21	Additions	Walking feature	1 P4	Design				
22		Cycling feature	1 P4	Design				
23								

The image shows three Trello boards side-by-side:

- Doing:** Contains four cards:
  - Priority 1 (most important)** Haala: Use Unity for AR feature.
  - Priority 1 (most important)** Haala: Create the app using Java.
  - Priority 1 (most important)** Rubel: Implement the middleware.
  - Priority 1 (most important)** Haala: Use JavaScript for AR feature.
- ToDo:** Contains six cards:
  - Priority 1 (most important)** Use maps API to track runs.
  - Priority 1 (most important)** A timer to show how long you have run for.
  - Priority 1 (most important)** Test and make sure our app does not interfere with other apps such as music apps.
  - Priority 2** A tutor in settings on how to use the app for the 1st time.
  - Priority 2** QR code scanner (for physical statues).
  - Priority 2** 3D printed objects.
- Finished:** Contains four cards:
  - Priority 1 (most important)** Simas: Create an ERD for the MySQL database.
  - Priority 1 (most important)** Simas: Implement the MySQL Database.
  - Priority 2** Rubel, Simas: Learn how to use/implement firebase.
  - Priority 2** Rubel, Simas: Users can make an account.

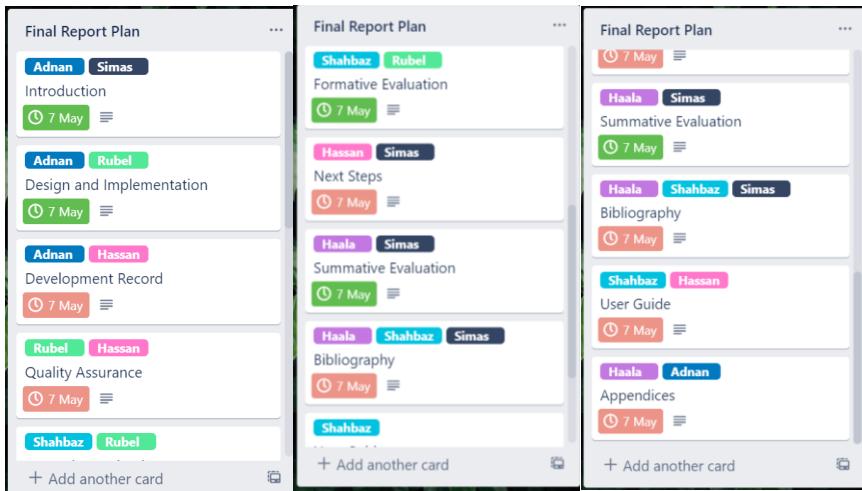
As you can see above, our team moved the information created at the start of the project with some modification to then use in our Trello. With this, our team assigned members with tasks. The above Trello screenshots show the state of our application before the team decided to move from Unity and Java to HTML5, CSS3 and JavaScript libraries. Below show changes to our Trello.

The image shows two Trello boards side-by-side:

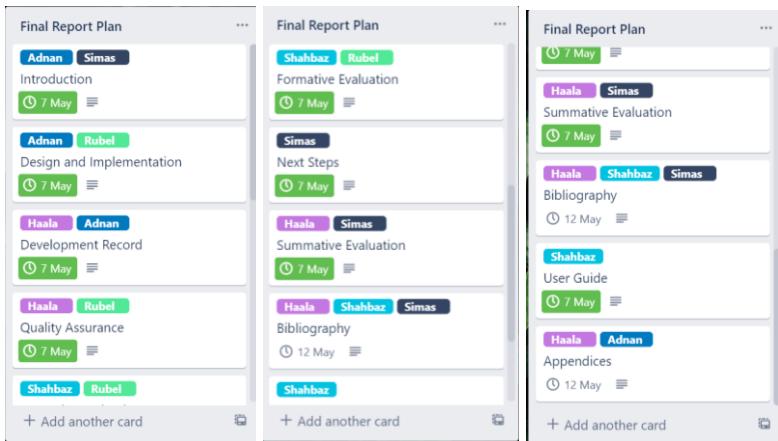
- Doing:** Contains four cards:
  - Priority 1 (most important)** Haala: Create a web app using HTML5, CSS3 and JavaScript.
  - Priority 1 (most important)** Haala: Create a tutorial for the AR.
  - Priority 1 (most important)** Haala, Adnan, Shahbaz, Rubel, Hassan, Simas: Use JavaScript for AR feature.
  - Function removed**: Use Unity for AR feature.
- ToDo:** Contains five cards:
  - Function removed**: Create the app using Java.
  - Function removed**: Implement the middleware.
  - Function removed**: 3D printed objects.
  - Function removed**: QR code scanner (for physical statues).
  - Function removed**: A timer to show how long you have run for.

As you can see, the priorities for our project has changed. Since our team decided to move away from Unity and Java and towards JavaScript, HTML5 and CSS3, this change is mirrored in Trello.

Our team also planned the writing of this report on Trello. Below is our original plan for this report.



However, due to an uncooperative member of the team whom our group has not been able to get a hold of, our team had to change the assignments of the different paragraphs on the report. This can be seen below.



Trello is a tool that our team consistently used throughout our development process. It has helped greatly in dividing work evenly and assigning deadlines for when the task should be complete. Since our team has had a lot of changes in the technology used throughout the development process, it was extremely helpful to have Trello to clearly show the tasks needing to be completed, tasks currently in process and finished tasks.

Each member of the team was assigned tasks that they were most confident with, a team member would be assigned during the “doing” stage of each feature. In our current Kanban, since no one in our team had any experience in creating augmented reality with JavaScript it important this would be completed and implemented, so every team member was assigned to this task. One team member was responsible for creating the web app design as well as producing a tutorial for the augmented reality feature. A tutorial was something our stakeholders asked for consistently throughout our whole project.

In our old Kanban where our team were creating an android application, “Simas” had the role of creating a MySQL database as well as creating the ERD for the database. This member alongside “Rubel” knew the most about databases in our group, therefore, is assigned this task. “Rubel” and

“Simas” had the task of implementing the firebase as well as creating a working register and login page in our first sprint. Both of these tasks were completed.

## Quality Assurance

### Unit testing for the early sprints:

Unit testing is a software testing method by which individual units of source code are tested to determine whether they are fit for use<sup>7</sup>. During the development process of the app, unit testing was conducted as part of the quality assurance process. For instance, during the development of the login and registration page on android studio, the team conducted unit testing by separating the code into functions and methods.

In terms of the java login page, one section included code to initialise the variables so that they reference the text boxes and login button from the login page of the app. This section was also responsible for loading the correct login XML form upon creation. Another section consisted of an ‘OnClickListener’, which allows you to determine the action taken when the specified button is pressed. A series of ‘IF’ statements are located within the body of this ‘OnClickListener’ to return feedback messages if the form is not correctly completed. The individual ‘IF’ statements were tested to ensure they also function independently. The final section involved code from Firebase to allow existing users to login. Testing these units separately allowed us to ensure each section conformed to the purpose and function it was intended to produce.

```
public class Login_form extends AppCompatActivity {

    EditText emailTxt, passwordTxt;
    Button lgn_btn;
    Button btn_signupForm;

    private FirebaseAuth Authentication;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_login_form);
        getActionBar().setTitle("Login Page");

        emailTxt = (EditText)findViewById(R.id.emailTxt);
        passwordTxt = (EditText)findViewById(R.id.passwordTxt);
        lgn_btn = (Button)findViewById(R.id.lgn_btn);
        btn_signupForm = (Button)findViewById(R.id.btn_signupForm);

        Authentication = FirebaseAuth.getInstance();
    }

    lgn_btn.setOnClickListener((v) -> {
        String email2 = emailTxt.getText().toString().trim();
        String password2 = passwordTxt.getText().toString().trim();

        if(TextUtils.isEmpty(password2) && TextUtils.isEmpty(email2))
        {
            if(TextUtils.isEmpty(email2))
            {
                Toast.makeText(context: Login_form.this, text: "Please enter your email address", Toast.LENGTH_SHORT).show();
                return;
            }

            if(TextUtils.isEmpty(password2))
            {
                Toast.makeText(context: Login_form.this, text: "Please enter your password", Toast.LENGTH_SHORT).show();
                return;
            }
        }
    });

    //Code from Firebase to allow existing users to login
    Authentication.signInWithEmailAndPassword(email2, password2)
        .addOnCompleteListener( activity: Login_form.this, (task) -> {
            if (task.isSuccessful())
            {
                startActivity(new Intent(getApplicationContext(), MainActivity.class));
            }
            else {
                Toast.makeText(context: Login_form.this, text: "password or email is incorrect", Toast.LENGTH_SHORT).show();
            }
        });
}
```

<sup>7</sup> Software Testing Fundamentals. 2020. *Unit Testing - Software Testing Fundamentals*. [online] Available at: <http://softwaretestingfundamentals.com/unit-testing/> [Accessed 10 May 2020].

Unit testing helped with the process of debugging the code. At one point, the team faced an issue with the registration page which did not appear when the button was pressed to direct the user to the register page. Unit testing allowed us to divide the code into units and isolate the issues.

By testing small sections of the code for functionality, the issue was efficiently found and amended. It turns out that the problem was caused by incorrect syntax. It would have been far more difficult to fix the problem if our team tried to find the issues while observing the code holistically.

#### **Unit testing for the final product:**

Unit testing for the web application was done in relatively the same manner. Since our web application was created in the last stretch of our project, our team used a template for the design of the application<sup>8</sup>. With this, the unit testing was about understanding each part of the CSS and HTML and using the design to create a tutorial page, an achievements page, an augmented reality page as well as a login and registration page.

For the web application, our team separated the pages as well as the code on the pages. Our team tested out small sections of code for each page to understand what it did. After this, our team needed to add JavaScript code for the index.js file which would handle the running of Node.js in our server.

An issue our team had was when our first web app sprint was uploaded to the server the CSS and JavaScript files that handled the design was not showing. Our team knew the issue was with the index.js file but did not know what section. Due to this our team took parts of the code in the index.js file and ran each part separately.

The team finally had a breakthrough when it was realised that the index.js file was not connected to the CSS and JavaScript files. Since in our data and the web course taught our team about web servers and the fact that the folders in our project needed to be connected to our index.js file so it shows on the web page, our team applied this knowledge as well as unit testing to figure out this issue and solve it.

After testing sections of code when any issue arises in our web application, our team then moved on to testing the component, which in this case is the whole page.

#### **Component testing for the early sprint:**

Component testing involves testing individual components separately without integrating with other components<sup>9</sup>. An example of this is the sign-up page that was created on the android studio. The java sign-up page was tested holistically to make sure that the sign-up process works independently to the other pages. It was important to test whether this page of the app allows users to create an account which in turn is stored within the database. It was found that this component worked along with the login component.

When creating the augmented reality section for our product using Unity, our team had a lot of small sprints where the component was tested. For example, our team created a sprint on Unity

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<sup>8</sup> templatemo. 2020. *Free Template 538 Digital Trend*. [online] Available at: <https://templatemo.com/tm-538-digital-trend/> [Accessed 11 May 2020].

<sup>9</sup> sathi, k., Books, S. and Sudha, S., 2020. *What Is Component Testing Or Module Testing (Learn With Examples)*. [online] Softwaretestinghelp.com. Available at: <https://www.softwaretestinghelp.com/what-is-component-testing-or-module-testing/> [Accessed 11 May 2020].

where augmented reality was able to be implemented and a coin showed on in the environment using the camera of the mobile.

This sprint, however, would crash after a few seconds. Our team implemented unit testing to find the problem however our lacking knowledge in C# made finding the solution to issue extremely hard. This is when our team moved on to JavaScript as our main technology for creating augmented reality meaning that our team did not manage to do a system testing for the earlier sprints.

### Component testing for the final product:

For the final web app, the individual web pages were tested separately to ensure the pages functioned correctly. For instance, when isolated, the AR page should direct the user to the AR aspect of the web app and the floating cubes should appear on the screen.

This component was tested on multiple laptops as our team had different brands of laptops. This helped to see if the augmented reality worked on different systems and devices. By doing this our team would reduce any future issues that would arise on different devices, the main reason our team decided to create a web application is because of its accessibility of different devices.

The tutorial page shows a tutorial of the concept of pixelRun. This was first tested with WebGL and Three.js. However, after the team tested this on different browsers our team found that WebGL was not available on the older version of Firefox, Opera, Safari and Chrome browsers<sup>10</sup>.

This component issue was solved by moving from WebGL and Three.js and going back to Unity to create this tutorial and link it to the tutorial web page.

This created a new component outside the web application. This component was tested on the Unity after each unit of the C# scripts was separately tested, the component was built on the PC. This will be linked to the tutorial web page where users will have a clearer idea of the pixelRun concept and understand how the coin collection, point and reward systems work.

### System testing for the final product:

When unit and component testing for products were completed our team finally had a full software to test<sup>11</sup>. Throughout this project, our team has changed our technology from trying to create an android mobile application using Unity and Java, to create a web application with HTML5, CSS3 and JavaScript libraries, as well as returning to Unity to create a tutorial game for users that can then be linked to the web application.

Due to these changes our team has only completed a system test with the web application. Two different web applications were tested on a system level. Each member of our team tested the first sprint of the web application on their laptops, this is due to the issue of the CSS and JavaScript scripts not being connected to the webserver. After, the system was fully tested on “localhost” by most of the team members and was shown to stakeholders for evaluation.

Our team interviewed our stakeholders using the “localhost” version of our web application for our first sprint. The results of these interviews helped in creating the second sprint for our web application which was also shown to our stakeholders on “localhost”. These stakeholders were

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<sup>10</sup> Caniuse.com. 2020. *Can I Use... Support Tables For HTML5, CSS3, Etc.* [online] Available at: <https://caniuse.com/#feat=webgl/> [Accessed 11 May 2020].

<sup>11</sup> Software Testing Fundamentals. 2020. *System Testing - Software Testing Fundamentals.* [online] Available at: <http://softwaretestingfundamentals.com/system-testing/> [Accessed 11 May 2020].

interviewed during Covid-19 lockdown so they were mostly friends and family, this bias should be considered by the reader when this is further discussed in the formative evaluation.

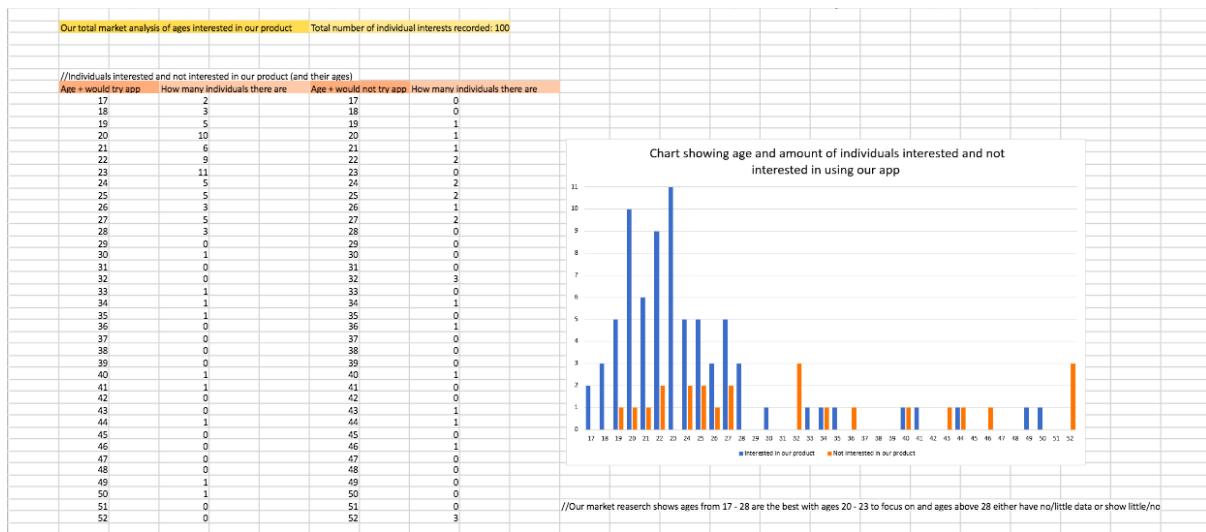
## Formative Evaluation

### Stakeholders:

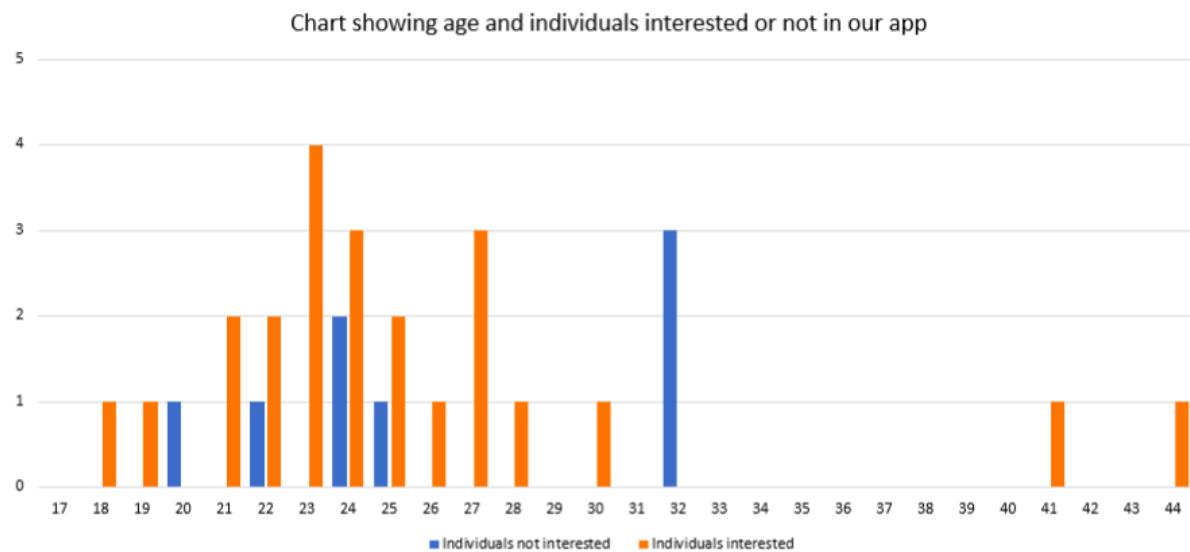
Throughout the development process of the project, a large amount of market research was conducted. When designing the low-fidelity prototypes, the team split into groups and conducting the interviews. In total, 100 participants were involved, in sets of 10. After each set of interviews, the team met up, discussed the feedback, collated the data, and designed the next set of questions accordingly. The interviews consisted of a variety of people from Goldsmiths university, including students and staff, to ensure that our team had a wide range of age groups. Some interviews also take place within gyms because it was initially assumed that people who care about their health may be more likely to be interested in our idea. It was important to include a substantial amount of open-ended questions to obtain as much feedback and information from the users as possible, rather than just 'yes' and 'no' responses. Below shows an image of the questions used for the first set of interviews.

