

# **FitU: Motivating Fitness**

A Major Qualifying Project Report

submitted to the Faculty of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

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by

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## Abstract

Lack of exercise is a serious and growing problem on college campuses. In order to address this issue, we created FitU, a step-counting game for mobile devices to motivate the students and faculty of Worcester Polytechnic Institute to get more exercise by walking. FitU was specifically designed for students who have little interest in physical activity and might prefer to spend their time playing video games. As they walk, players automatically earn tokens which they can then spend on virtual elements such as items and mini-games. This system rewards players for walking and uses the aforementioned gameplay elements to keep them interested. We built the FitU app using the Unity game engine and store player data in a Parse database. We performed user testing on our prototype app and the results indicated that it shows promise as a fitness motivation tool.

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# 1 Introduction

Many young adults do not get the recommended daily amount of physical activity. Insufficient exercise is a growing problem that can lead to health conditions such as heart disease, diabetes, and cancer (Buttussi, Chittaro, 2011, p. 51). College aged students in particular are likely to suffer from unhealthy lifestyles. An Auburn University study found that 70% of students gain weight during college, with an average gain of 12 pounds (Gropper, Simmons, Connell, Ulrich, 2012). The percentage of overweight students increased from 18% to 31% after four years of college. The researchers found that the extra weight was primarily caused by increased fat mass, which they attributed to late nights, poor diet, and lack of exercise (Gropper, Simmons, Connell, Ulrich, 2012). By getting more exercise, college students will be less likely to suffer from weight gain and health risks.

Walking for at least thirty minutes per day is a viable yet simple form of exercise. A 1998 study conducted by Pekka Oja, Ilkka Vuori, and Olavi Paronen measured the effects of having their subjects walk to and from work. They found that for their subjects, who were young to middle-aged adults of low to moderate fitness levels, 30 minutes of walking per day improved aerobic fitness and resulted in more burned fat (Oja, Vuori, Paronen, 1998). They recommended walking as a health-enhancing exercise due to the ease at which it can be implemented into the average person's daily routine.

All students of Worcester Polytechnic Institute must fulfill a physical education requirement, either by participating in varsity or club sports or by taking four physical education courses (WPI Athletics). One such physical education course is Walking for Fitness. Due to the minimally strenuous nature of walking as a physical activity, Walking for Fitness has a reputation for being an easy way to fulfill the P.E. requirement. For this reason, we believe that some students who take the course may be uninterested in physical activity and may not get sufficient additional exercise.

Studies have shown that fitness games are effective motivators that can be used to counter the problem of insufficient exercise (Buttussi, Chittaro, 2011, p. 51). Unfortunately, most existing exercise support devices only interest users who are already motivated to exercise (p. 51). Devices such as Fitbits are effective tools for people who are determined to exercise more, but they do not provide motivation for the apathetic. Mobile phones offer more potential for these users. Most people already own a mobile phone, so no new devices need to be purchased. Walking for Fitness students are likely to already be in the habit of keeping phones in their pockets while walking. Estimates suggest that there are almost two billion smartphone users worldwide (Statista). In the United States, about 85% of people ages 18-29 own smartphones (Smith, 2015). Based on this information, we can assume that the vast majority of WPI students are smartphone owners. Due to their portability, convenience, and ubiquity, mobile phones seem to be the ideal candidates for a fitness game.

## 1.1 The Goal of this Major Qualifying Project

The objective of this project was to create a mobile game that would motivate the students and faculty of Worcester Polytechnic Institute to spend more time walking. We specifically targeted a user base of students who take the course Walking for Fitness for physical education credit. Many of these students are likely to prefer spending their free time playing video games rather than exercising, and we tailored our app towards people who might have that mindset. By playing our game, these students would have a reason to continue walking even outside of scheduled classes. FitU provides an interactive experience that rewards players for steps walked. Using gameplay elements such as points, items, and mini-games as motivating factors, our game attempts to engage users so that they will actively desire to continue playing. By harnessing the appeal of video games, our app reinforces a healthy behavior: walking for fitness.

