4. Development

This section outlines the development stage of the project. It details the development of the Android application (including the process of creating the user interface, database, and subsequent gamification elements of the app), as well the subsequent user studies and machine learning implementation that followed.

**4.1. User Interface**

Shortly after completing the research and planning, the development of the project commenced. This chapter begins with an overview of the app’s development. As was the case in the project plan, the user interface of the app was the first thing to be built – subsequently based on the wireframes developed on Mockingbot.com.

Android Studio was the platform used to develop the app, utilised because of its immense capabilities and array of built-in libraries – which made the design and implementation of the app much easier. Notably, Android Studio divides the app into its layout and its functionality, using XML and Java, respectively. For the layout, tool

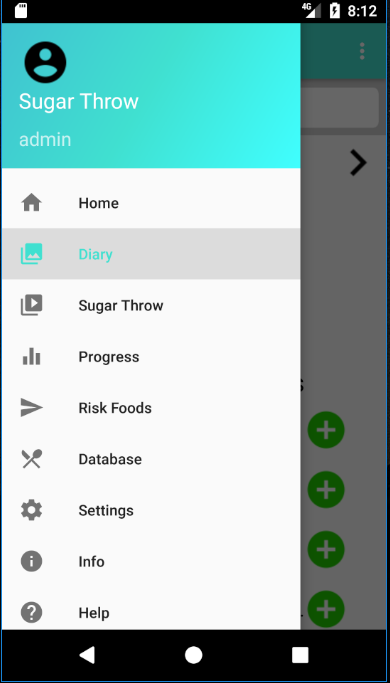
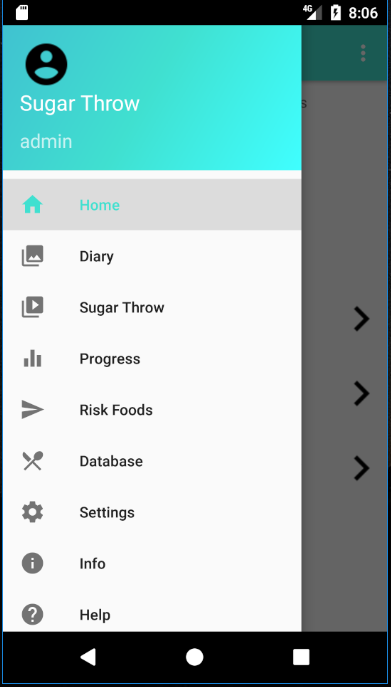
The following subchapters will go into detail regarding some of the user interface features.

***4.1.1. Navigation Drawer***

Navigation around the app was pertinent to its usability. Subsequently, a navigation drawer (or side menu) was added, with its implementation made easier by the built-in libraries in

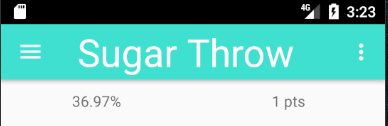
Android studio. The IDE has an activity titled NavigationDrawerActivity, which comes with an already existing side menu. This was customised to include the features present within the app, and to include the username of the user who is currently logged in (see figure x).

Moreover, the items that existed with the navigation drawer could be selected (code which was editable within the activity in Java).