- 1) How old are you?
- 2) Do you ever run? If yes, how long are the sessions? How many times a week?
- 3) Do you ever cycle? If yes, how long are the sessions? How many times a week?
- 4) (We explain what AR is) then ask if the individual would be interested in using this and why?
- 5) Show different pictures of the LFP sketches and make the participant choose the most interesting ones. Also ask sketch new ones if they have any ideas of a design they would like.
- 6) Show what looking through AR would be like and if that would be something they would be interested in?
- 7) Would they prefer glasses through the journey or the actual phone at 'pit stops'?
- 8) Would you be interested in different collectable items (like the coins, or keys...) and what type of collectibles?
- 9) Would different statues of the different objects be of interest to you?
- 3.5) Would you be interested in an app which is revolved around this?

Once all 100 interviews were completed the data was collated again. The feedback provided the team with valuable data and helped shape our high-fidelity designs. The interview answers were made into tally charts which were converted to a graph, this was much easier to understand and analyse. The user feedback led to a better understanding of the age groups that would be most interested in the concept. It was found that people in their early twenties were most likely to use the app. As age increases from 17 onwards, interest for the app increases up to a certain point. After you go past the early-twenties age point, interest dips and so it was established that our optimum age was young adults.



The software “inVision” was used to design the high-fidelity prototype. InVision allows you to create interactive mockups for wireframes and designs. Upon completion, the high-fidelity prototype trials began. 30 individuals were interviews in total. Individuals were presented with all the different pages of the prototype and asked open-ended questions. This time focus was more on the UI and included questions such as, what theme colours people preferred. The user’s opinion on the layout of the pages and opinions on features present were also asked about. A 3D printer was used to create a crown collectable object to show users along with the prototype on inVision. Similarly, to the low-fidelity interviews, the high-fidelity interviews provided the team with data on the age range of the desired audience. The graph below presents the relationship between age and level of interest:



User evaluation was also conducted for the web application, where 15 people were interviewed. This involved explaining the concept of the web app to the stakeholder and showing them a demo. The following questions were asked during the interviews:

- 1) *How old are you?*
- 2) *Do you like the concept of an augmented reality running web application?*
- 3) *Do you run as exercise?*
- 4) *What do you think about the web application being web-based (and accessed online), not on the app store/needig to be downloaded?*
- 5) *What do you think of the design of the web page?*
- 6) *Would this be an application you would use regularly?*
- 7) *Would you pay for this application?*
- 8) *Would this type of application motivate you to run more?*
- 9) *What addition to this application would make you more likely to use it?*

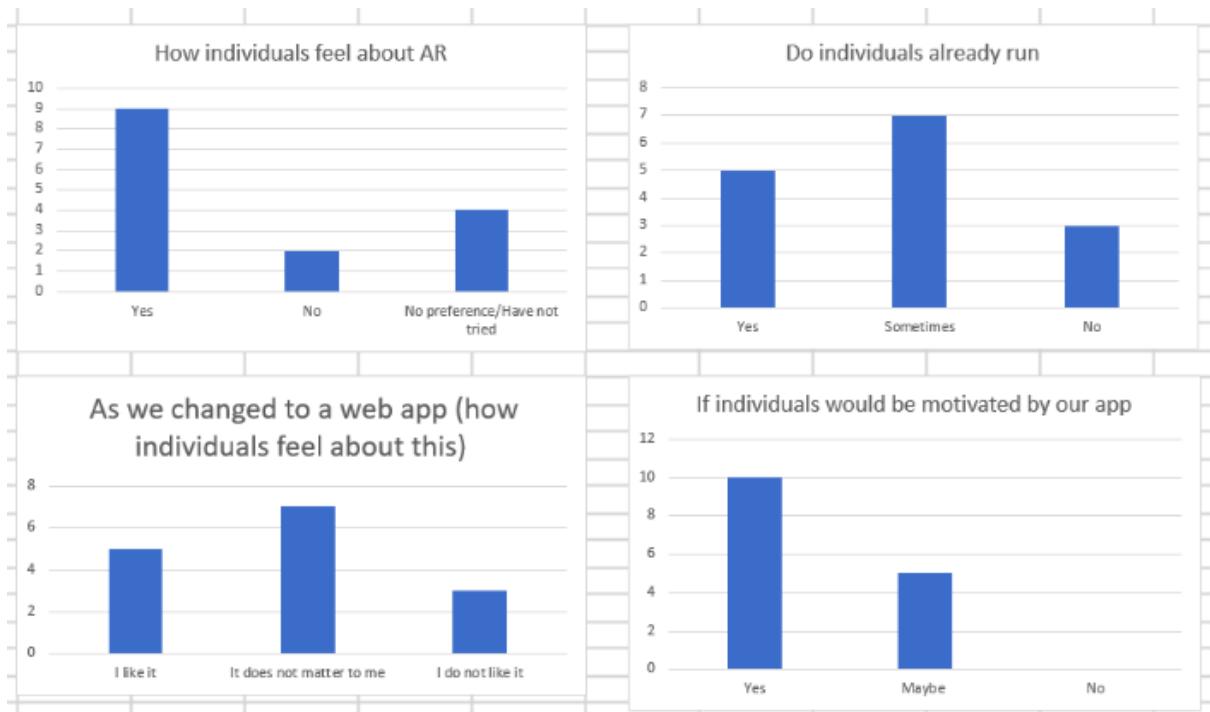
After collating the data from these interviews, it was found that, out of the 15 people interviewed 9 of the individuals liked the concept of augmented reality, 2 people didn't like the idea and the rest were not sure. Therefore, most of the stakeholders liked the idea. Furthermore, it was found that a very large number of individuals (80%) went on runs often or sometimes. This provided the reassurance that the correct people were being asked for input on the web app. Initially, the plan was to create a mobile application which would be much more of a convenience for the augmented reality aspect of the app, however, it was decided that this would be adjusted and a web app would be developed instead. Therefore, the team felt the need to ask users for their opinion on the application being web-based. 7 individuals did not mind the application being web-based and 5 individuals liked it. This may be because the web application still can be used on your mobile phone.

When the project was first embarked upon, one of the most important purposes for building this application was to motivate ordinary people and gym members into living a healthier life by running. The aim was to achieve this by making the process of runs more fun and engaging. People need the motivation to do things and this app aims to be that motivation for running. For this reason, it was pleasing to find that 67% of individuals claimed that the app would motivate them to run. The rest of the individuals responded with a 'maybe'.

The final question of the interview was open-ended because it is important to also gather some qualitative data along with the quantitative data. It provided users with the freedom to answer the question openly with no bias. Interestingly, many users said they would like to use the app with friends (e.g. to see their achievements and data). This is understandable, given that competitions with random users and friends always provides extra motivation. Individuals also reported that sound effects within the augmented reality feature of the web app would be a nice feature. For example, a satisfying noise when you collect coins. Interviewees also mentioned that a coin counter could be added to inform users about the number of coins that have been currently collected during a run. The responses to these questions provide the group with an understanding of some features that could be implemented in future versions.

#### **Ethical audit:**

For each of our interviews our team made sure to explain to our stakeholders the project concept in its entirety and why our group was collecting this data and where the data was going to be used. Sensitive information like names were not asked to respect and protect the privacy of those who wanted to participate in the interviews.



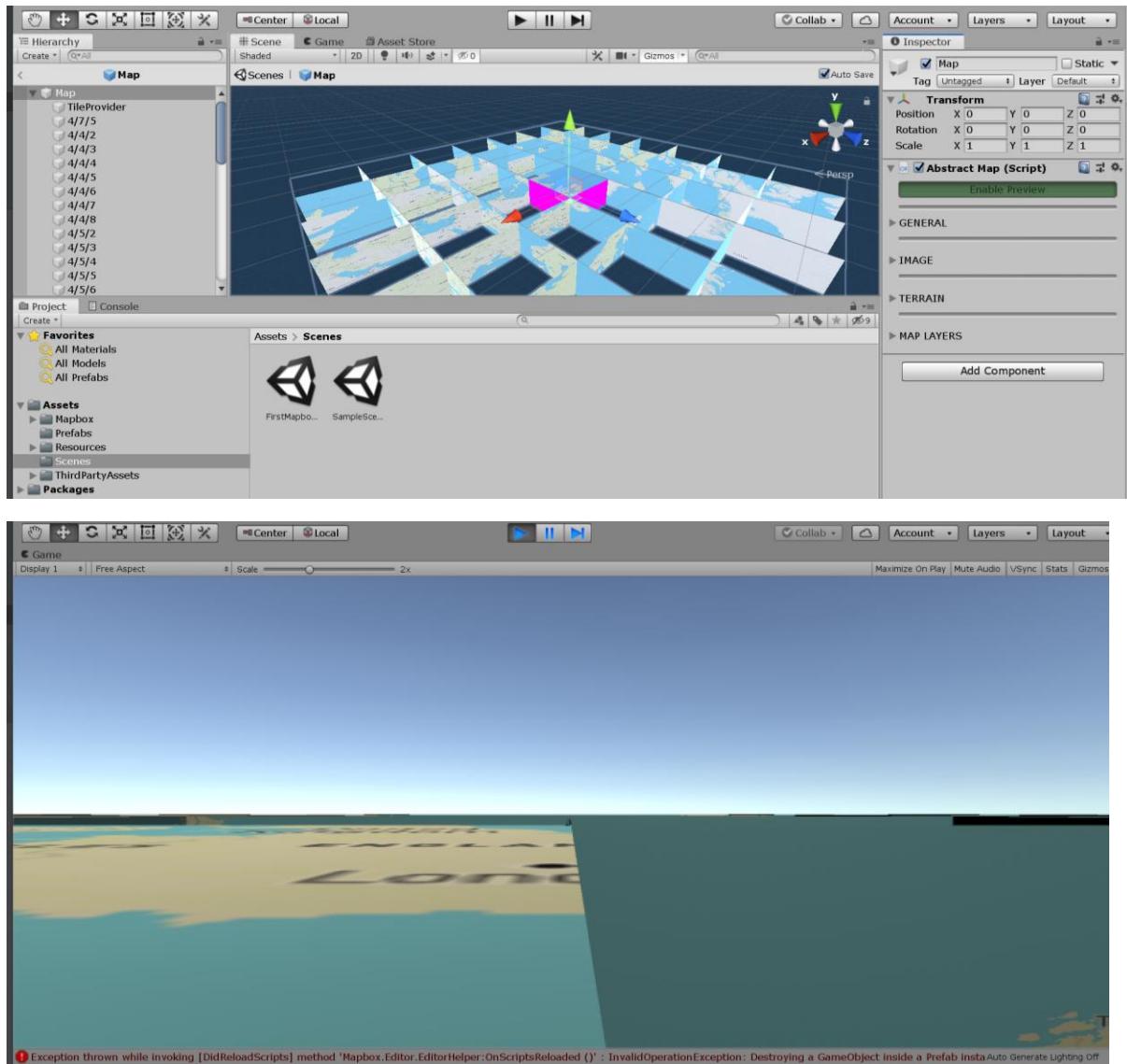
In conclusion, from the numerous instances of user evaluation conducted, positive results were generally yielded. These interviews were vital in the development of the application as it provides a good understanding of what the target audience liked or disliked and what addition can be included. User evaluation was found to be especially important during the early stages of development when the team had a limited understanding of the target audience and therefore needed input to help mould the project. The first 100 sets of interviews, for the low-fidelity prototypes, led to the understanding that aiming the app towards gym members was not a suitable approach and therefore, from that point onwards the focus shifted to aiming the app towards ordinary people, trying to get into fitness. Each set of interviews help to adjust the project based on feedback to ensure that the application was as user-friendly and user-driven as possible.

### Technologies tested:

Throughout this project our team has used different technologies, learning, and evolving through the challenges. The first technology our team used to create our first sprint which was a mobile application was Unity and Android Studio. There were quite a few sprints created and dedicated to the augmented reality section of our mobile application.

The main sprints of this section did not work because it did not implement augmented reality. Our team tried to implement augmented reality with Unity and Mapbox as you can see below. Our goal when trying to implement Mapbox and Unity was to use template code that our team could change to meet our priorities of creating a coin collection function.

This was because no one in our team knew how to implement Mapbox or use Unity, augmented reality was a new spectrum in games so there were not a lot of tutorials that could explicitly show us how to implement augmented reality with Mapbox. Below is our first attempt using Mapbox with Unity.



Reflecting on this sprint, it was evident that it would not work. Not only did our team not completely understand the C# code used but, to implement augmented reality there would have needed to be a gyroscope function and a function that connected to the camera. This was not understood until a few failures later.

A sprint that managed to implement augmented reality showed a coin in the real-life environment. This could be built on android and the coin also rotated. Below are screenshots of this sprints on android phones as well as the unity project that created it.

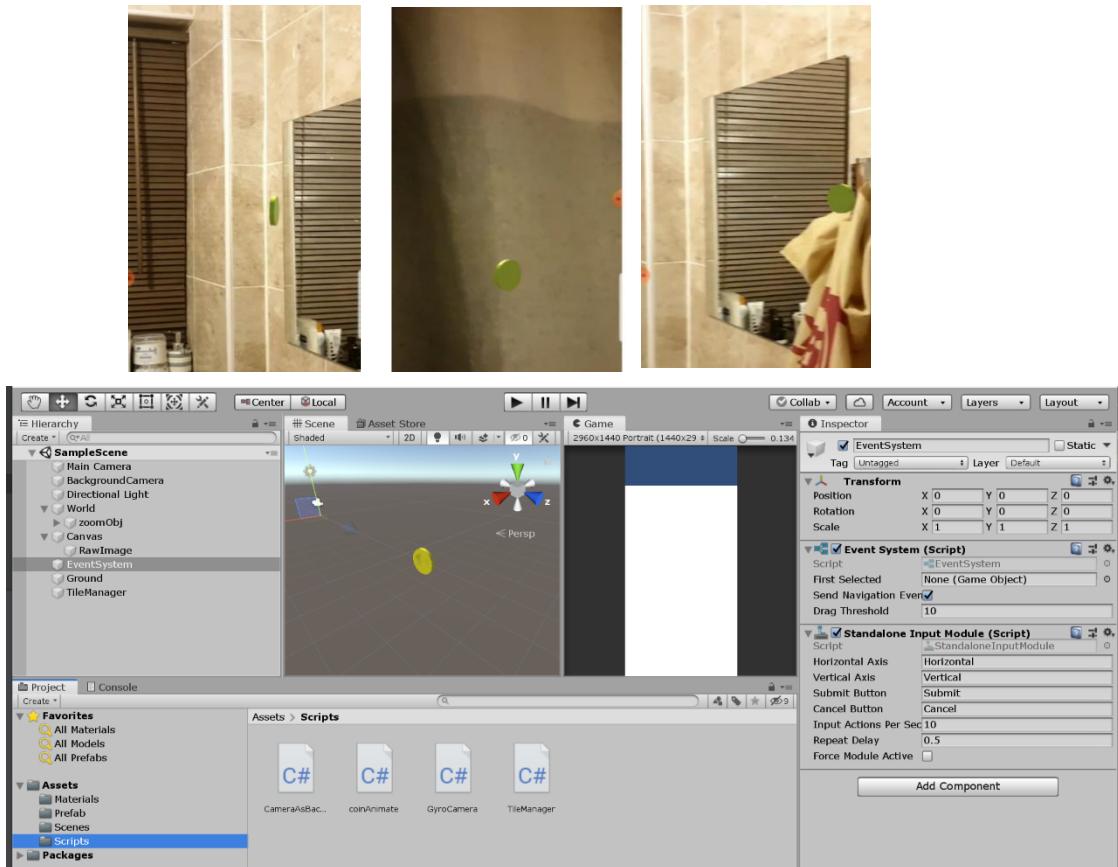


Figure 4 Unity attempt to implement augmented reality

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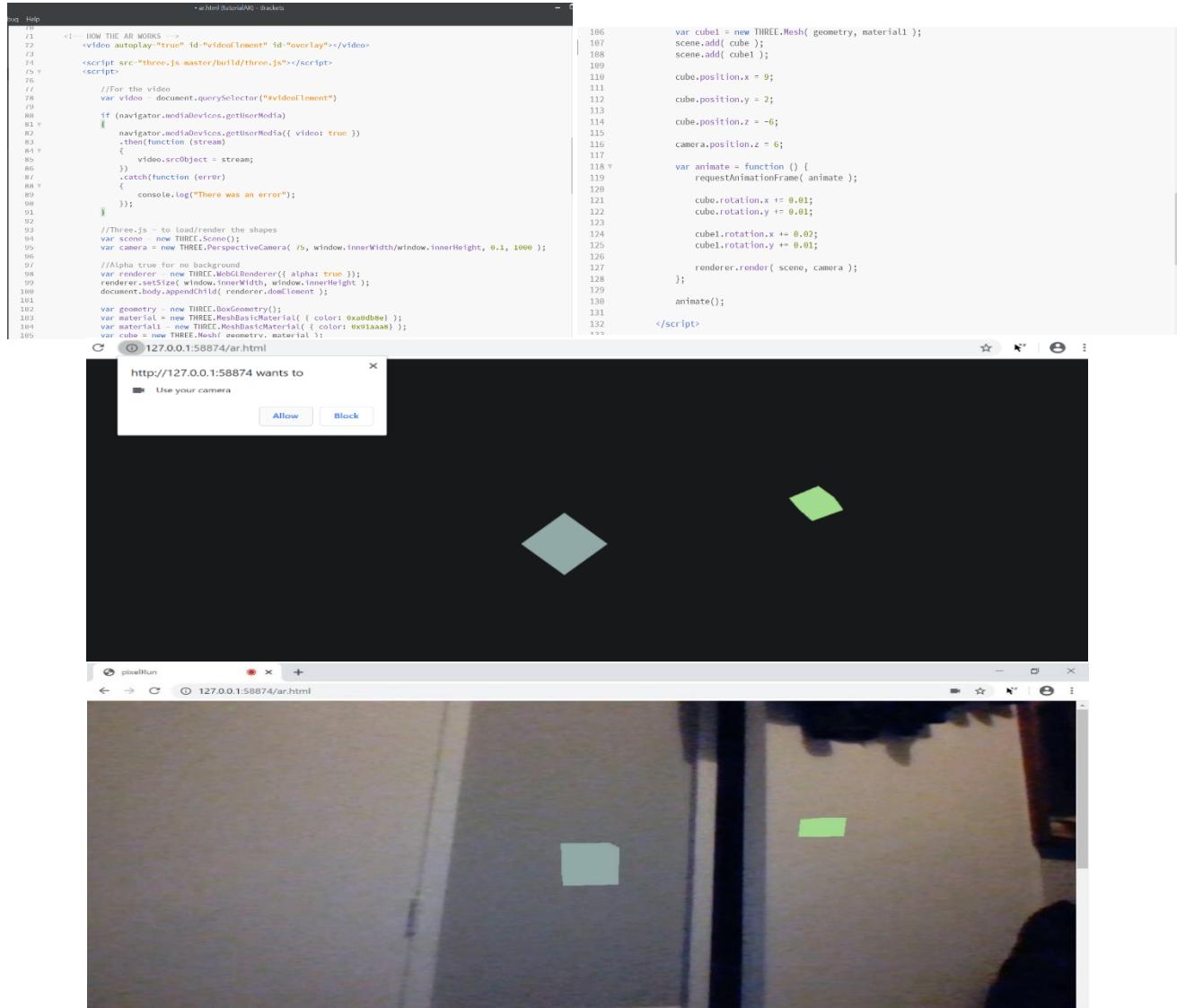
The app that was downloaded in an android phone crashed after a few seconds of opening the application. The issue with this sprint was the gyroscope script, more specifically the gyroscope function of the application. This function created camera stability so even if the phone were flipped then the coins would still be centred in the same place. Our team was not sure that this was the main issue that caused the application to crash but it was tested among our group with different phones which produced the same outcome.