## 2 Literature Review

### 2.1 Motivation through Gameplay

Fitness games have two main benefits over more traditional fitness programs and devices: their motivational pull and their enjoyability. Games and game-like interactions have been shown to be effective tools to capture and hold the attention of users. Arguably the most important goal of a game is to motivate users to continue playing (Von Ahn, Dabbish, 2008, p. 61). A fitness game that motivates users to continue playing is also motivating them to continue exercising, which is ultimately the main objective of this project. Game elements also increase user enjoyment, which is important because we want our users to think of exercising as a fun task rather than a grueling one (p. 61). Ideally, users of our game will come to find walking to be an enjoyable activity.

#### 2.1.1 Score

In order to make our game effective, we decided to incorporate gameplay elements that have been shown to increase user motivation and enjoyment. One of the most direct ways to do this is to display a score. By using a concrete, strictly increasing number to represent progress, games can motivate users to continue improving (Von Ahn, Dabbish, 2008, p. 63). Scores can foster competition between players as they race in an attempt to earn more points than the other player. Even without competition, having a clear indicator of progress provides a source of constant positive reinforcement.

#### 2.1.2 Randomness

Randomness is another effective gameplay element. In controlled doses, randomness can keep games feeling fresh and unpredictable (Vin Ahn and Dabbish, 2008, p. 64). In a walking game, the winner does not necessarily need to be the player who walked the most steps. Other factors, including randomness and player choices, can influence the outcome as well. Random elements such as items with variable effects and randomly generated mini-game settings can add variation and keep the competition exciting. However, randomness should be used in moderation. If randomness plays too big of a role in determining the outcome, players will see the game as unfair and meaningless. Randomness should never be a more significant factor than skill or effort. The player who walks the most steps should have the highest chance of winning, and that chance should continue to increase with steps taken.

### 2.1.3 Social Dynamics

Social dynamics such as competition and cooperation have also been shown to boost user interest and engagement with games (Buttussi, Chittaro, 2011, p. 51). Although they are seemingly opposites, competition and cooperation both provide a similar appeal because they encourage users to interact with others. Most multi-player games chose to focus on only one of these social dynamics, but incorporating both can increase user engagement even further.

### 2.1.4 Intrinsic Motivators

Games use a variety of other methods to stimulate the player's intrinsic motivation. According to cognitive motivation theory, factors that boost feelings of control and competence also increase motivation (Ryan, Rigby, Przybylski, 2006, p. 349). Players who feel a sense of mastery over the game will continue to play it, while players who struggle to succeed will become frustrated and quit. Intrinsic motivation is also supported by meaningful choices, rewards as feedback, and player freedom (p. 349). These elements all give the player a sense of agency and a desire to succeed.

### 2.1.5 Types of Players

In their paper on the motivational appeal of video games, Ryan, Rigby, Przybylski identify four broad categories of players: killers, socializers, achievers, and explorers. Killers are the players who crave competition and strive to win against others. Socializers are focused on other forms of interaction with other players, such as cooperation, and are usually less concerned with the outcome of the game. Achievers strive for personal success and the pursuit of control or power. Explorers simply want to discover and learn more about the game world. Successful games find ways to appeal to all four of these player types (Ryan, Rigby, Przybylski, 2006, p. 348).

## 2.2 Related Work

As part of our research, we identified and studied six mobile phone apps that were advertised as tools or games to help motivate users to get more exercise. All of these apps were available for free from the Google Play Store. By studying the work of projects that shared our objective, we aimed to learn which design decisions were effective and which were not. Figure 1 below displays the names of the six apps and some basic information about each.