***4.1.2 HUD and Toolbar***

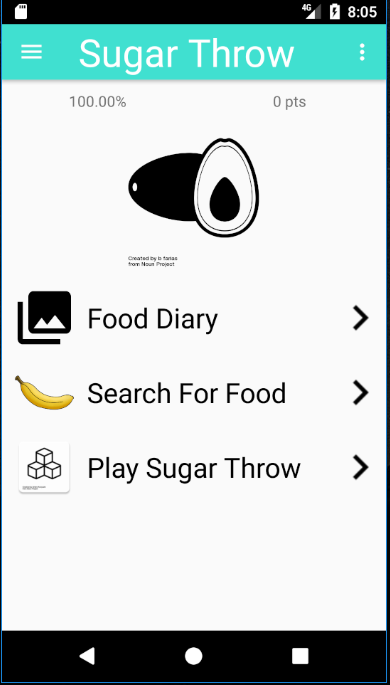
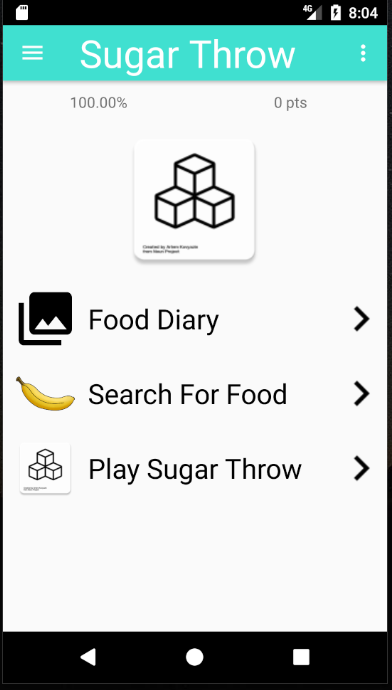
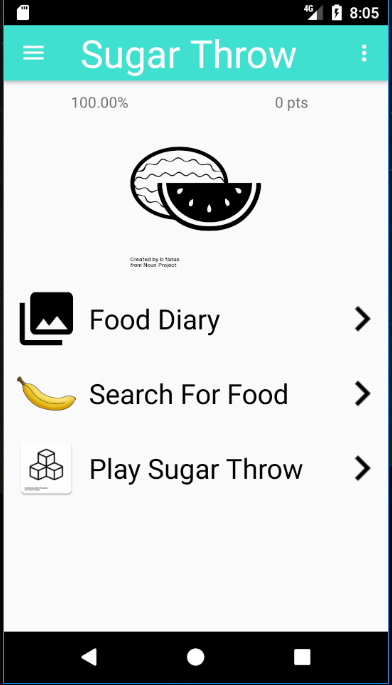
To give the user more information on the home page of the app, a heads-up display (HUD) was created. The HUD includes the amount of sugar the user has left on their daily allowance and the total number of points they have obtained thus far.



Another significant feature in the image above is the toolbar. Not only was this used for access to the navigation drawer (toggling the burger navigation icon), but also included the title of the activity and an options menu (seen on the right of the above image).

***4.1.3 ImageSlider***

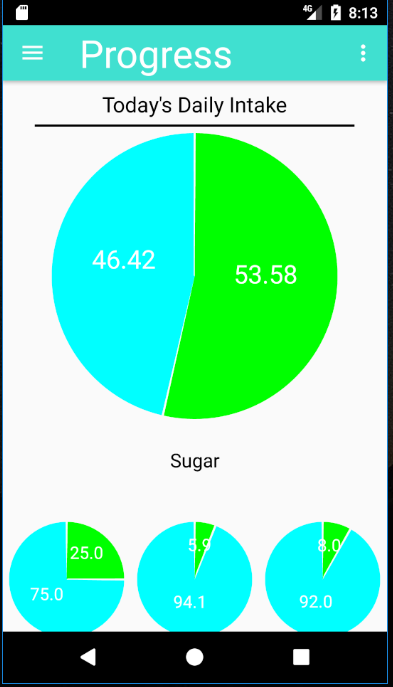
The ImageSlider class inherits the methods and functionality from the PagerAdapter class. The latter class is used to allow multiple images to occupy one space (thereby mimicking an image carousel). Subsequently, if the user swipes left or right on the “hero image” on the homepage, another image will appear (see figure).



***4.1.4 MPAndroidChart Library***

Much of what Android offers through the SDK was enough to suffice for this app. However, the Android Packaging Kit (APK) is limited when it comes to creating charts and graphs (which were necessary for displaying the daily intake and usage streak in a graphical form).