It was then our team found that augmented reality could be implemented using the JavaScript library, three.js<sup>12</sup>. Our team found that with a combination of three.js and a-frame (which is a web framework that can be used to create augmented and virtual reality experience) augmented reality could be created. This prospect was extremely appealing to our group because JavaScript was a familiar language and our team learnt from experience that it is hard to write code in a language that our group could barely understand; making JavaScript a more optimal alternative.

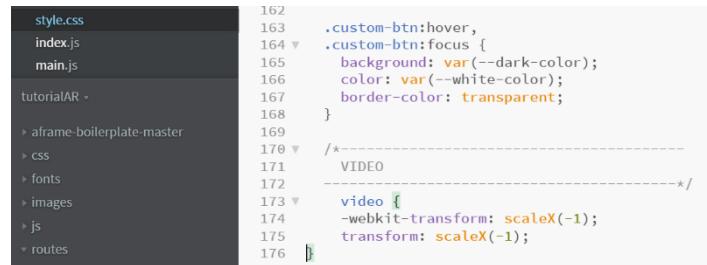
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<sup>12</sup> Jeromeetienne.github.io. 2020. *Augmented Reality In Three.Js*. [online] Available at: <http://jeromeetienne.github.io/slides/augmentedrealitywiththreejs/> [Accessed 12 May 2020].

With this move to JavaScript to create augmented reality, our team started by creating a web page using HTML, this web page included WebGL and Three.js code to create boxes. This was then layered with code that would access the camera of the device being used.



This was a huge success as this was the first implementation of augmented reality our team had created that presented the least amount of issues. One glaring issue our team had with this implementation was that the camera was inverted. This was fixed by adding related CSS commands to our code in our second and final sprint.



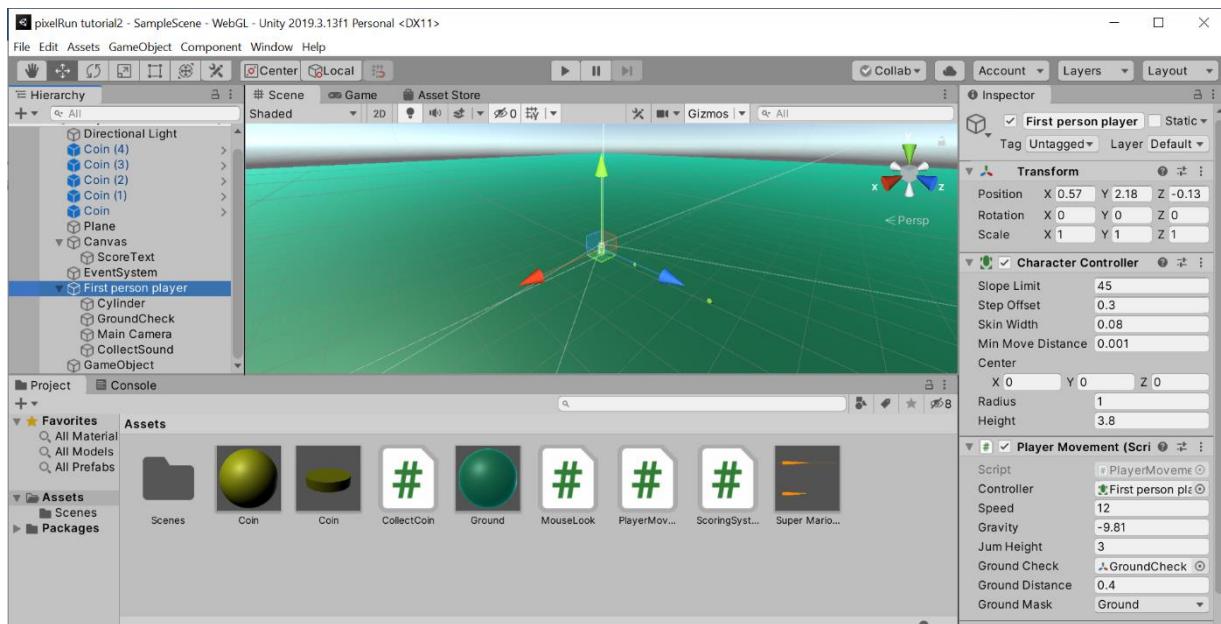
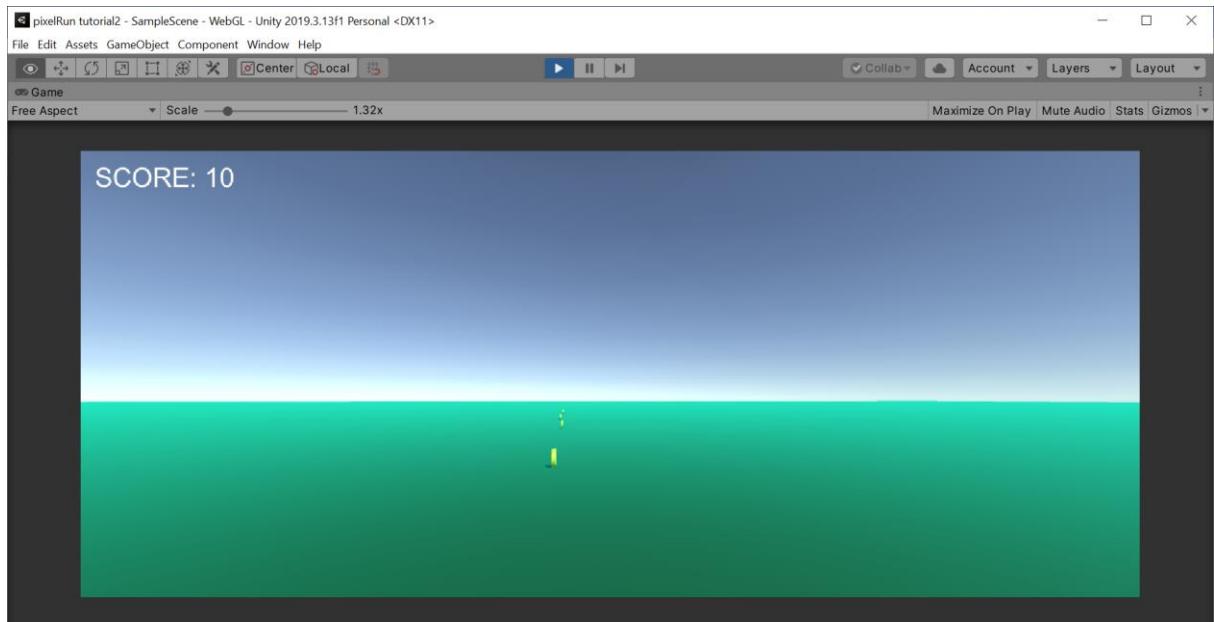
Our final sprint which is our final product creates a web app around this augmented reality page. Due to this sprint being created at a late stage and with Covid-19 present, making it impossible to meet as a team; group chat on WhatsApp was used as a replacement. Our team decided to use a template for the design of our application due to the restraint in time and inability to collaborate face to face. This template was modified to emulate the high-fidelity prototype created with InVision.

Our team stuck to the main colours and implemented the most important aspects of our application and our product which were an informative home page, and achievements page and augmented reality page, as well as a login and registration page (our team had originally planned to also create a statistics page but later realised that it could not function without user input and data which our team did not have). A recurring function that our stakeholders wanted from the beginning our project was a tutorial as the concept of pixelRun was unique and our team had a lot of questions asking about its functionality and how our stakeholders could use this application.

This was first attempted by using WebGL and Three.js, our team managed to create a space where users could use the up button on their keyboard to move around the space filled with boxes. The right and left keys would allow the user to move retrospective to the key pressed. The issue that our team ran into with this implementation was that while coins could be added into the environment, it was difficult to implement a first player function that would collect these coins and without being able to collect these coins a scoring system could not be implemented.



After learning from our mistakes, the team decided to try returning to Unity and create a first player coin collection game that collects coins and displays a score at the top of the screen. This was an experimental way to try and evolve the app and try different ideas that built on previous failures. This provided an alternative to the augmented reality section of our application as our team realised that the AR could not be completed in time. Connecting our Unity tutorial to the tutorial page implemented in the web application was the last function added to our project taking advantage of all past learning and technologies used.



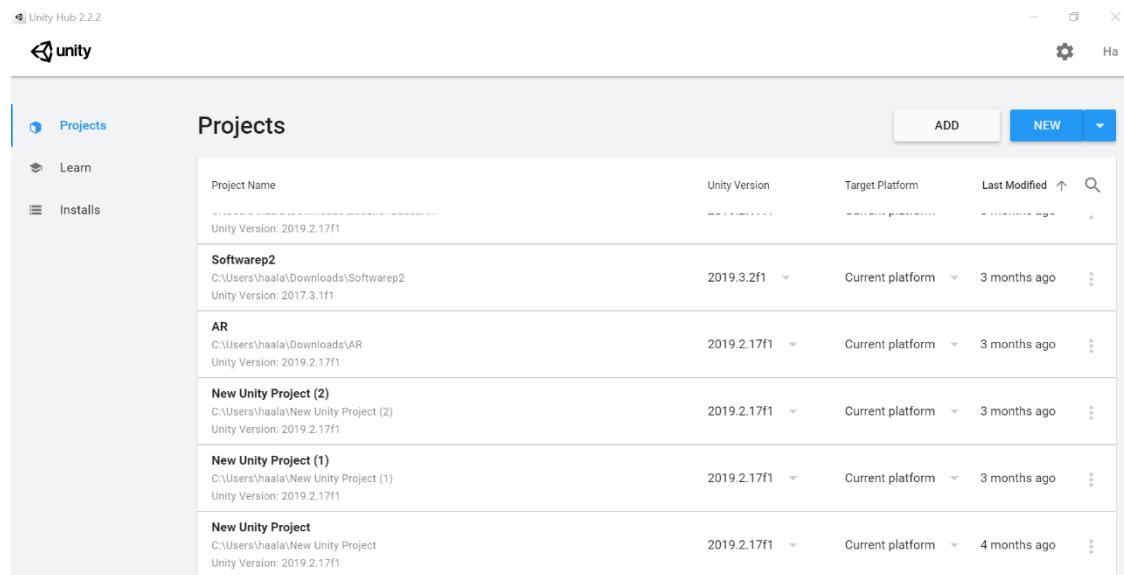
## Summative Evaluation

At the start of our project, our team wanted to create a virtual reality fitness game aimed at gym members. Market research results concluded that gym members would not be interested in our project because they not only pay for a gym membership, but they also pay for the gym lifestyle/equipment e.g. expensive shoes, equipment, and gym clothes.

Making gym members our stakeholder would be asking that they buy expensive virtual reality headsets for some simple cardio that they could do anywhere. Most gym members that our team interviewed said that they go to the gym for weights which our team would not be able to provide an alternative to.

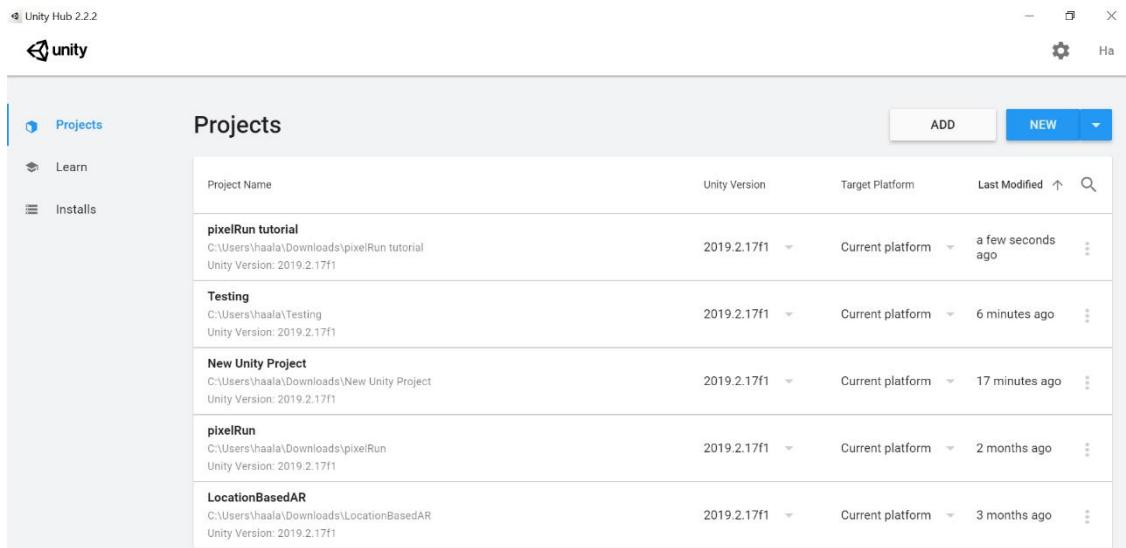
Taking this information, our team decided to veer away from virtual reality and use augmented reality. This would provide access to more users as they would not be responsible for buying expensive VR headsets to use our application and sticking to what was already available with phones.

Sticking with the theme of fitness our team decided to create an application that would promote running. Using augmented reality technology instead of virtual reality would provide more accessibility as our team could create a mobile application that would be available to android users. For this, our team started by trying to create augmented reality on Unity. Our team tried out different methods and tutorials to create this application:



The screenshot shows the Unity Hub interface version 2.2.2. The main window title is "Unity Hub 2.2.2". The top navigation bar includes the Unity logo, a search bar, and settings/hotkey icons. On the left, there's a sidebar with "Projects" selected, "Learn", and "Installs" sections. The main content area is titled "Projects" and displays a table of local projects. The columns are "Project Name", "Unity Version", "Target Platform", and "Last Modified". The table contains the following data:

Project Name	Unity Version	Target Platform	Last Modified
Softwarerep2	2019.3.2f1	Current platform	3 months ago
AR	2019.2.17f1	Current platform	3 months ago
New Unity Project (2)	2019.2.17f1	Current platform	3 months ago
New Unity Project (1)	2019.2.17f1	Current platform	3 months ago
New Unity Project	2019.2.17f1	Current platform	4 months ago

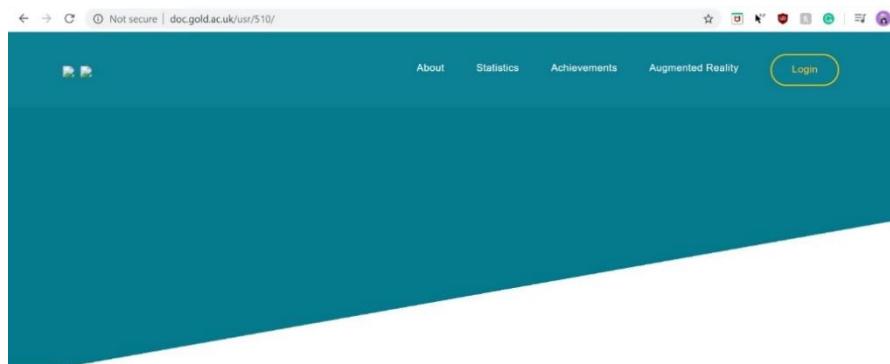


However, our team could not implement augmented reality into the application. One success was when our team managed to get a coin to show in the real-world environment, nonetheless, interacting with the coin was not possible and the application would crash after a few seconds. After this, our team decided to put Unity on hold and try another route.

Our team found that AR could be created using JavaScript. Our team first tried using Expo, however, this could only be used on iOS and switching over onto an unfamiliar mobile operating system and using swift did not seem like a viable option. Understanding that our team could not create an android application our team decided to create a web application.

Our team would be able to design the application with HTML5 and CSS3. The augmented reality section would be created using a JavaScript library called three.js and a web framework called A-frame. Our team would create a MongoDB database to hold the user's progress and display it in the achievements and statistics page. If our team created a dynamic web application, it would create further accessibility as both android and iOS users would be able to use it on their phones.

While our team had the basic AR and accompanying website working in “localhost”, it did not work when our team uploaded it into our web server. This is due to an issue with the CSS and JavaScript files. Our team finally found a solution when realising that the CSS, JavaScript, and image files needed to be connected in the index.js file:



```

Select sysadmin@doc510: ~/tutorialar
var express = require('express')
const app = express()
const port = 8080

// New code added to your Express web server
require('./routes/main')(app)
app.set('css', __dirname + '/css')
app.set('view engine', 'ejs');
app.use('/css', express.static(__dirname + '/css'));
app.engine('html', require('ejs').renderFile);

app.listen(port, () => console.log(`Example app listening on port ${port}!`))

```

index.js" 13L, 418C      10,44      All ↴

This however did not completely fix the multiple issues, our team faced with our server. Main issues with the CSS and JavaScript files were fixed and can be seen on our server:

<http://doc.gold.ac.uk/usr/510/>. However, since the page is not secure with HTTPS, the augmented reality page does not show as it supposed to on the server. Our team also faced an issue with the tutorial page where a video tutorial had been linked and does not show. There, however, is a link to the folder of this tutorial game so users can download it and play on the PC.