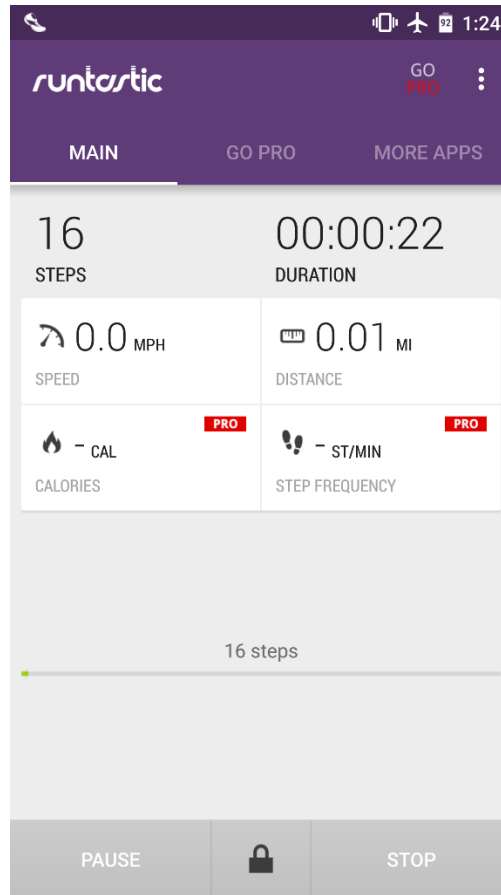
App Name	Company	Sensor Type Used	Social Media	Operating System
Runtastic Pedometer [1]	Runtastic	Accelerometer	Facebook Google+ Twitter	iOS Android
Zombies, Run! [2]	Six to Start	Accelerometer GPS	Twitter	iOS Android
NexTrack [3]	Nexercise Apps	Accelerometer GPS	Facebook Google+	iOS Android
Shape Up Battle Run [4]	Ubisoft	Accelerometer GPS		iOS Android
Battlesuit Runner [5]	Olive Seraph	GPS	Facebook	iOS Android
Wokamon [6]	Noodum Co.	GPS	Facebook Instagram Twitter	iOS Android

**Figure 1: Table of Mobile Fitness Apps**

2.2.1 Runtastic Pedometer

Runtastic Pedometer tracks steps using the accelerometer and calculates calories burned with a formula that is based on the user’s height and weight. In addition to calories burned, it tracks distance traveled, walking speed, and steps taken per minute. It relies on user input in order to track heart rate, mood, surface type, weather, and temperature. It also allows users to enter their step length, units of measurement, and other settings. It includes a feature that allows users to play their own music but has no other sounds. The interface is simple and straightforward, blending text and icons. Figure 2 below shows a screenshot of Runtastic Pedometer’s main screen, which displays little but the numbers that are being tracked. It is a well-designed app but relies fairly heavily on user input. It is focused on activity tracking and has no real game elements.

Our app was influenced by Runtastic Pedometer’s interface and step tracking, but we opted not to focus on as many variables, excluding factors such as mood and weather. Unlike Runtastic Pedometer, FitU is a game, and there is not much in common between them besides pedometer functionality.



**Figure 2: Runtastic Pedometer Screenshot [1]**

### 2.2.2 Zombies, Run!

Zombies, Run! Combines traditional step-counting with an immersive game world to create a unique and engaging experience. It makes use of three different tracking options that can be set by the user: GPS, accelerometer, and a constant speed. It asks the user to enter their stride length in order to estimate distance traveled. The game revolves around zombie chase sequences and item pickups, both of which are signaled by voice notifications. It uses a horror survival narrative to motivate the user to keep running, simulating a life-or-death scenario. The player listens to characters' voices while walking and occasionally picks up random items. New missions are released over time to prevent the game from becoming stale. The app tracks distance traveled, time, and steps. Figure 3 below shows the app's mission screen. The player's item count is displayed in the top-left. Below that is a header bar that shows the numbers that are being tracked. At the bottom of the screen are the audio controls. The interface has no clutter and most of the screen space is taken up by a large logo.

Zombies, Run! can connect to Twitter and sync to an online ZombieLink. It also includes “Abel Township,” a gameplay mode which is not directly related to walking. In this mode, players can build a town using the supplies that they gathered during their walks. Even though this extra game mode does not involve walking, players must walk in order to pick up new items and progress. Zombies, Run! is an immersive and exciting game that succeeds at motivating players to exercise.