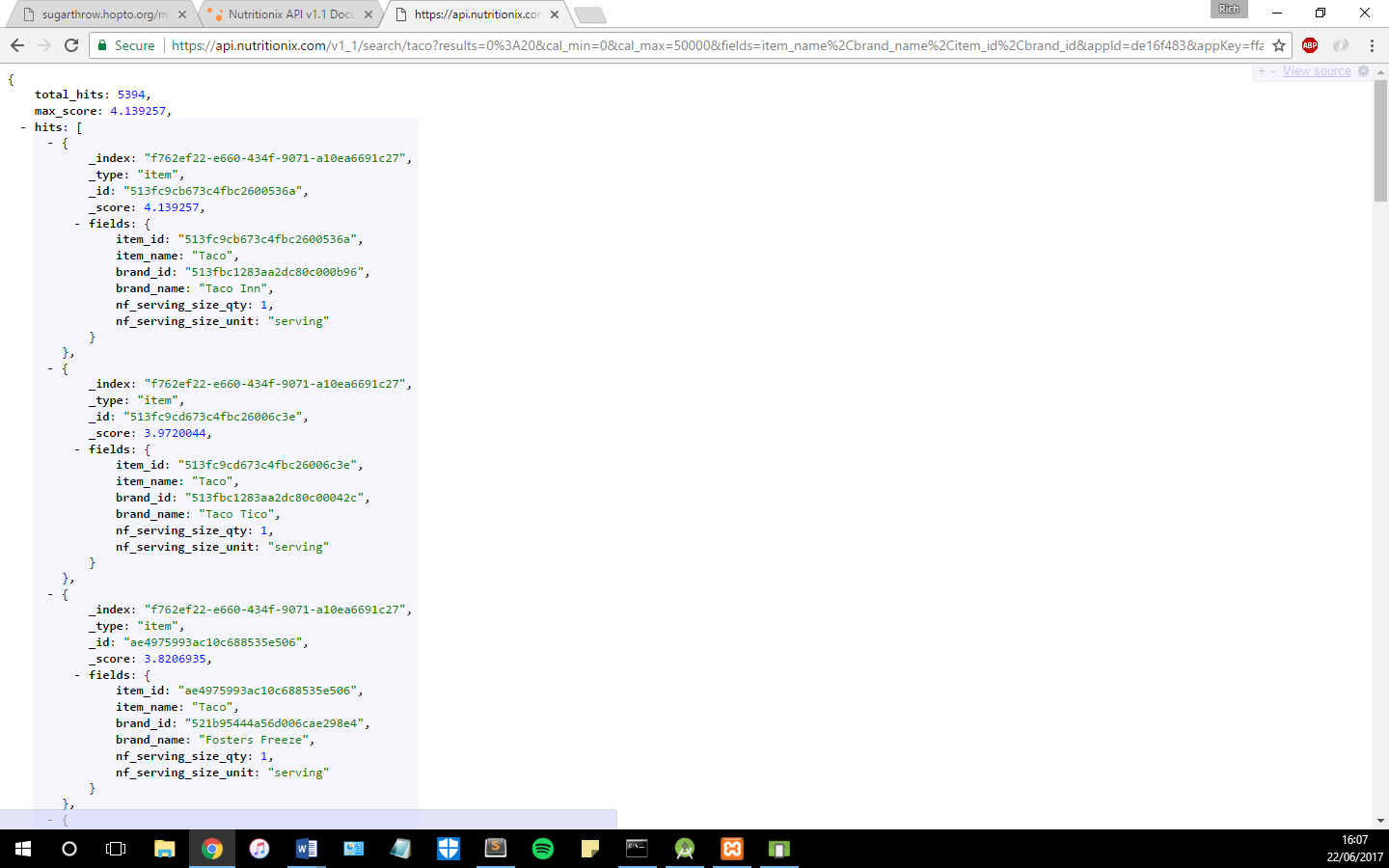
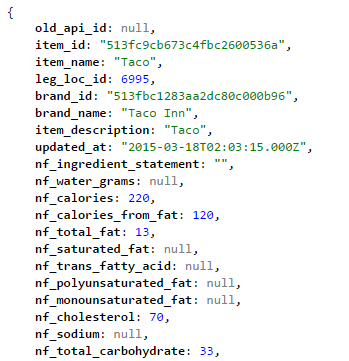
Subsequently, the MPAndroidChart library – developed by PhilJay (2017) – was added to the list of dependencies.