At a stage where our team could not figure out the CSS issue, our team decided to show our stakeholders a version of our web application hosted on “localhost”. Our team explained our concept before each interview.

Our team showed them the first sprint of the web application, 15 stakeholders were interviewed and the data showed a largely negative reaction to the design of our web application, they, however, did not mind that it was a web application because they would still be able to use it on their phones.

The design—included below—however, was not favoured, especially due to colours used. This was therefore changed and improved upon.

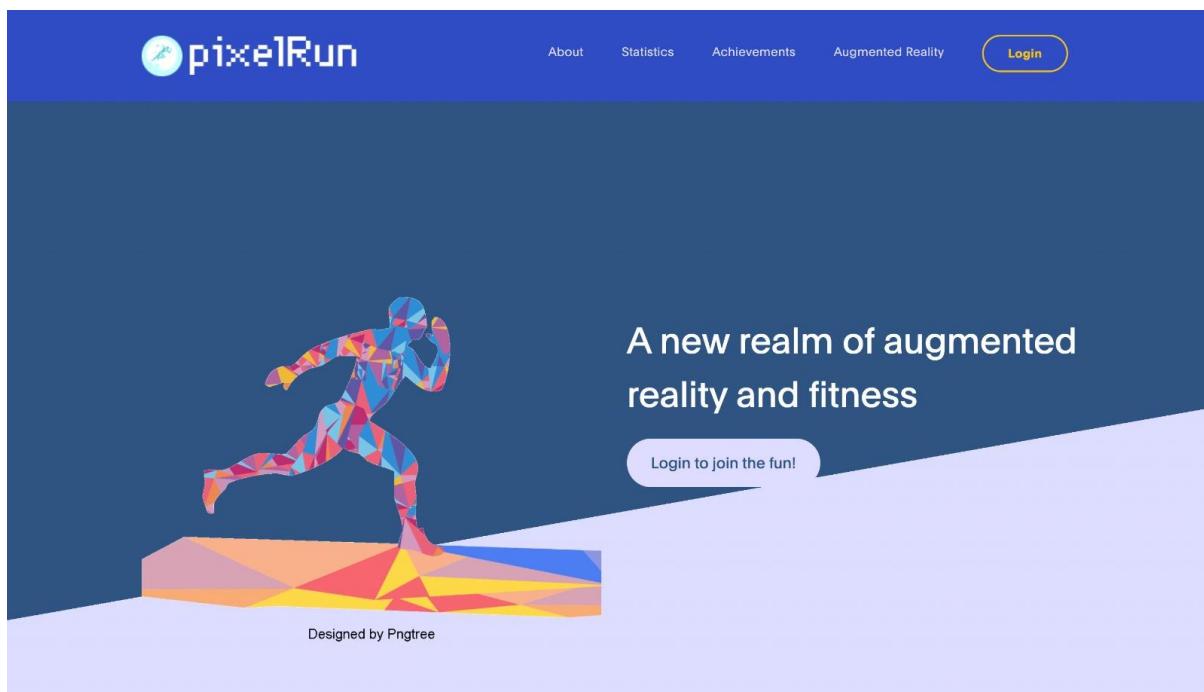


Figure 5 First web app sprint

The second sprint of our web application was shown to 15 more stakeholders, they had a more positive reaction to the design and general look of the web application.

The screenshot shows the homepage of the pixelRun website. At the top, there's a navigation bar with links for About, Tutorial, Achievements, Augmented Reality, Login (in a green button), and Register. Below the navigation is a large teal header section containing the text "A new realm of augmented reality and fitness" and a "Login to join the fun!" button. To the right is a stylized 3D runner character composed of colorful pixels. Below the teal section, the main content area has a white background. It features the text "A unique augmented reality game for runners and non-runners alike". Underneath this, there's a paragraph explaining the concept: "Our concept is an augmented reality app designed for runners; it's called pixelRun. So augmented reality is a type of technology that expands on the physical world by adding layers that contains digital information. With this technology we could add sounds, videos and graphics to the existing environment. It would be designed so that runners would be able to see coins on a route during their break, collecting these coins would give them points, when collecting a predetermined amount, they would receive achievements/trophies. This would not only keep the runners active during their break but also entertained! We want to create this app to make the activity of running more interesting, it would be providing motivation for these runners." Below this text is a colorful illustration of several runners in motion. Further down, there's a call-to-action: "Please take a look through our progress with main sprints". Below this are three screenshots: one showing the Unity editor interface for a mobile AR sprint, another showing the Unity editor for a web application, and a third showing the final web application with the pixelated runner on a 3D surface.

A new realm of augmented reality and fitness

Login to join the fun!

Designed by Pngtree

A unique augmented reality game for runners and non-runners alike

Our concept is an augmented reality app designed for runners; it's called pixelRun. So augmented reality is a type of technology that expands on the physical world by adding layers that contains digital information. With this technology we could add sounds, videos and graphics to the existing environment. It would be designed so that runners would be able to see coins on a route during their break, collecting these coins would give them points, when collecting a predetermined amount, they would receive achievements/trophies. This would not only keep the runners active during their break but also entertained! We want to create this app to make the activity of running more interesting, it would be providing motivation for these runners.

Please take a look through our progress with main sprints

Second mobile AR sprint

Web application

First web sprint

We make augmented reality ambitiously

#### CONTACT INFO

+44 000 000 0000  
pixelRun@gold.ac.uk

#### OUR STUDIO

8 Lewisham Way, New Cross, London SE14 6NW

After the final interviews for the current app version, the data was collated to see the progress, and the next steps the team would take, to keep evolving the app and make it as functional and user friendly as possible (as a side note; there were less than desirable amount of interview conducted due to the interference of Covid-19 lockdown procedures. However, a suitable amount was collected for the ability to direct progression from the collected data. This was the case for every sprint and interview set affected by Covid-19).

The collated and visualized data showed the following:



From the interviews the team conducted, the individuals were mostly contained within our target market (with slight deviation); to only gain feedback from individuals our team found would be the most interested and suited to use the application (from previous market research).

The team also made sure to consider the interest in augmented reality (with majority viewing it as an exciting concept) and how many individuals already exercised. This would be important to see if individuals would be motivated due to our concept and idea.

Owing to the decision of switching from a regular app to one on the web, it was important to find out if individuals would mind this change; meaning the team would try to adjust our idea and use a different technology that could put the app from the web to one you could install. The feedback, however, showed that this was not something that had to change and that our clients would still be interested.

In this stage of the sprint/design, our team also found that the clientele was content with the design and the look/feel of our application. This was an improvement from the past set off interviews and a good direction for the presentation of the application.

The mode of the interviews showed that the app would be used sometimes however if our team wanted a more accurate number it would mean that when individuals used the app that data could be used. It could also mean as the app is new this option was chosen, or that individuals do not want to exercise too regularly, especially if just starting.

The team included the question if users would “pay” for the application. It was a potential way to try and see the actual interest of future users with a minimum being very loyal. However, this could be

due to the stage of the app being not fully developed and therefore forming this opinion. Another reason would be that not many individuals would like to pay for apps and prefer free experience.

The team's goal of motivating users has been reached. All users replied that they would either be motivated or are leaning towards being motivated; this app was developed with this idea in mind. Users also provided some extra comments, which are a good insight into the next steps that our application could be developed in. This is very useful as this means the team can develop the app based on user input, which has been the method of progress from the beginning of this development.

Overall, the app has had many alterations from user input to the way it would be created. The app needs to work more than the technology "behind the scenes" that drives the application's abilities. At this moment, the application is that this is a beta version of the app and a very liked design. Nevertheless, it would require more work on the functionality, such as the ability to create an augmented reality space that could collect coins, and load models, however, the app has much interest and is functional in the parts that have been tested. The next section of "Next Steps" will outline further the plan of getting the product to a more structurally sound prototype, and the direction of evolution the app would take.

## Next Steps

The application at the current state has some functionalities and a favoured design (favoured by the target market). However, functionalities are missing from the original designs and what would make the app more complete.

The application has been successfully transported and uploaded to a GitLab space and can be accessed online. The team has succeeded to link the CSS and style the application however, the camera does not work on the webserver. This would be the next step for the app to be truly on a server (and not entirely on localhost). This means the logical next step is to make sure the website has an https over an HTTP link. This is to ensure the camera would work; the method to link the camera to our app requires an https connection for the method used. This would then mean cubes would be displayed in an augmented reality fashion (it also means the best version of the developed app is now accessed by folder and on "localhost").

The logical next step would be to improve upon the shape (from cube to coin being allowed to be imported) and be able to collect these items. This would bring the app to a beta version that is more functional and can be used. After this (and even previous steps) users would be questioned to see how the teams' developmental process has progressed. Any good insight would change some development to suit the views and needs of our target market.

An important part to improve the app even further would be to add the collection of coins and store this value in the database. This would then allow for the creating of the "past data" and show users the statistics of their use of the application. This would be done by creating a database. Our team had first created an MYSQL database for the mobile application but for this web application, the team decided it would be best to go with a NoSQL database such as MongoDB. MongoDB has more of a flexible schema than MYSQL<sup>13</sup>, and mongo dB can handle higher volumes of data and is faster at retrieving data which is all things needed for our application. Our team has created a basic mongo

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<sup>13</sup> Shah, M., 2017. *Mongodb Vs. Mysql - Dzone Database*. [online] dzone.com. Available at: <https://dzone.com/articles/comparing-mongodb-amp-mysql/> [Accessed 12 May 2020].

dB database that handles registration and login. Both the registration and login work on the server. In the future our team would like to extend this database to also handle coin collection data.

```
sysadmin@localhost:~/finalapp$ mongo
MongoDB shell version v3.6.3
connecting to: mongodb://127.0.0.1:27017
MongoDB server version: 3.6.3
Server has startup warnings:
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten]
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten] ** WARNING: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten] ** See http://dochub.mongodb.org/core/prodnotes-filesystem
2020-03-16T15:47:12.646+0000 I CONTROL [initandlisten]
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten]
> use pixelrundo
switched to db pixelrundo
> show collections
users
> db.users.find().pretty()
{
    "_id" : ObjectId("5ebc2c3e5a66f68ea97f2609"),
    "firstname" : "Haala",
    "lastname" : "Sudi",
    "username" : "Hahme005",
    "email" : "hahme005@gold.ac.uk",
    "password" : "1234"
}
{
    "_id" : ObjectId("5ebc4e27f8da4d1b7b9e73e1"),
    "username" : "Test4",
    "password" : "$2b$10$RGUyUfcFZcn9zaHYDq8H/O4NbZSAzJOIaewuZwI5kJxirRqQTB6pm",
    "email" : "test4@gmail.com"
}
{
    "_id" : ObjectId("5ebc66c3f8da4d1b7b9e73e2"),
    "username" : "Test7",
    "password" : "$2b$10$yMdm1.XH0KuglsqELaH/Ohd1V330kkox1ABA/MT4LS9ivPLCbEea",
    "email" : "test7@gmail.com"
}
>

```

Figure 6 mongo dB database

```
1  module.exports = function(app){
2    const {check, validationResult} = require('express-validator');
3    const redirectLogin = (req, res, next) => {
4      if (!req.session.userId) {
5        res.redirect('./login');
6      } else {
7        next();
8      }
9    };
10   });
11  );
12  );
13 //Register page main
14 app.post('/registered',[check('email').isEmail()], function (req,res) {
15   // saving data in database
16   const errors = validationResult(req);
17   if (!errors.isEmpty()) {
18     res.redirect('/register');
19   } else {
20
21     var MongoClient = require('mongodb').MongoClient;
22     var url = 'mongodb://localhost';
23     const bcrypt = require('bcrypt');
24     const saltRounds = 10;
25     const plainPassword = req.sanitize(req.body.password);
26
27     bcrypt.hash(plainPassword, saltRounds, function(err, hashedPassword) {
28       //Store hashed password in your database.
29       MongoClient.connect(url, function(err, client){
30         var db = client.db('pixelrundo');
31         if (err) throw err;
32         db.collection('users').insertOne({
33           username: req.body.username,
34           password: hashedPassword,
35           email: req.body.email});
36         client.close();
37         res.send('You are now registered, Your user name is: '+ req.body.username + '  
><br/>'+'<a href=' + '/login'+ '>Login</a>');
38       });
39     });
40   });
41 });
42 );
43 //Login page
44 app.get('/login', function (req,res) {
45   res.render('login.html');
46 });
47 //After user has loggedin
48 app.post('/loggedin', function (req,res) {
49   const saltRounds = 10;
50   const plainPassword = req.body.password;
51   const bcrypt = require ('bcrypt');
52   bcrypt.hash(plainPassword, saltRounds, function(err, hashedPassword) {
53     //Check if the hashed password with the password saved in DB
54     if (err) throw err;
55     MongoClient = require('mongodb').MongoClient;
56     var url = 'mongodb://localhost';
57     MongoClient.connect(url, function(err, client) {
58       if (err) throw err;
59       var db = client.db('pixelrundo');
60       db.collection("users").findOne({username: req.body.username},function(err, result) {
61         if (err) throw err;
62         if(result == null){
63           res.send('Login Unsuccessful, wrong username!'+<br />'+<br />'+<a href=' + '+'Home</a>');
64         } else {
65           // **** save user session here, when login is successful
66           req.session.userId = req.body.username;
67           res.send('You are now loggedin, You user name is: '+ req.body.username + '  
><br/>'+'<a
```

### Ethical audit:

While this is very basic, the above shows how our team would handle form data and the steps it would take to ensure security. Using bcrypt<sup>14</sup>, which is a function used to hash passwords, our team could secure the passwords in the database.

This main.js also includes a sessions<sup>15</sup>, which in this case is used in the login, saves the users session until they log out where then the session is destroyed and the user can no longer access the web pages. This is paired with the redirect login feature implemented where the users do not have access to the web pages until they log in. All these future features show security on our web server.

<sup>14</sup> Boterhoven, D., 2016. *Why You Should Use Bcrypt To Hash Passwords*. [online] Medium. Available at: <https://medium.com/@danboterhoven/why-you-should-use-bcrypt-to-hash-passwords-af330100b861/> [Accessed 12 May 2020].

<sup>15</sup> Hazelcast. 2020. *How Do Web Sessions Work? / Hazelcast*. [online] Available at: <https://hazelcast.com/glossary/web-session/> [Accessed 12 May 2020].

For the further future (after completion of these) many users have already reported that they would enjoy the addition of ‘friends’ and ‘social media’. This means the development of the app would evolve in that direction.

As a final note, the team has experimented with a 3D model idea, where models can be scanned, and then their models loaded to be used as collectables. This would be something to explore further, conduct more market research on, and an interesting evolution for the reality of the created application.

The main idea to always consider is our users’ opinions and their satisfaction. The mode reviews and ideas of users will always be the most valuable to make sure that the app develops in a steady fashion, which reflects what users want. With considering this, user satisfaction would be achieved due to users being listened to, hence the app would likely be more popular and used by the target market.

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# User Guide

## Overview:

The user guide is an explanation of what a “new user” would experience and the flow they would follow when trying out our application.

The Navigation Bar can be used to move to different areas of the website depending on the button pressed. A new user will have to make an account, this can be done by pressing the “Login” button. This button will redirect the user to a page where they can sign in or in this case make a new account.

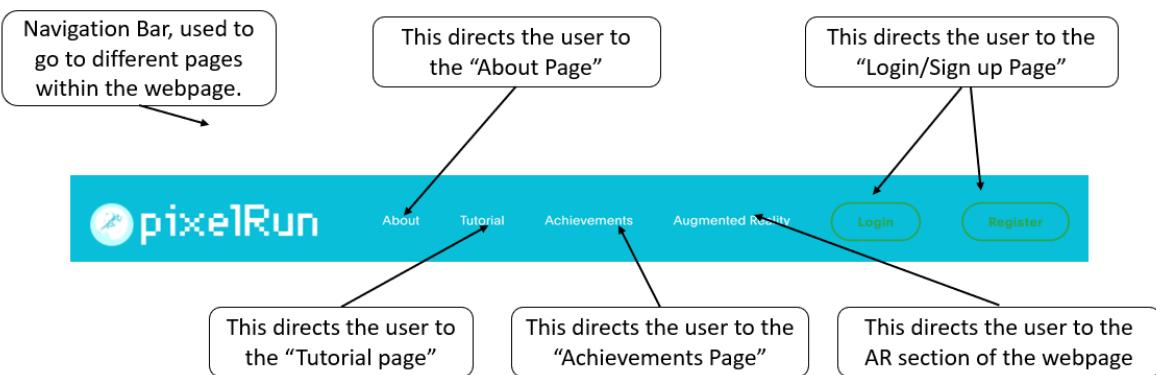
The user can sign in by making a new username and a password in the registration page. Once the user has made the account the user now has access to see the tutorial page, achievements page, and Augmented Reality page.

The About page gives a brief overview as to what the app is about, what the app does and shows how this app is much different from other apps.

The tutorial page is connected to Unity and the user will be able to play a short coin collection game that will emulate the product our team wishes to achieve in the future.

In the future, our achievements page will have all the achievements that the user has accomplished while using the web app. This will show all the trophies that have been collected, as a new user there will not be any achievements. The achievements page is a way for the user to see how far they have come and can be compared to friends online. Our current achievements page shows information about the points system and trophies that users will be able to achieve in the future when the augmented reality works and is linked to this page.

In the future, the augmented reality page is a feature the user can use to collect their coins during a run. This feature will pop up once the user has reached a stopping point in a run. During these stop points, the user can start collecting their coins which will only be in the rest area. The AR page will disappear once the user has collected all the coins. Our current augmented reality page shows cubes in the real world environment.



## Detail:

Login page and registration:

For a regular user, they will be able to sign-in to their account. For a new user, there is the registration page where they can sign up.