However, it is a quite different type of game than the one we created. Zombies, Run! is a story-based game that the user plays while walking or running. Our game is exclusively played between periods of walking and has no narrative elements. Zombies, Run! also makes use of audio to convey information, while our app uses visuals. The most significant similarity is that both games automatically reward the player with useful game resources as they walk. Our app’s header bar is quite similar to that of Zombies, Run! and both display only the most essential information.



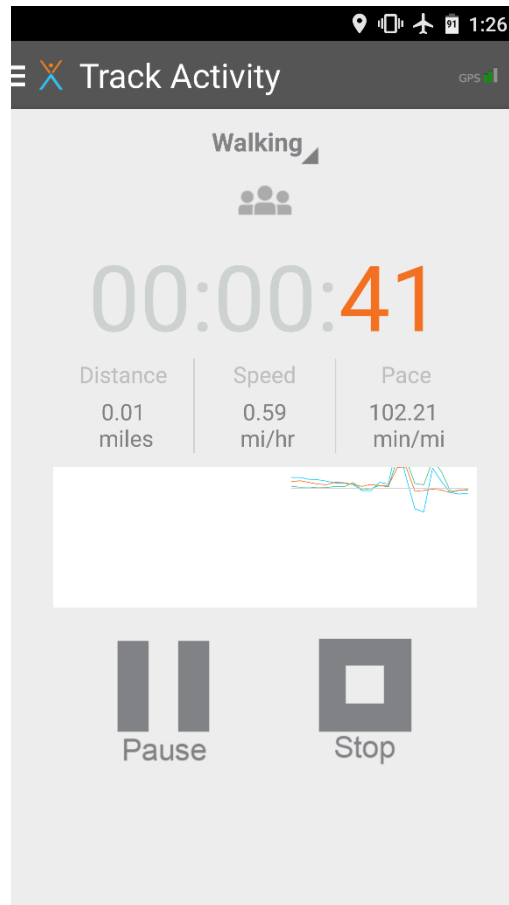
Figure 3: Zombies, Run! Screenshot [2]

### 2.2.3 NexTrack

NexTrack is a step-counting app that focuses on social elements. Upon starting the app, it recommends that you invite friends to join you, claiming that doing so will help you remain motivated. Users of the app can log all kinds of workouts using an extremely lengthy list of possible types. It uses the GPS and accelerometer for counting steps, but it also allows the user to manually set the time spent and miles walked for a given workout. Figure 4 below shows the app logging a walking activity using automatic input from the phone's sensors. It graphs the user's speed over time to provide a visualization of the data.

The app asks users to record their weight, water intake, and sleep, making it a very general purpose fitness app. It can display the weather and temperature using GPS. It does include some basic game elements; users can earn points which will gradually increase their user level. Points can even be exchanged for real-life rewards. The app features a leaderboard of friends, allowing for competition between players. While the game elements are minimal and cheating is very easy due to manual input, NexTrack has some potential as a flexible fitness tracker.

Unlike NexTrack, our app focuses exclusively on walking and is not designed to support other types of workouts. Because our app is a competitive game, cheating could be an issue. To address this, we do not allow the user to manually log workouts. Cheating is still possible with our app because the accelerometer can be fooled with a shaking motion that mimics walking, but this requires much more effort than cheating with NexTrack.



**Figure 4: NexTrack Screenshot [3]**

#### 2.2.4 Shape Up Battle Run

Shape Up Battle Run offers a choice of pedometer or GPS tracking. It asks the user for their age, gender, height, and weight in order to calculate calories burned. Additionally, it tracks steps walked, distance walked, and a unit of score called “bolts.” Shape Up Battle Run is essentially a rhythm game in which users need to sync their steps to the beat of the music to get bonus points. It allows users to compete directly in multi-player races. It also includes a single-player story mode in which verbal information is fed through the user’s earphones. The app has its own music, sound effects, and unlockable achievements. Figure 5 below shows the app’s interface during a single-player race. There is much more of a focus on appealing and colorful graphics with Shape Up Battle Run than with the other apps we studied.