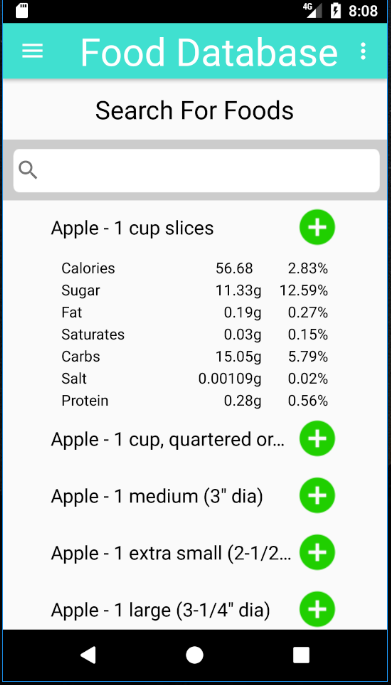
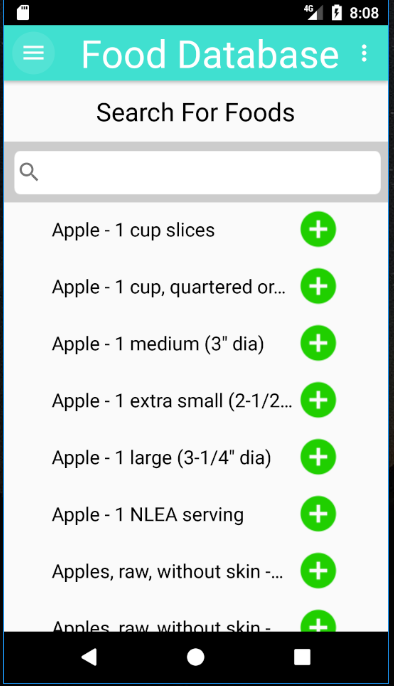
***4.2 Nutritionix API***

In order to obtain food items and nutritional information corresponding to those items, an online food database was needed. The Nutritionix API offered free access to over 500,000 grocery items from Canada, the US, and the UK (cite). Although there are certainly more effective and richer APIs that exist online, Nutritionix offered the minimal requirements necessary for a project of this calibre. It was therefore the ideal choice.

***4.2.1 How the API worked (Volley requests)***



***4.2.2 Returning Results to the App***



***4.2.3 Limitations of the API***

***4.2.4 Caching the Data***

***4.3 SQLite Database***

A database is pivotal to the app in order to record the user’s daily food intake. As a result, an SQLite database was created. Notably, MySQL databases are expensive (cite)…Alternatively, SQLite databases are known to be useful for embedded systems (such as apps), as they are simple, and therefore less expensive.