### Login

Please login below

Username:

Password:

### Register

Please register below

First name:

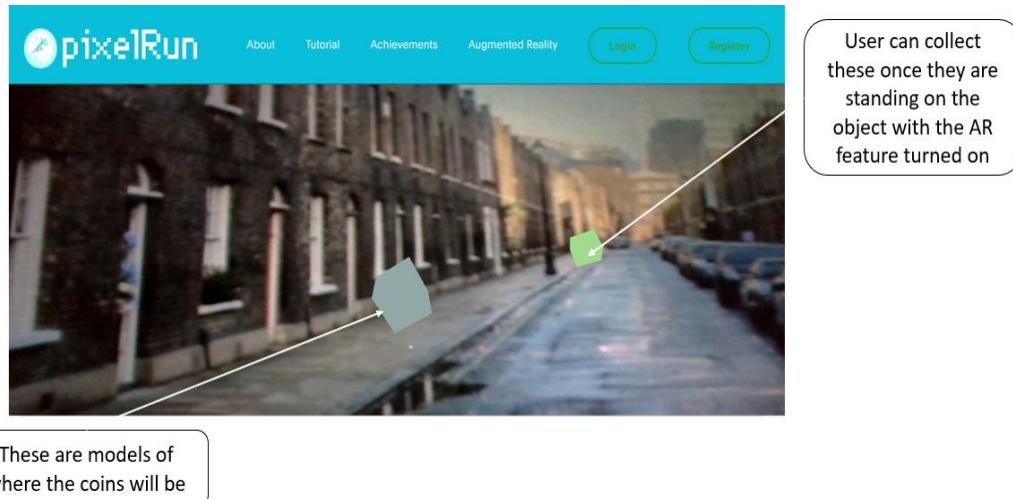
Last name:

Email:

Username:

Password:

Augmented reality page:



The AR function will only work when the user has successfully made it to the rest spot. Once the user opens the web app, the AR function will automatically pop up. The user then will have to keep the phone up, the coins will be spread out within the area and can be collected by walking up to it. Once the coins in the area have been collected the coin total is updated immediately. The AR page can be stopped by exiting out of it, the AR function is not something the user will have to do.

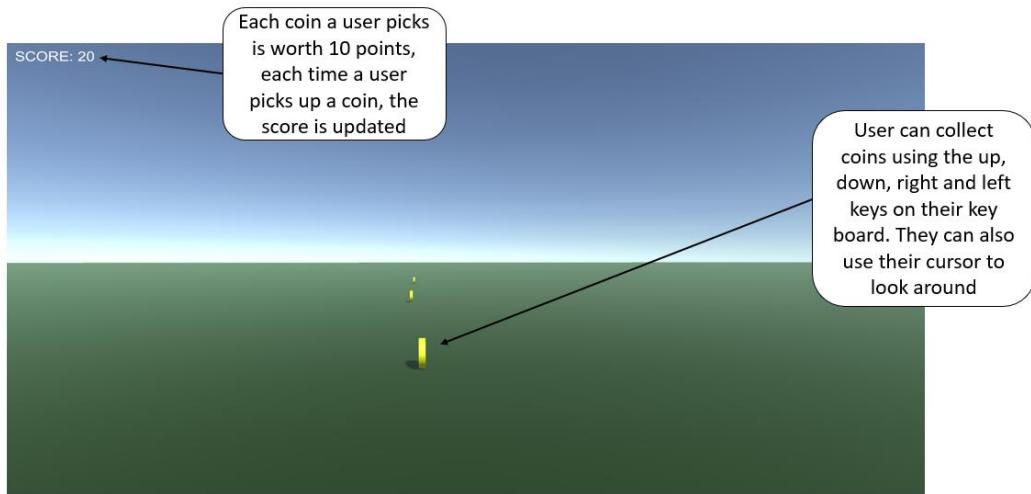
Achievements:

The Achievements page will show all the achievements that the user has completed. These are presented by a trophy and the name of the achievement underneath if the user taps or hovers over the trophy a small definition will pop up about the achievement. The Achievements are reached by

going on runs, they are awarded as soon as the user has completed it and will show up on the page instantly.

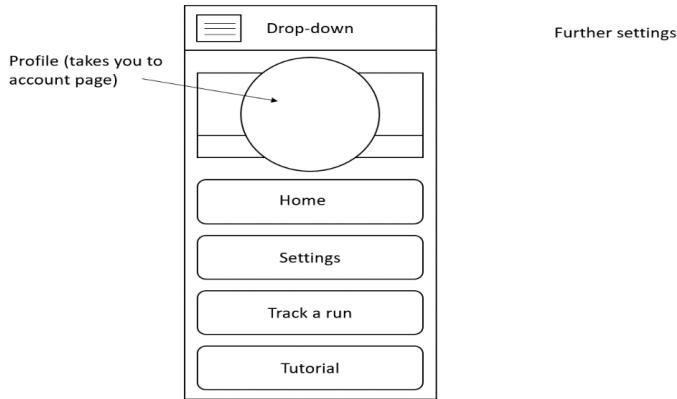
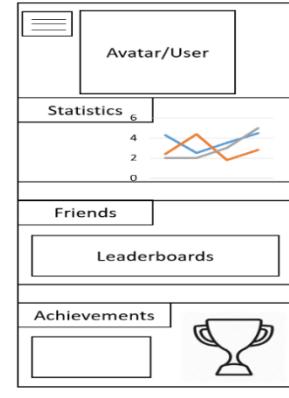
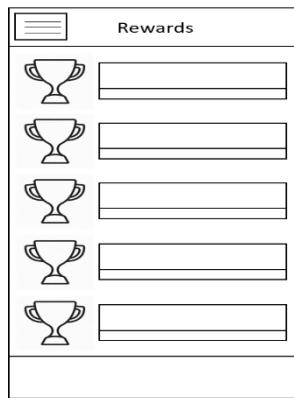
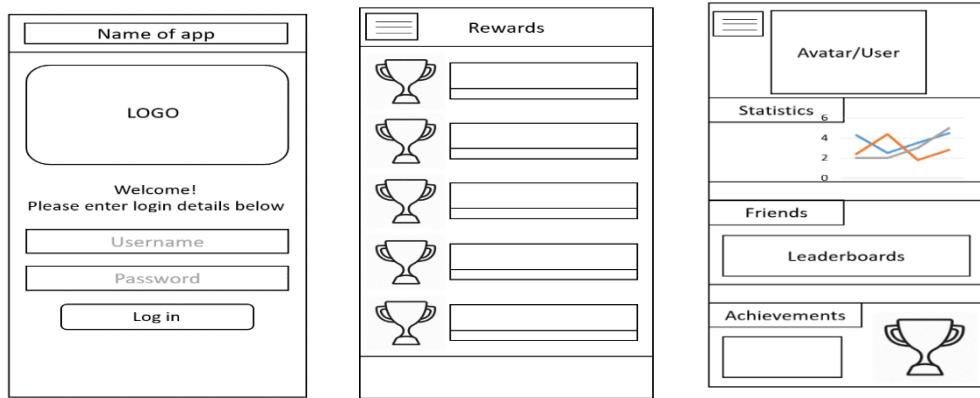
Tutorial page:

This page shows users a model of the augmented reality page. They can pick up coins and the score will increase. This is a feature that has been highly requested and shows our ability to listen to our stakeholders and implement features they want (below is a simple version of what would be integrated into the main application).

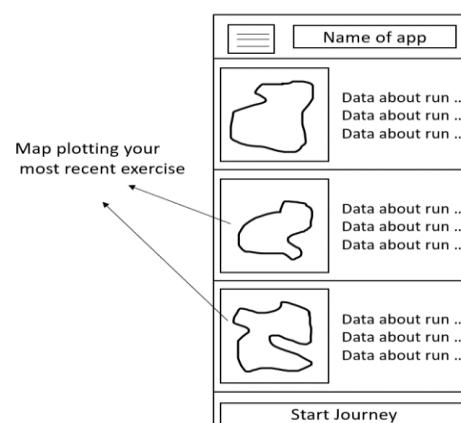
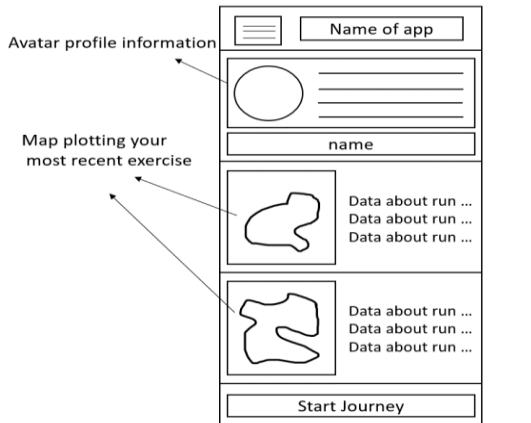
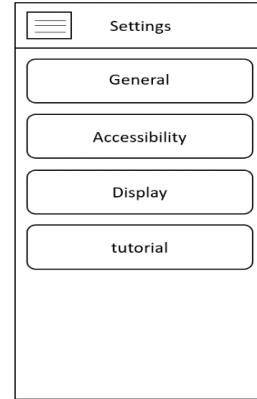


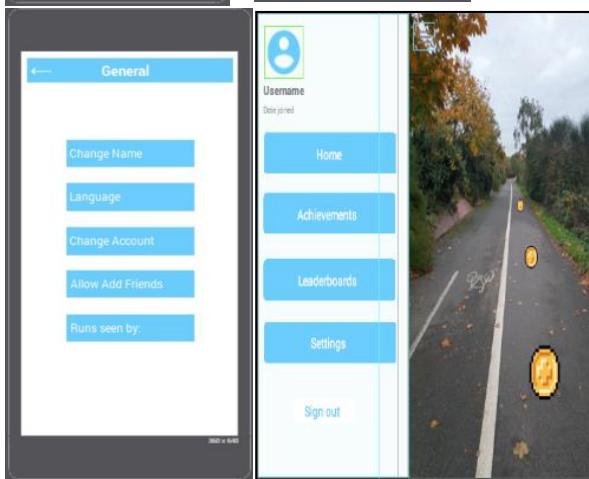
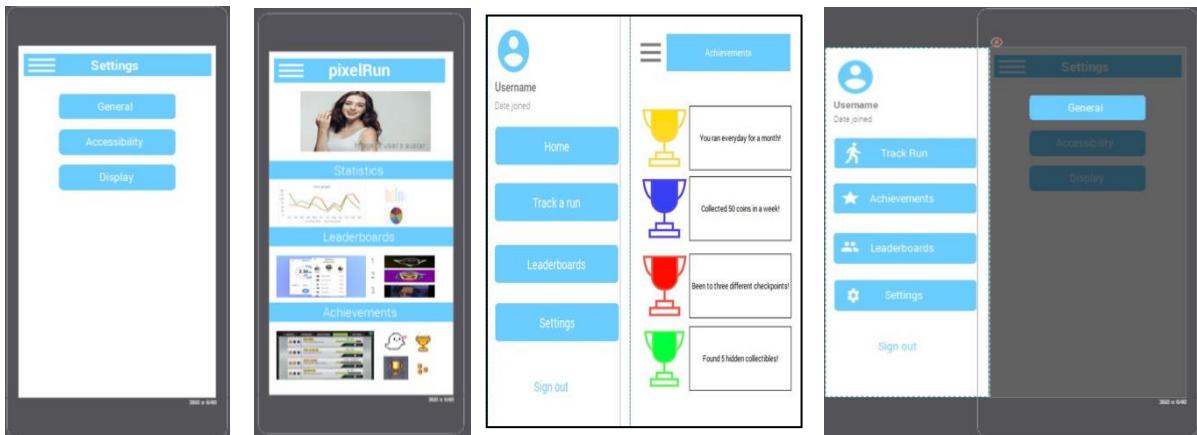
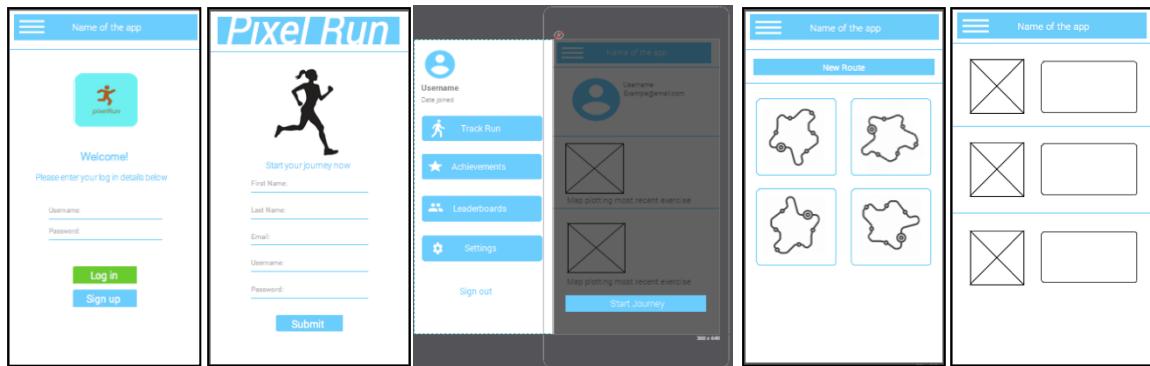
# Appendices

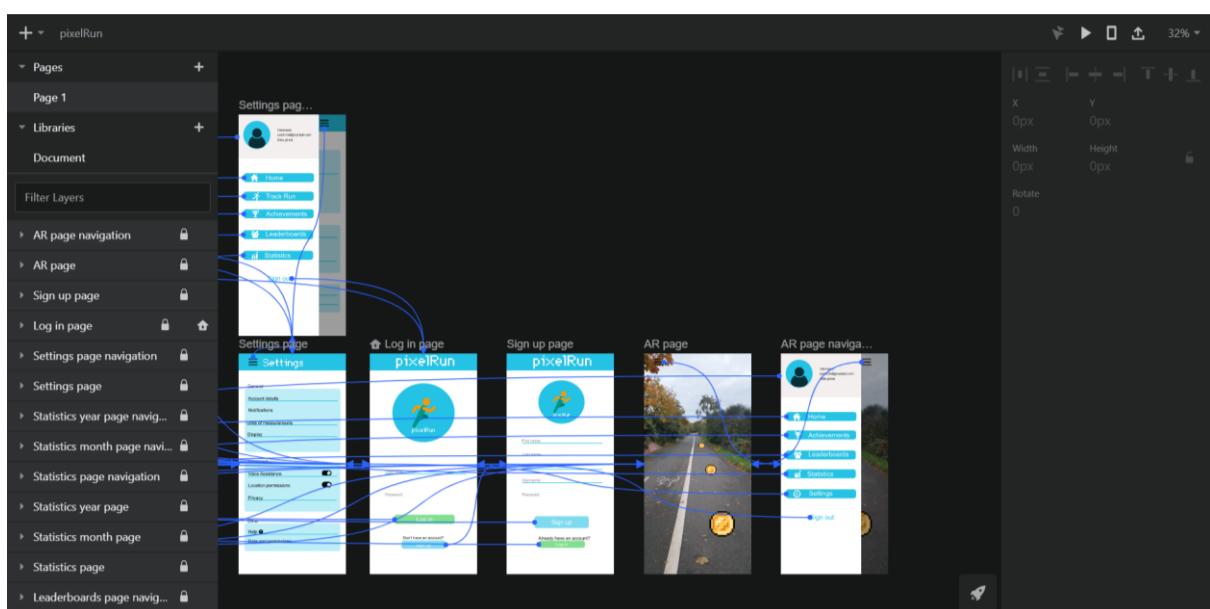
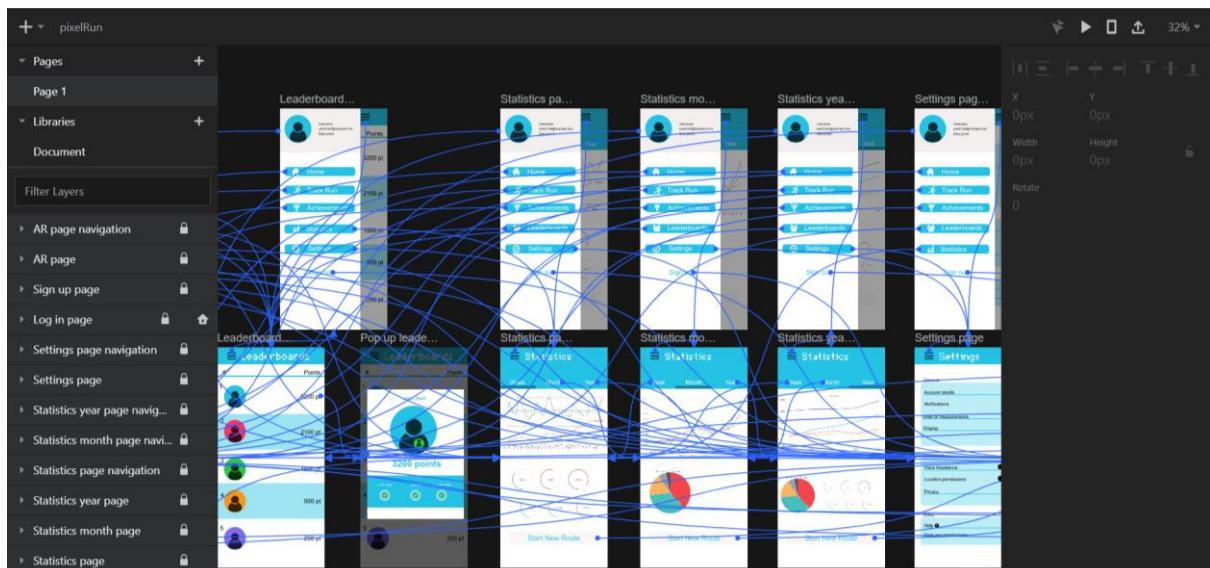
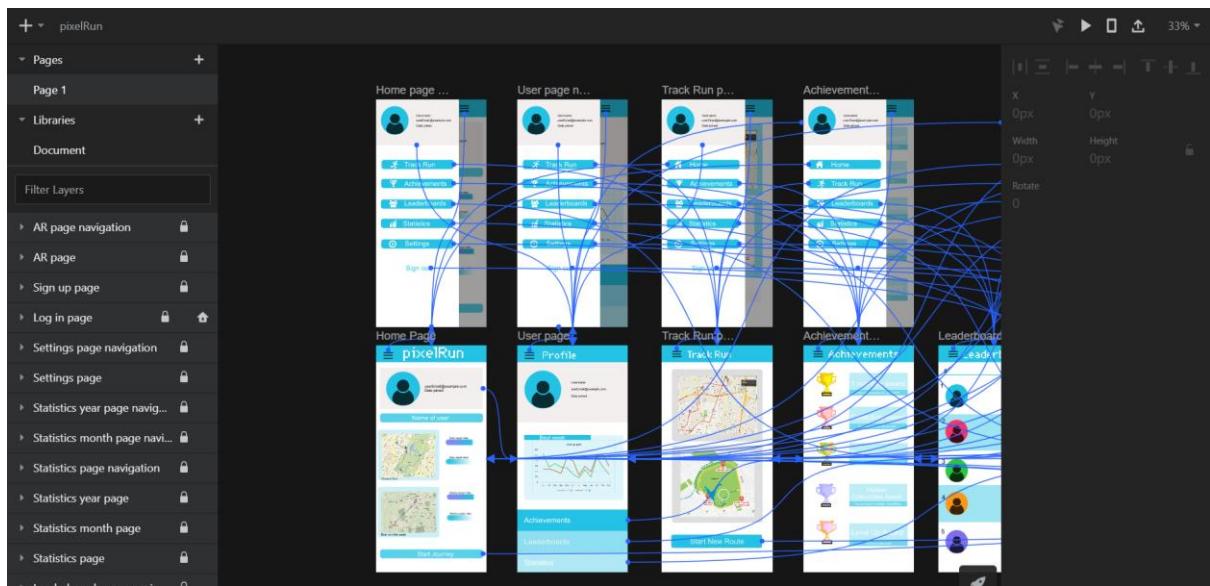
## Design and implementation



Further settings







[About](#)[Tutorial](#)[Achievements](#)[Augmented Reality](#)[Login](#)[Register](#)

A new realm of augmented reality and fitness

[About](#)[Statistics](#)[Achievements](#)[Augmented Reality](#)[Login](#)

A new realm of augmented reality and fitness

Login to join the fun!