The app syncs to a Uplay account that can also be connected to an Xbox One. Shape Up Battle Run offers a unique type of gameplay that stands in contrast to the other apps that were studied, which have otherwise been fairly passive during the walking process.

Our app uses a similar style of fast-paced gameplay in our mini-games, but a key difference is that Shape Up Battle Run requires players to be engaged with the gameplay while walking. We wanted to prevent our gameplay from being a distraction during walking, so we took a different approach. We also decided that unlike Shape Up Battle Run, our app would have no music. Music is necessary for the rhythm game experience of Shape Up Battle Run, but we believed that users of our app would prefer to listen to their own music while walking.

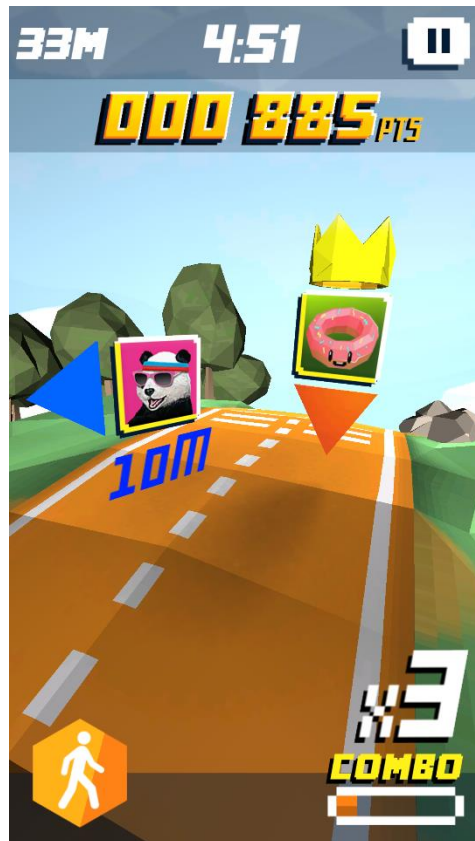
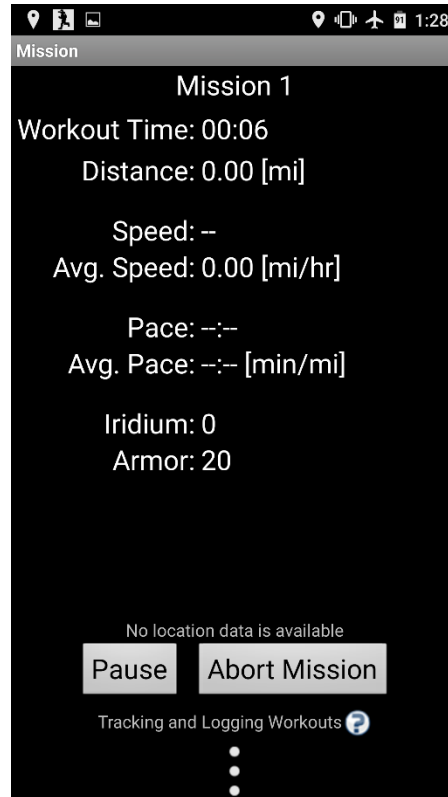


Figure 5: Shape Up Battle Run Screenshot [4]

### 2.2.5 Battlesuit Runner

Battlesuit Runner is a simple game that uses the GPS for distance tracking. It logs distance traveled, current speed, average speed, current pace, and average pace. It features a verbal story through the earphones. Players complete missions to earn iridium, which can be used to upgrade the battlesuit. Figure 6 below depicts the app's interface, which is extremely minimalistic but includes the necessary tracking information. The gameplay is not very deep and the app does not actually count steps. Nevertheless, its game mechanics offer some potential as a motivator for walking.

Like Battlesuit Runner, our app features a currency that is earned by walking that can be spent on various advantages for the player. The key difference is that our app does not make use of audio information during the walking process.