***4.3.1 Creating the Database***

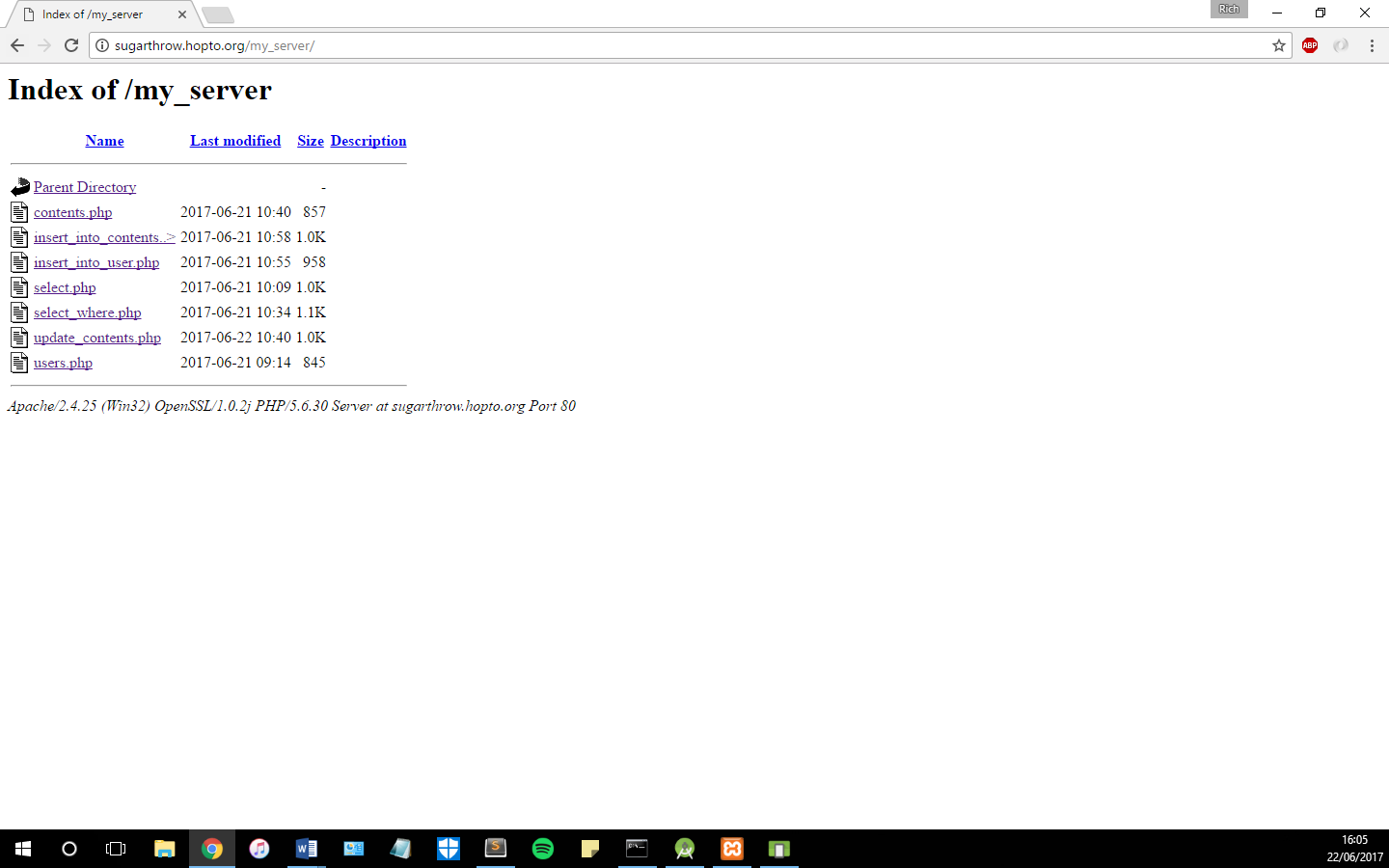
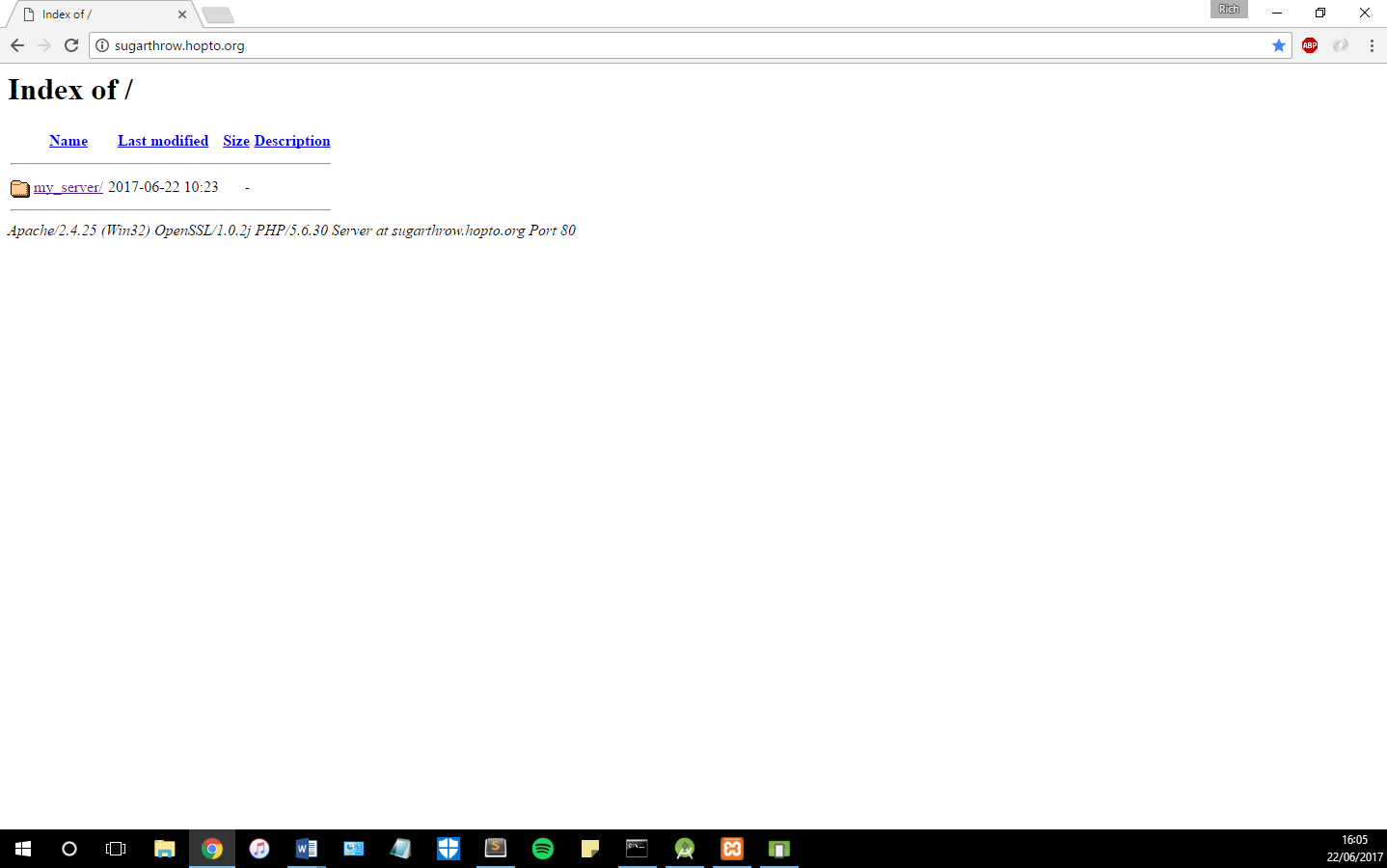
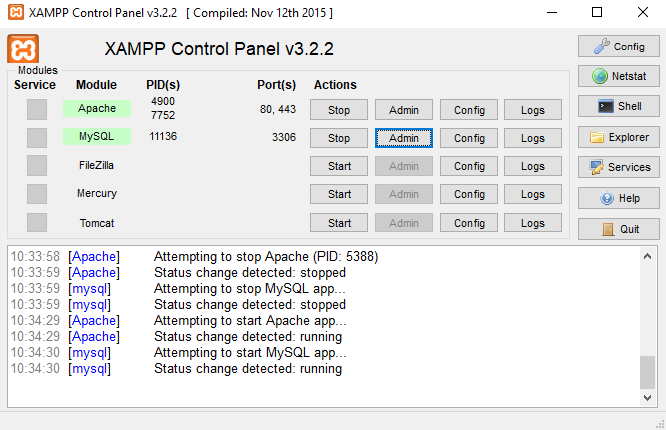
A Connector class inherited the SQLite operations from the SQLiteOpenHelper class that exists within the Android SDK. This class was used to establish a connection with an SQLite database that sat within the assets directory of the Android project.