Designed by Pngtree



## Development record

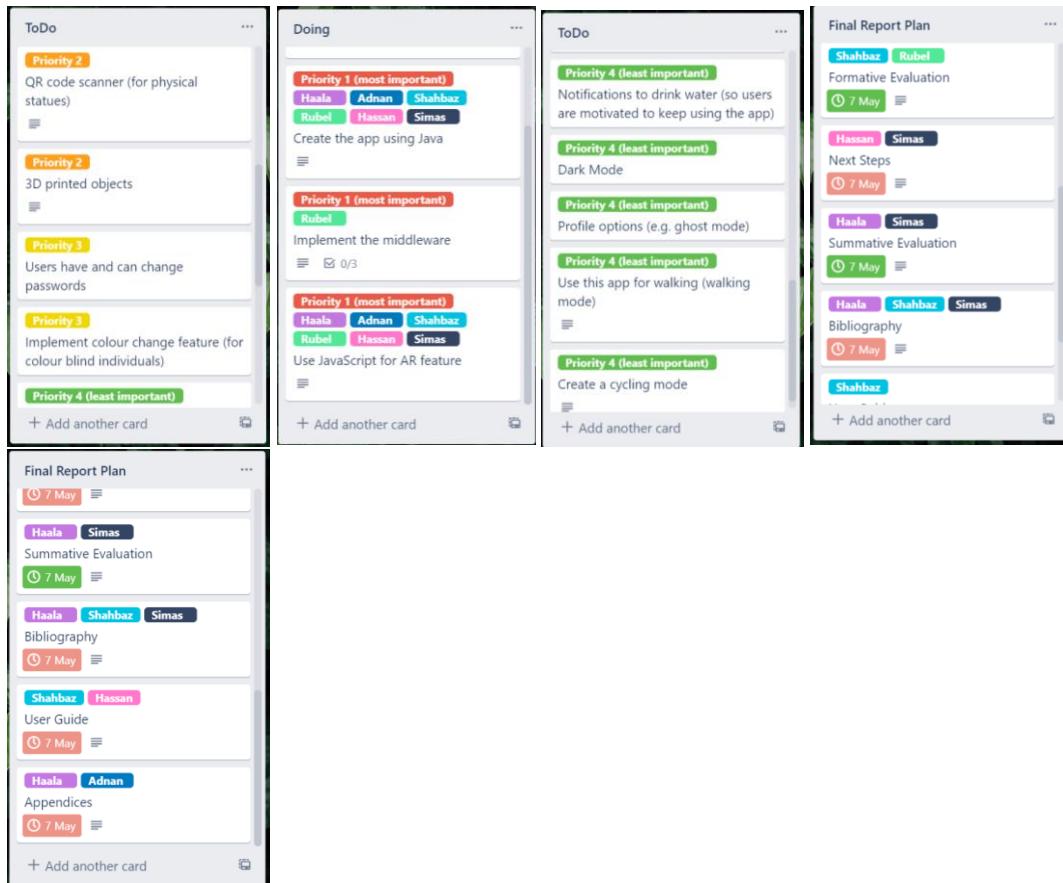
Software projects features - Saved						
	A	B	C	D	E	F
1	Important features:	Extras:				
2	Display data (log it) (1st)	3D models (3rd least voted)				
3	Setting (colours/dark mode) (7th)	A timer to show how long you've run (4th least voted)				
4	Customise profile (6th)	A tutorial for app (5th least voted)				
5	Prompts and rewards (4th)	Notifications to drink water (least voted)				
6	Security features (passwords/username) (1st)	Extra setting like dark mode (second least voted)				
7	Able to compare with other users with ghost mode	Record run with glasses (4th least voted)				
8	Able to use wireless headphones (3rd)	Share on social media (most voted)				
9	In-app instructions (directions) (6th)	In-app instructions (directions) (moved to extras)				
10						
11	Manageable features:	Manageable extras:				
12	Display data	Share on social media				
13	Settings (extra is customisable features)	3D models				
14	Security features	A timer to show how long you've run				
15	Prompts and rewards	Record your run				
16	Able to compare with other users with ghost mode	Extra settings like dark mode				
17	Able to use wireless headphones	Notifications to drink water				
18	A tutorial for app (moved from extras)	Interaction with google maps (record location)				
19						
20	Family	Feature	Complexity	Priority	Status	Owner
21	Accessibility settings	Colour change for colour blindness, font change		1 P3	Design	
22	Achievements/Motivation	Rewards like point and badges for milestones reached (per 10 km a month), positive affirmation		3 P1	Design	
23	Security	for the first connection the user receives an email confirmation		2 P3	Design	
24	Display data	Visualizing data of the the user and displaying it on the home screen		2 P1	Design	
25		Comparing it with others		4 P2	Design	
26		Share on social media		4 P4	Design	
27		A timer to show how long you've run		1 P1	Design	
28		Notification to drink water		2 P4	Design	
29		Use google maps to track runs		3 P1	Design	
30	General settings	Privacy, audio, location, units of measurements, bluetooth		2 P1	Design	
31		A tutorial for first time users on how to use the app, when this happens the tutorial will be available		2 P2	Design	
32		QR code scanner		3 P1	Design	
33		Dark mode		2 P4	Design	
34	Interference	Make sure our app doesn't interfere with bluetooth device		1 P1	Design	
35		Our app should be able to run in conjunction with other apps		P1	Design	
36	Physical objects	Objects outside the AR app that are in real life		2 P2	Design	
37		3D objects		2 P2	Design	
38		QR codes stickers		2 P1	Design	
39						

## Old Trello:

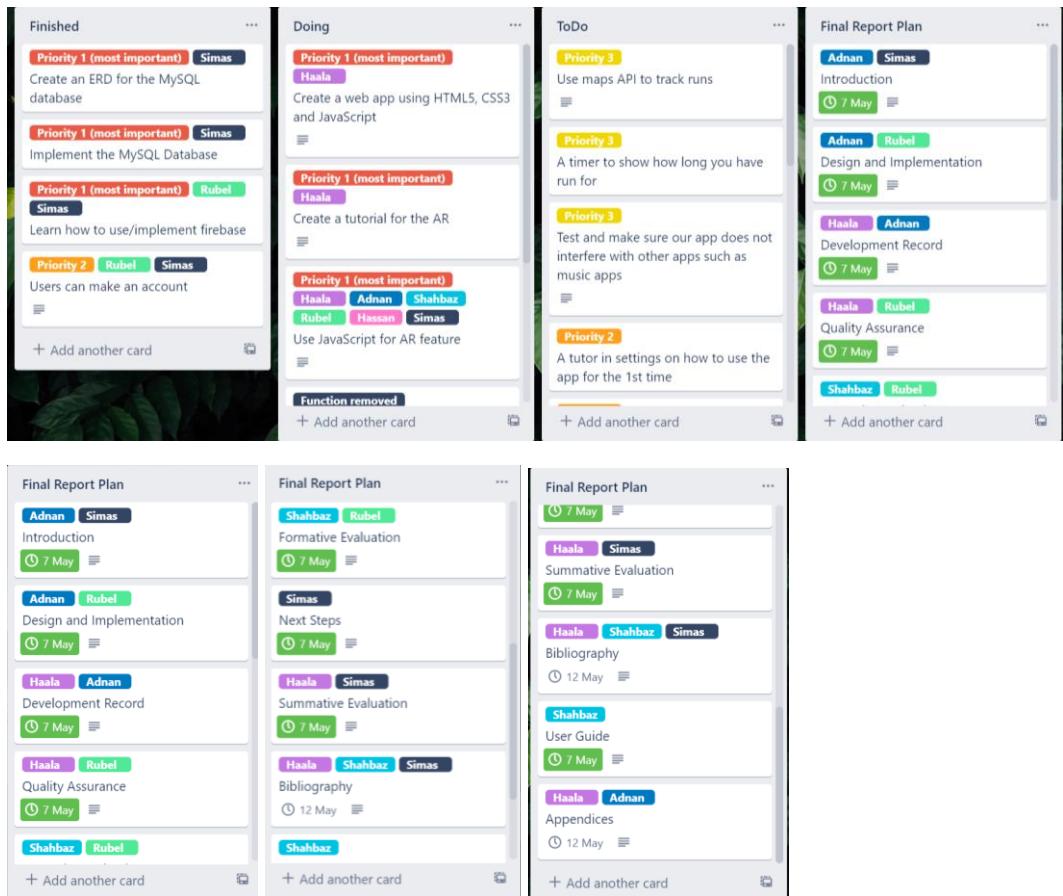
The Trello board is organized into four main sections:

- Finished:** Contains cards for creating an ERD for MySQL, implementing the MySQL database, learning Firebase, and creating an account.
- Doing:** Contains cards for using Unity for AR, creating an app using Java, implementing middleware, and adding another card.
- ToDo:** Contains cards for using a maps API to track runs, creating a timer, testing app interference, and adding another card.
- Final Report Plan:** Contains cards for an introduction, design and implementation, development record, quality assurance, and adding another card.

Each card includes a priority level (Priority 1 or Priority 2) and a list of assigned team members (Adnan, Simas, Haala, Shahbaz, Rubel, Hassan).



## New Trello:



## Quality assurance

```
public class Login_form extends AppCompatActivity {

    EditText emailTxt, passwordTxt;
    Button lgn_btn;
    Button btn_signupForm;

    private FirebaseAuth Authentication;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_login_form);
        getActionBar().setTitle("Login Page");

        emailTxt = (EditText)findViewById(R.id.emailTxt);
        passwordTxt = (EditText)findViewById(R.id.passwordTxt);
        lgn_btn = (Button)findViewById(R.id.lgn_btn);
        btn_signupForm = (Button)findViewById(R.id.btn_signupForm);

        Authentication = FirebaseAuth.getInstance();
    }
}
```

```
lgn_btn.setOnClickListener((v) -> {
    String email2 = emailTxt.getText().toString().trim();
    String password2 = passwordTxt.getText().toString().trim();

    if(TextUtils.isEmpty(password2) && TextUtils.isEmpty(email2))
    {...}

    if(TextUtils.isEmpty(email2))
    {
        Toast.makeText(context: Login_form.this, text: "Please enter your email address", Toast.LENGTH_SHORT).show();
        return;
    }

    if(TextUtils.isEmpty(password2))
    {
        Toast.makeText(context: Login_form.this, text: "Please enter your password", Toast.LENGTH_SHORT).show();
        return;
    }
})
```

```
//Code from Firebase to allow existing users to login
Authentication.signInWithEmailAndPassword(email2, password2)
    .addOnCompleteListener( activity: Login_form.this, (task) -> {
        if (task.isSuccessful()) {
            startActivity(new Intent(getApplicationContext(), MainActivity.class));
        }
        else {
            Toast.makeText(context: Login_form.this, text: "password or email is incorrect", Toast.LENGTH_SHORT).show();
        }
});
```

## Formative and Summative Evaluation

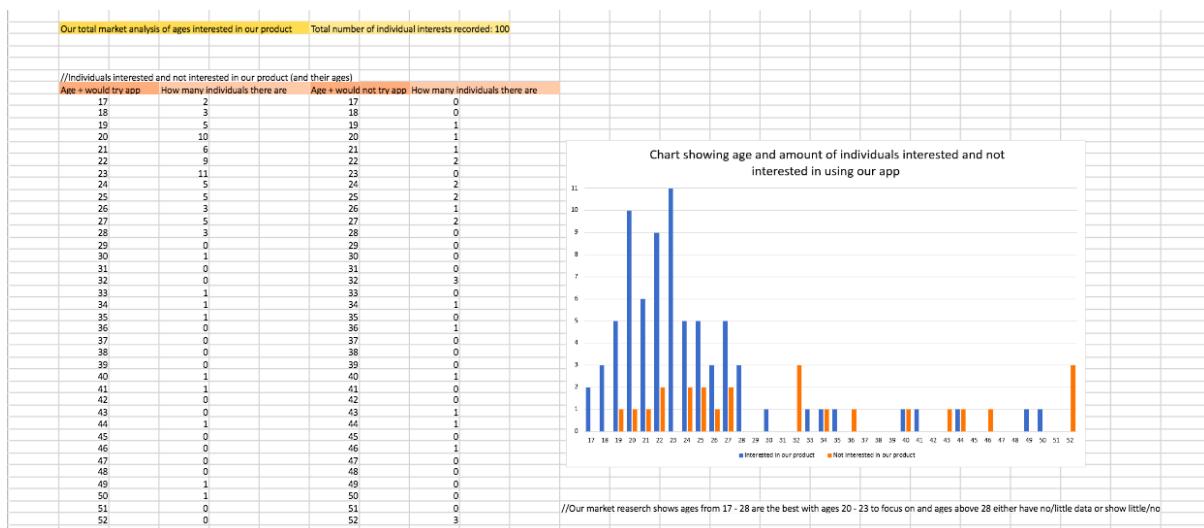
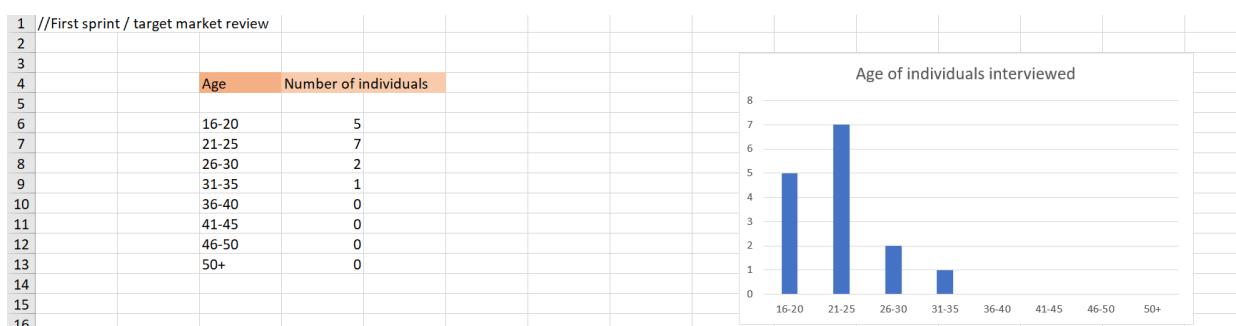
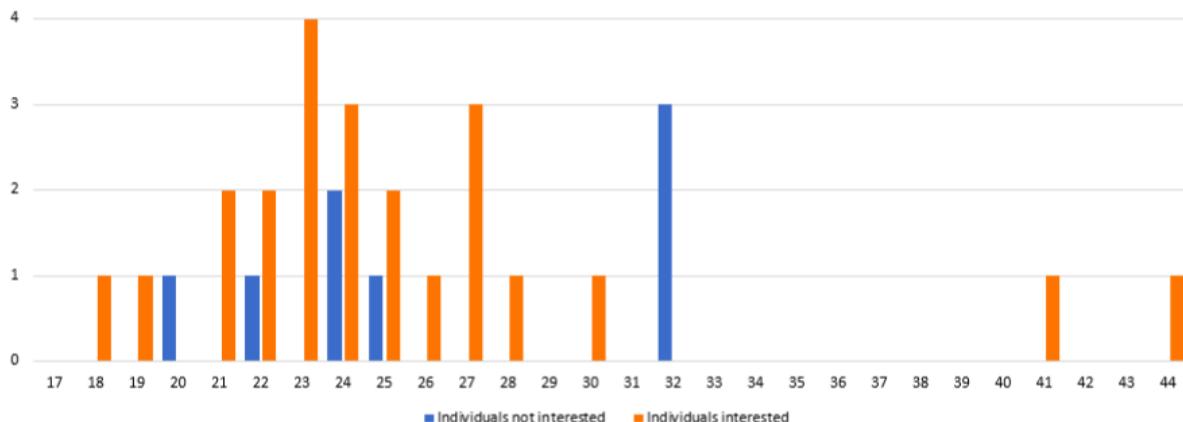


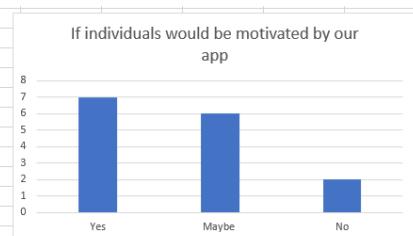
Chart showing age and individuals interested or not in our app

5

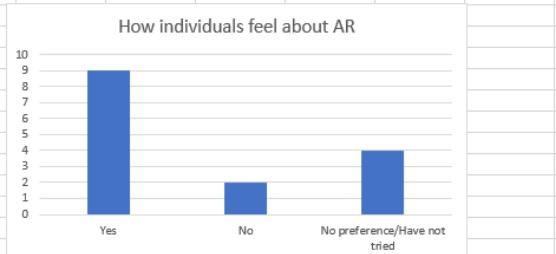
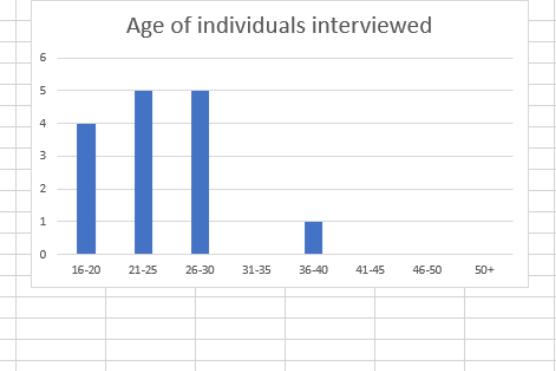