***4.3.2 Storing Information from the API***

* Diary
* Goals (explained later)
* Food database
* Progress

***4.4 Online Database***

***4.4.1 Creating a Server***



***4.4.2 Logging in and Signing Up***

***4.4.3 Hashing passwords***

***4.5 Unity Game***

Purpose of the Unity game

***4.5.1 Changes made to the game***

***4.5.2 Problems with the game***

***4.6. Gamification Elements***

***4.6.1 Goals***

***4.6.2 Feedback***

***4.6.2 Self-Monitoring***

***4.7 User Acceptance Testing***

Following the completion of the user interface and most of the app’s functionality, user acceptance testing was performed. User acceptance testing is … (cite).

Two students were selected based on convenience to test the app. As this was simply an exercise to determine how usable the app was, the interviews were very informal. Notably, each student was asked to play around with the app for 15 minutes; navigating around the app, adding foods they’d eaten, playing the free-throw game, etc.

From these user tests, a number of flaws in the app were noticed. Most noticeably, there was an issue with …

Other feedback included:

* Improving the look of the app to make it more appealing
* Including information for students on how they could eat healthier, as the app is aimed towards students
* It needed to be made more clear what the HUD was displaying
* Be good to know when food was being inserted/removed

Considerably, this feedback was taken on board and the app went through a subsequent stage of development. In this stage, more “Toast” messages were implemented to give the user an idea of what they were doing, i.e. when a food was being inserted / removed, …

Similarly, these “Toast” messages were used to make the HUD display more click – the user would now be able to click on the items in the HUD and given more information on what the numbers represented.

In addition, a significant amount of time was set aside to improve the look and feel of the app. Much of the feedback from the user acceptance testing was that the design didn’t look very appealing. If the interface is not appealing, it is not engaging. Therefore, a lot of time was put into this exercise as user engagement was a key determinant of this project; this project aims to improve attitudes towards healthy eating by making an *engaging*, gamified application.

5. User Studies

This section outlines the user studies that went underway following the completion of the app.

***5.1. Pilot Study***

***5.2 User Study***

***5.3 Gathering data from the User study***

6. Extension Task – Machine Learning

4.5 Results of Machine Learning Tests

7. Conclusions