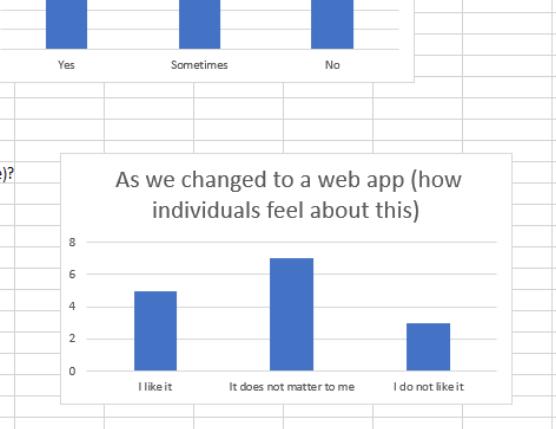
115	Would this application motivate you to run more?
116	Yes      Maybe      No
117	7            6            2
118	
119	
120	
121	
122	
123	
124	
125	
126	
127	
128	
129	<u>Any extra useful/interesting comments made:</u>
130	Many individuals said they would like a social media implementation (which for the team is a future goal)
131	
132	Be able to choose different collectables
133	
134	A tutorial would be nice
135	
136	



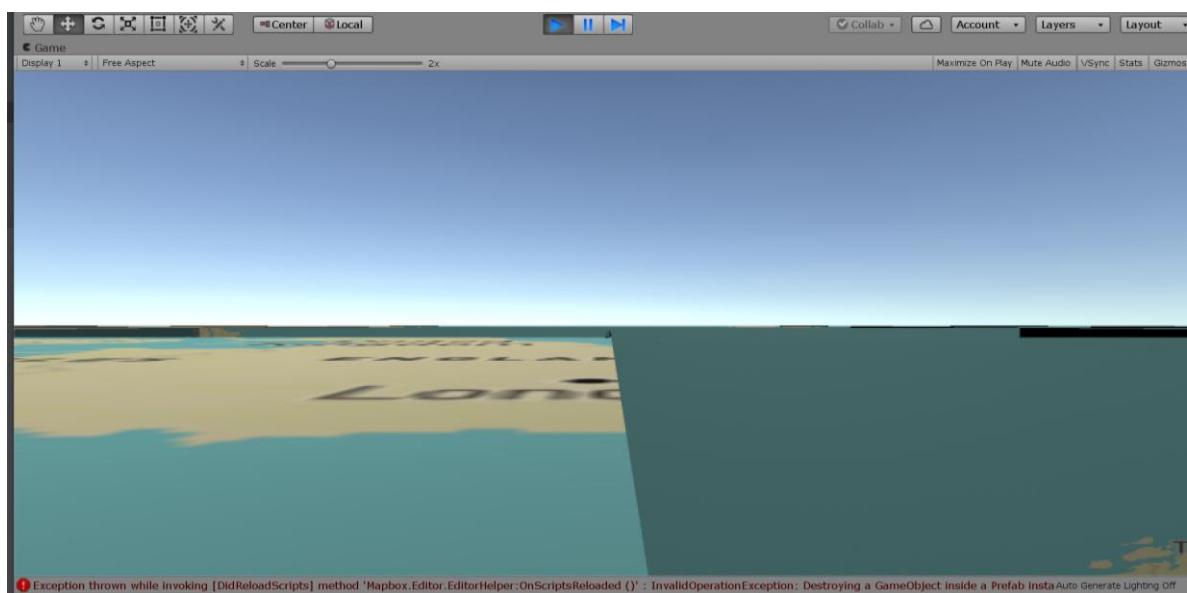
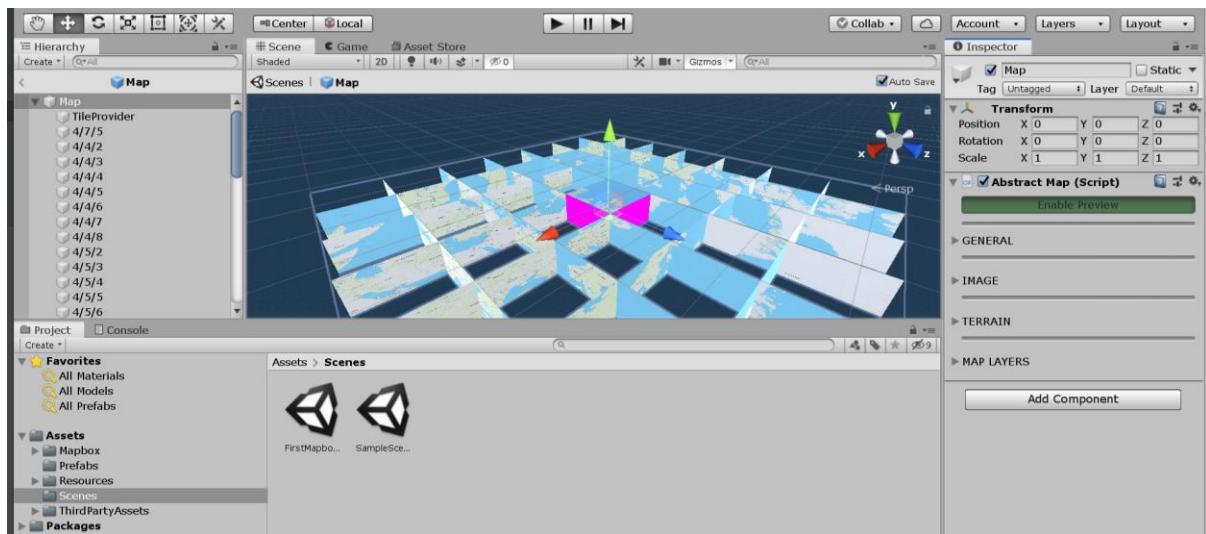
1	//Second sprint / target market review																		
2																			
3																			
4	<table border="1"> <thead> <tr> <th>Age</th> <th>Number of individuals</th> </tr> </thead> <tbody> <tr><td>16-20</td><td>4</td></tr> <tr><td>21-25</td><td>5</td></tr> <tr><td>26-30</td><td>5</td></tr> <tr><td>31-35</td><td>0</td></tr> <tr><td>36-40</td><td>1</td></tr> <tr><td>41-45</td><td>0</td></tr> <tr><td>46-50</td><td>0</td></tr> <tr><td>50+</td><td>0</td></tr> </tbody> </table>	Age	Number of individuals	16-20	4	21-25	5	26-30	5	31-35	0	36-40	1	41-45	0	46-50	0	50+	0
Age	Number of individuals																		
16-20	4																		
21-25	5																		
26-30	5																		
31-35	0																		
36-40	1																		
41-45	0																		
46-50	0																		
50+	0																		
5																			
6																			
7																			
8																			
9																			
10																			
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12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22	Do you like the concept of Augmented Reality?																		
23	Yes      No      No preference/Have not tried																		
24	9            2            4																		
25																			
26																			
27																			
28																			
29																			
30																			
31																			



36	Do you run as exercise?
37	Yes      Sometimes      No
38	5            7            3
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	What do you think about the application being web based (not on the app store)?
52	I like it      It does not matter to me      I do not like it
53	5            7            3
54	
55	
56	
57	
58	
59	
60	
61	
62	
63	
64	



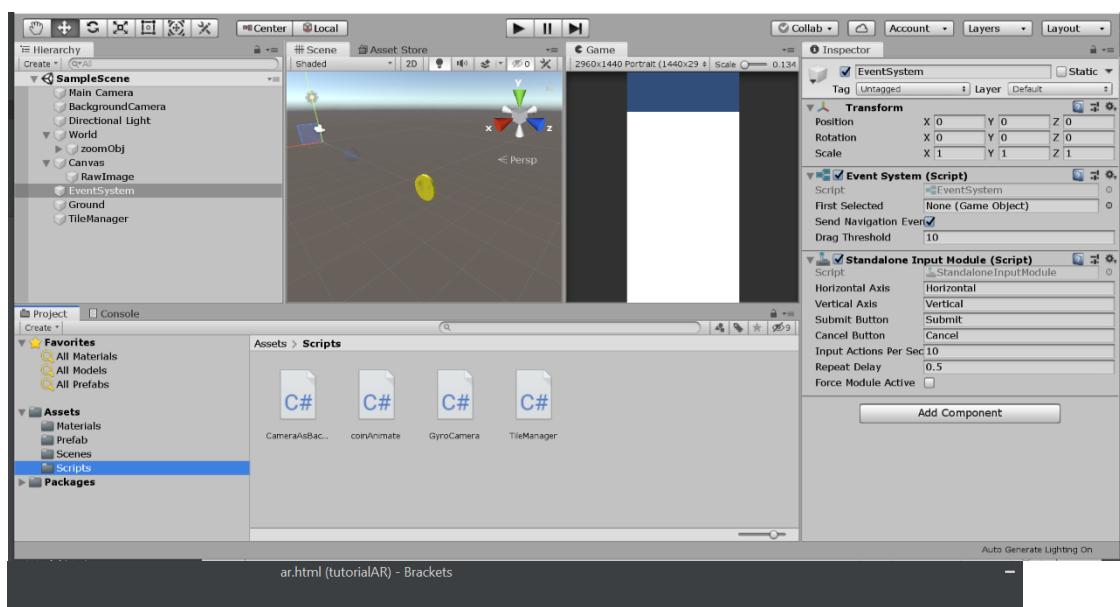






Unity\_test2.mp4

Unity\_test1.mp4



```
<!-- HOW THE AR WORKS -->
<video class="ar" autoplay="true" id="videoElement" id="overlay"></video>

<script src="three.js-master/build/three.js"></script>
<script>

//For the video
var video = document.querySelector("#videoElement");

if (navigator.mediaDevices.getUserMedia)
{
    navigator.mediaDevices.getUserMedia({ video: true })
    .then(function (stream)
    {
        video.srcObject = stream;
    })
    .catch(function (error)
    {
        console.log("There was an error");
    });
}

//Three.js - to load/render the shapes
var scene = new THREE.Scene();
var camera = new THREE.PerspectiveCamera( 75, window.innerWidth/window.innerHeight, 0.1, 1000 );

//Alpha true for no background
var renderer = new THREE.WebGLRenderer({ alpha: true });
renderer.setSize( window.innerWidth, window.innerHeight );
document.body.appendChild( renderer.domElement );

var geometry = new THREE.BoxGeometry();
var material = new THREE.MeshBasicMaterial( { color: 0xa0db8e} );
var material1 = new THREE.MeshBasicMaterial( { color: 0x91aaa8} );
var cube = new THREE.Mesh( geometry, material );
```

```
ar.html (tutorialAR) - Brackets

        (function() {
            'use strict';

            var cube = new THREE.Mesh( geometry, material );
            scene.add( cube );
            scene.add( cube1 );

            cube.position.x = 9;
            cube.position.y = 2;
            cube.position.z = -6;
            camera.position.z = 6;

            var animate = function () {
                requestAnimationFrame( animate );

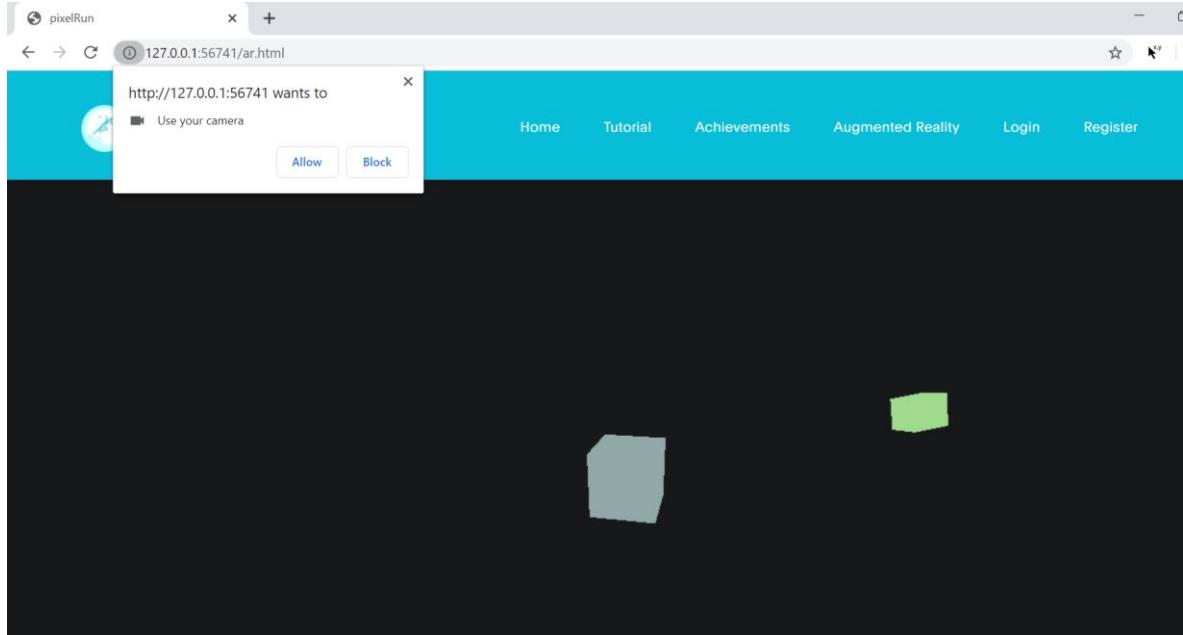
                cube.rotation.x += 0.01;
                cube.rotation.y += 0.01;

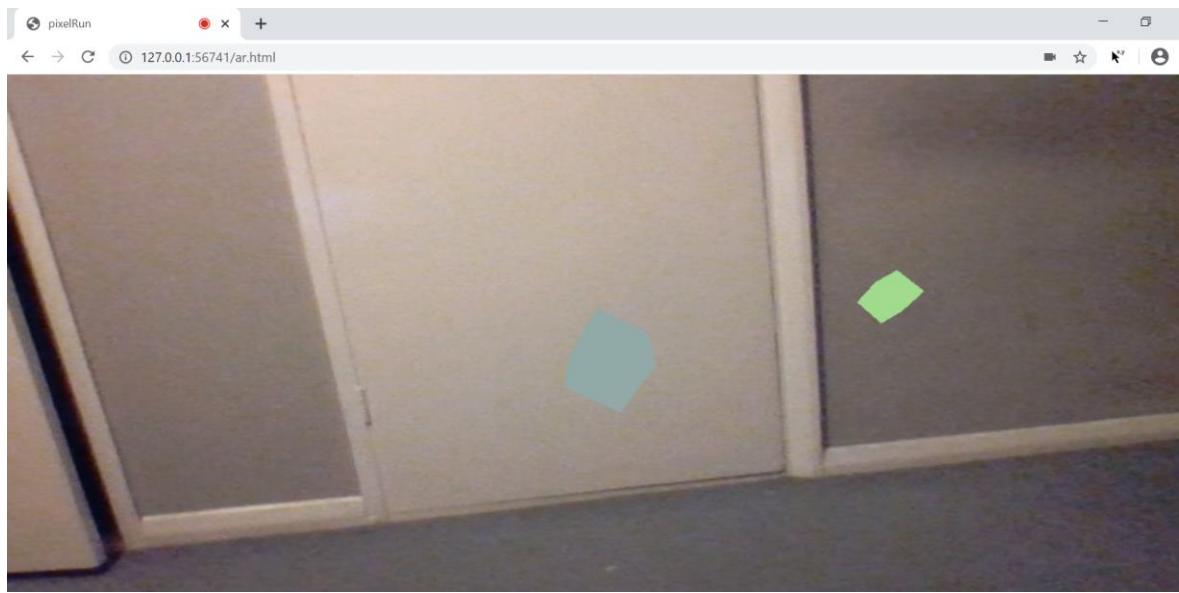
                cube1.rotation.x += 0.02;
                cube1.rotation.y += 0.01;

                renderer.render( scene, camera );
            };

            animate();

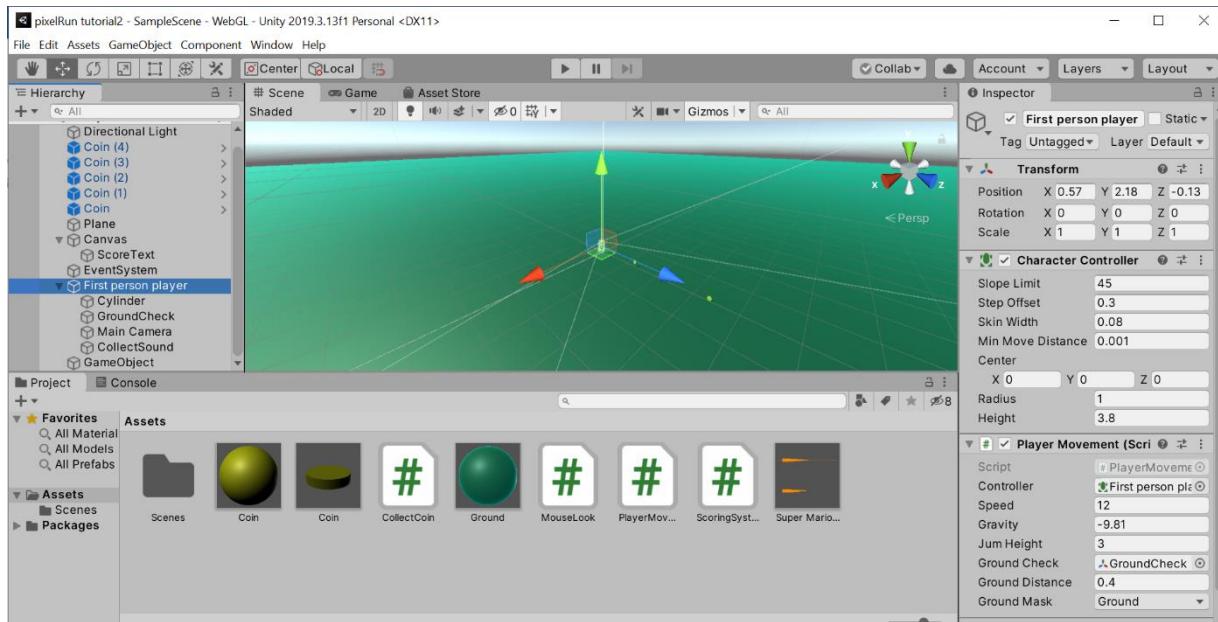
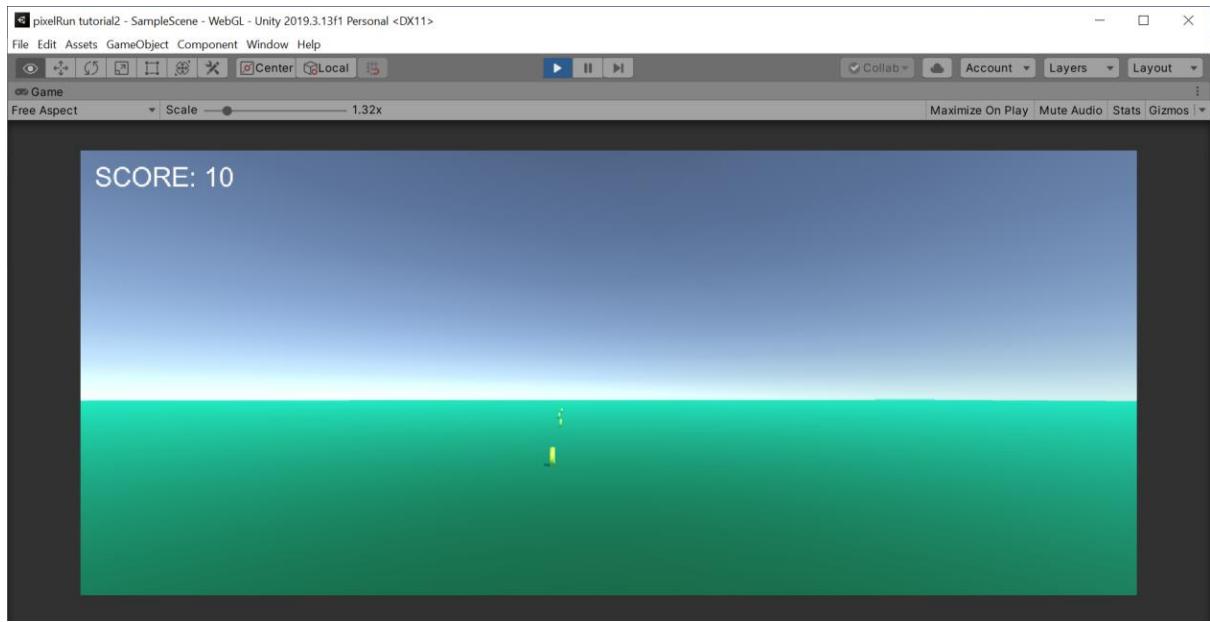
        </script>
```





```
/*-----  
VIDEO  
-----*/  
  
/*FOR THE AR TO WORK*/  
.ar {  
    width: 100%;  
    height: 100%;  
    object-fit: fill;  
    z-index: -1;  
    position: absolute;  
    -webkit-transform: scaleX(-1);  
    transform: scaleX(-1);  
}
```





Unity Hub 2.2.2

unity

## Projects

ADD NEW

Project Name	Unity Version	Target Platform	Last Modified
Softwarep2 C:\Users\haala\Downloads\Softwarep2 Unity Version: 2019.2.17f1	2019.3.2f1	Current platform	3 months ago
AR C:\Users\haala\Downloads\AR Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	3 months ago
New Unity Project (2) C:\Users\haala\New Unity Project (2) Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	3 months ago
New Unity Project (1) C:\Users\haala\New Unity Project (1) Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	3 months ago
New Unity Project C:\Users\haala\New Unity Project Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	4 months ago

Unity Hub 2.2.2

unity

## Projects

ADD NEW

Project Name	Unity Version	Target Platform	Last Modified
pixelRun tutorial C:\Users\haala\Downloads\pixelRun tutorial Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	a few seconds ago
Testing C:\Users\haala\Testing Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	6 minutes ago
New Unity Project C:\Users\haala\Downloads\New Unity Project Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	17 minutes ago
pixelRun C:\Users\haala\Downloads\pixelRun Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	2 months ago
LocationBasedAR C:\Users\haala\Downloads\LocationBasedAR Unity Version: 2019.2.17f1	2019.2.17f1	Current platform	3 months ago

← → ⌂ Not secure | doc.gold.ac.uk/usr/510/

About   Statistics   Achievements   Augmented Reality   Login

```
sysadmin@doc510:~/finalapp/views
hahmee005@igor.gold.ac.uk's password:
Last login: Wed May 13 21:29:02 2020 from 86.22.248.139
-----GOLDSMITHS COLLEGE DEPARTMENT OF COMPUTING-----
          ( )
          | / \ / \ | - - | | |
          | | ( ) | ( ) | |
          | \_ \_ | \_ / | |
          | \_ / |
Email enquiries regarding this server to sysadmin@doc.gold.ac.uk
-----
[hahmee005@igor ~]$ ssh sysadmin@myserver.doc.gold.ac.uk -p 2510
sysadmin@myserver.doc.gold.ac.uk's password:
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-65-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

* Ubuntu 20.04 LTS is out, raising the bar on performance, security,
and optimisation for Intel, AMD, Nvidia, ARM64 and Z15 as well as
AWS, Azure and Google Cloud.

https://ubuntu.com/blog/ubuntu-20-04-lts-arrives

* Canonical Livepatch is available for installation.
- Reduce system reboots and improve kernel security. Activate at:
  https://ubuntu.com/livepatch
Last login: Wed May 13 22:22:24 2020 from 158.223.1.108
sysadmin@doc510:~$ cd finalapp
sysadmin@doc510:~/finalapp$ ls
achievements.html      builds   images    js        nohup.out      register.html    tutorial.html
aframe-boilerplate-master.css index.html login.html npm-debug.log  routes       views
ar.html                fonts    index.js  node_modules package-lock.json three.js-master
sysadmin@doc510:~/finalapp$ cd routes
sysadmin@doc510:~/finalapp/routes$ ls
main.js
sysadmin@doc510:~/finalapp/routes$ cd ..
sysadmin@doc510:~/finalapp$ cd views
sysadmin@doc510:~/finalapp/views$ ls
achievements.html ar.html index.html login.html register.html tutorial.html
```

```
var express = require('express');
var bodyParser = require('body-parser');
var MongoClient = require('mongodb').MongoClient;
var url = 'mongodb://localhost/pixelrundb';
var validator = require('express-validator');
var session = require('express-session');
const expressSanitizer = require('express-sanitizer');
const app = express();
const port = 8000;
MongoClient.connect(url, function(err, db){
  if(err) throw err;
  console.log("Database created!");
  db.close();
});
app.set('views', __dirname + '/views');
app.use(expressSanitizer());
app.use(session({
  secret: 'somerandomstuff',
  resave: false,
  saveUninitialized: false,
  cookie: {
    expires: 600000
  }
)));
app.use(bodyParser.urlencoded({ extended: true }));
require('./routes/main')(app);
// new code added to your Express web server
app.use('/css', express.static(__dirname + '/css'));
app.use('/images', express.static(__dirname + '/images'));
app.use('/fonts', express.static(__dirname + '/fonts'));
app.use('/js', express.static(__dirname + '/js'));

app.engine('html', require('ejs').renderFile);
app.listen(port, () => console.log(`Example app listening on port ${port}!`))
```

## Next steps

```
sysadmin@doc10:/#finalapp$ mongo
MongoDB shell version v3.6.3
connecting to: mongodb://127.0.0.1:27017
MongoDB server version: 3.6.3
Server has startup warnings:
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten]
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten] ** WARNING: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine
2020-03-16T15:47:09.607+0000 I STORAGE [initandlisten] ** See http://dochub.mongodb.org/core/prodnotes-filesystem
2020-03-16T15:47:12.646+0000 I CONTROL [initandlisten]
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.
2020-03-16T15:47:12.647+0000 I CONTROL [initandlisten]
> use pixelrundb
switched to db pixelrundb
> show collections
users
> db.users.find().pretty()
{
    "_id" : ObjectId("5ebc2c3e5a66f68ea97f2609"),
    "firstname" : "Hala",
    "lastname" : "Sudi",
    "username" : "Hahme005",
    "email" : "hahme005@gold.ac.uk",
    "password" : "1234"
}
{
    "_id" : ObjectId("5ebc4e27f8da4d1b7b9e73e1"),
    "username" : "Test4",
    "password" : "$2b$10$RGuYufCFZcn9zahHyDq8h/O4NbZSAzJ0IaevuZwISkJxirRqQTB6pm",
    "email" : "test4@gmail.com"
}
{
    "_id" : ObjectId("5ebc66c3f8da4d1b7b9e73e2"),
    "username" : "Test7",
    "password" : "$2b$10$YnYdM1.XH0Kug1sqELah/0Hd1V330kkoX1ABA/MT4LS9ivPLCbEea",
    "email" : "test7@gmail.com"
}
```

```
1 //This page models the technologies that will be used in the future for this application.
2 //It shows form handling using a MongoDB database as well as the hashing of passwords
3 //using bcrypt. This shows access control by redirecting users to the login page
4 //if they have not signed in. When signed in, the users session will be saved until
5 //they log out which will destroy this session.
6
7
8
9 ▼ module.exports = function(app){
10     const {check, validationResult} = require('express-validator');
11 ▼     const redirectLogin = (req, res, next) => {
12 ▼         if (!req.session.userId) {
13             res.redirect('./login')
14         }
15         else
16     {
17         next ();
18     }};
19
20
21     //Register page main
22 ▼     app.post('/registered',[check('email').isEmail()], function (req,res) {
23         // saving data in database
24         const errors = validationResult(req);
25         if (!errors.isEmpty()) {
26             res.redirect('./register');
27         }
28
29         var MongoClient = require('mongodb').MongoClient;
30         var url = 'mongodb://localhost';
31         const bcrypt = require('bcrypt');
32         const saltRounds = 10;
33         const plainPassword = req.sanitize(req.body.password);
34 }
```

```

  ...
  35    bcrypt.hash(plainPassword, saltRounds, function(err, hashedPassword) {
  36      //Store hashed password in your database.
  37      MongoClient.connect(url, function(err, client){
  38        var db = client.db ('pixelrundb');
  39        if (err) throw err;
  40        db.collection('users').insertOne({
  41          username: req.body.username,
  42          password: hashedPassword,
  43          email: req.body.email});
  44          client.close();
  45          res.send('You are now registered, Your user name is: '+ req.body.username + '<br />+'<br />'+'<a href=' + '/login'+!>Login</a>');
  46        });
  47      });
  48    }
  49  });
  50
  51  //Login page
  52  app.get('/login', function (req,res) {
  53    res.render('login.html');
  54  });
  55  //After user has loggedin
  56  app.post('/loggedin', function (req,res) {
  57    const saltRounds = 10;
  58    const plainPassword = req.body.password;
  59    const bcrypt = require ('bcrypt');
  60    bcrypt.hash(plainPassword, saltRounds, function(err, hashedPassword) {
  61      // check form data hashed password with the password saved in DB
  62      if (err) throw err;
  63      MongoClient = require('mongodb').MongoClient;
  64      var url = 'mongodb://localhost';
  65      MongoClient.connect(url, function(err, client) {
  66        if (err) throw err;
  67        var db = client.db ('pixelrundb');

  db.collection('users').findOne({username: req.body.username} ,function(err, result) {
  if (err) throw err;
  if(result == null){
  res.send('Login Unsuccessful, wrong username'+ '<br />+'<br />'+'<a href=' + '/login'+!>Back</a>' + '<br />+'<br />'+'<a href=' + '/'+!>Home</a>');
  }
  else {
  // **** save user session here, when login is successful
  req.session.userId = req.body.username;
  res.send('You are now loggedin, You user name is: ' + req.body.username + '<br />+'<a href=' + '/'+!>Home</a>');
  }
  client.close();
  })
  });

  app.get('/logout', redirectLogin, (req,res) => {
  req.session.destroy(err => {
  if (err) {
  return res.redirect('./')
  }
  res.send('you are now logged out. <a href=' + '/'+!>Home</a>');
  })
  });

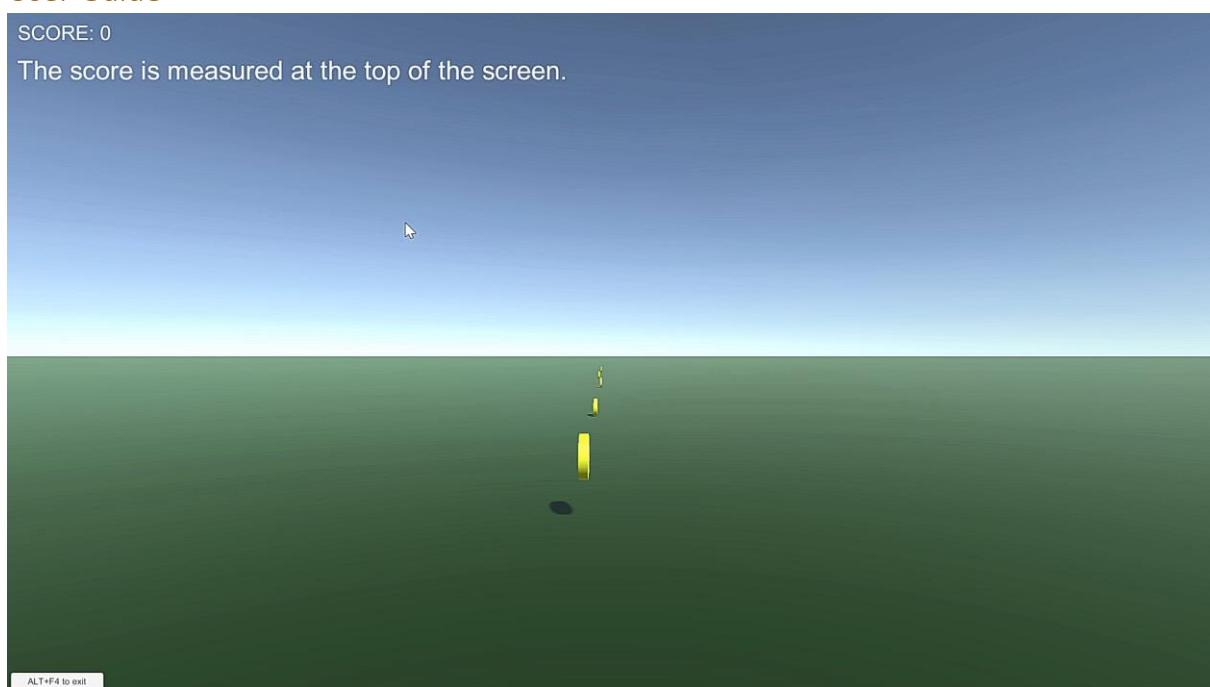
  app.get('/', function (req,res) {
  res.render('index.html');
  });
  app.get('/ar', redirectLogin, function (req,res) {
  res.render('ar.html');
  });
  app.get('/achievements', redirectLogin, function (req,res) {
  res.render('achievements.html');
  });

```

## User Guide

SCORE: 0

The score is measured at the top of the screen.



SCORE: 10

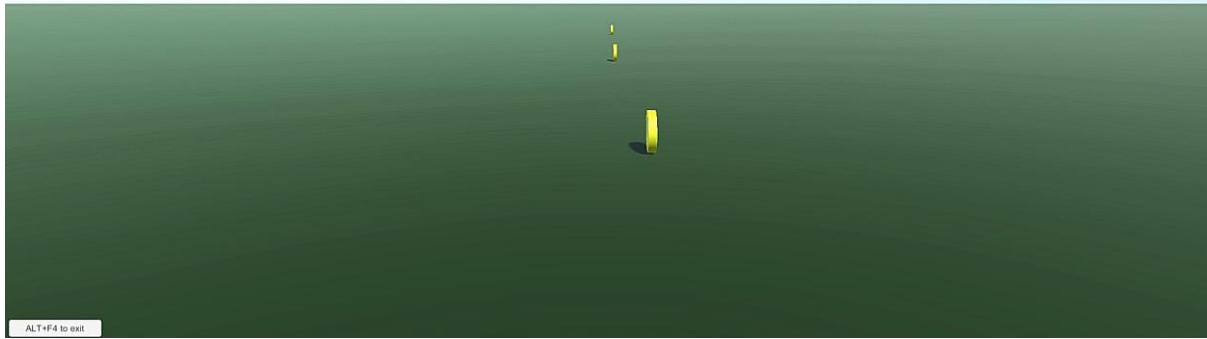
Each coin is worth ten points.  
The score will go up by 10 when the  
coins are collected

You will hear a ding  
when a coin is collected



SCORE: 20

Up key moves you forward.  
Down key moves you backwards.  
Right key moves you to the right.  
Left key moves you to the left.



SCORE: 50

You can use your mouse cursor  
to look around the enviroment.



pixelRun tutorial.mp4

# Gitlab

The screenshot displays the GitLab web interface. At the top, there's a navigation bar with links for 'Projects', 'Groups', and 'More'. A search bar is located at the top right. Below the navigation, a sidebar on the left shows 'Software Projects 10' and various group management options like 'Group overview', 'Details', 'Activity', 'Issues', 'Merge Requests', 'Kubernetes', and 'Members'. The main content area shows the 'Software Projects 10' group details, including its ID (1421) and a 'Leave group' button. A 'New project' button is also present. Below this, a table lists subgroups and projects, each with a star icon, count, and creation date. The table includes columns for 'Subgroups and projects', 'Shared projects', 'Archived projects', 'Search by name', and 'Last created'. The main focus is on the 'finalApp' project under 'Software Projects 10'. The project details page shows a summary with 4 commits, 1 branch, 0 tags, and 87.4 MB files. It features a commit history with a single commit from 'Simas Cesnuskas' made 2 hours ago. Below the commit history is a file list table with columns for 'Name', 'Last commit', and 'Last update'. The table lists numerous files and their last commit details.

Name	Last commit	Last update
aframe-boilerplate-master	Final app commit	23 hours ago
builds/pixelRun	Final app commit	23 hours ago
css	Final app commit	23 hours ago
fonts	Final app commit	23 hours ago
images	Final app commit	23 hours ago
js	Final app commit	23 hours ago
node_modules	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
routes	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
three.js-master	Final app commit	23 hours ago
views	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
achievements.html	Final app commit	23 hours ago
ar.html	Final app commit	23 hours ago
index.html	Final app commit	23 hours ago
index.js	Shows index.html but the links do not work yet	22 hours ago
login.html	Final app commit	23 hours ago
nohup.out	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
npm-debug.log	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
package-lock.json	Final commit, many issues fixed such as the login now works, howe...	2 hours ago
register.html	Final app commit	23 hours ago
tutorial.html	Final app commit	23 hours ago