**Figure 6: Battlesuit Runner Screenshot [5]**

## 2.2.6 Wokamon

Wokamon is a colorful and engrossing game that features gradual progression through purchases. It features multiple types of currency that can be used to purchase upgrades and accessories for the player's Wokamon creatures. It makes use of people's innate desire to collect and customize. There are many different unlockable options, but users need to keep walking in order to generate enough points to make more purchases. The app tracks steps walked, calories burned, and distance traveled. Calories burned are calculated using the player's height, weight, and gender. Figure 7 below shows a screenshot of the app's main screen, which contains only the essentials and serves as a dashboard with links to other parts of the app.

Wokamon allows players to add friends and includes a friend leaderboard. It can also connect to several different social media sites: Facebook, Twitter, and Instagram in order to post updates regarding

the player's progress. It can be synced to Google Fit, Fitbit, or Mi Band so that points can be accumulated without a phone. It utilizes unlockable achievements and daily gifts as additional rewards. Wokamon uses these constant rewards to hook their users, and it uses them very effectively.

Our app uses a system similar to that of Wokamon in which players can earn multiple varieties of points. By separating the win condition from the currency, there is no longer a reason for players to be hesitant about spending the currency that they gain. Having multiple currencies also opens up new possibilities for interesting interactions between variables. For example, a player may be able to choose to decrease one currency in order to increase another. Options including this one are present in both Wokamon and our own app. Our app's interface, particularly our use of a main dashboard screen, was modeled largely after the main screen of Wokamon. A series of icons provide easy, one-click navigation to other parts of the app.

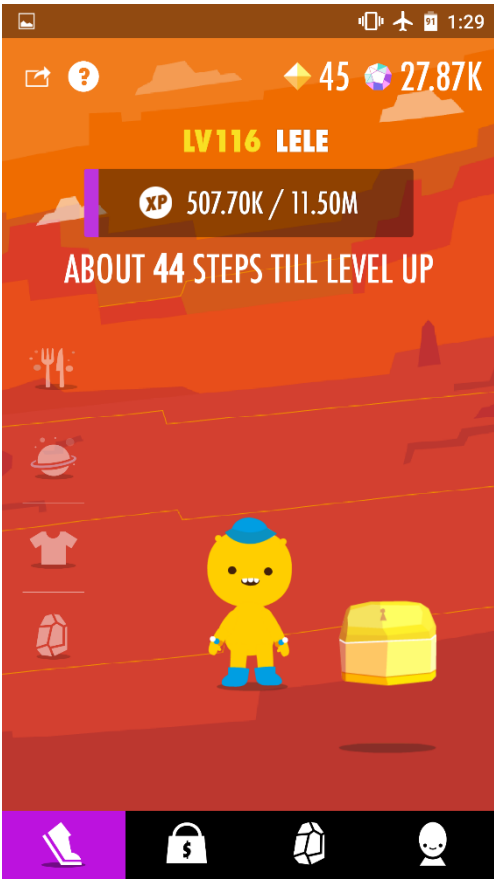


Figure 7: Wokamon Screenshot [6]



## 3 Research

### 3.1 Feature Analysis of Existing Fitness Games and Apps

After we spent some time studying each of these six fitness motivation apps, we created criteria that could be used to evaluate them. We decided to use a numerical scorecard that would include scores for a number of key components that we deemed important for any fitness tracking and motivating game. These individual components were derived from our research on fitness games and the elements that make them effective. Figure 8 below provides descriptions for each of these components.

<b>Component Name</b>	<b>Description</b>
Motivational Quality	How successful are the app's attempts to get its users to walk more?
Feedback	How well does the game communicate information with the player?
Gameplay Depth	How interesting and immersive is the gameplay?
Sustained Interest Value	How long will the user remain invested in the app before losing interest?
Interface	How well-designed is the screen layout?
Learning Curve	How easy is it to use? Is there a help system?
Customization	To what extent can the player make decisions that create a personalized experience?
Social Media	Does the game allow the user to invite friends or share their progress through social media?
Tracking	How accurate is the step / distance tracking? Does the app offer multiple different tracking methods?

**Figure 8: Evaluation Scorecard Components**

For each of the six apps, we assigned it a score ranging from 0 to 3 in each component category. A score of 0 indicates that the component is not present at all within the app. A score of 1 indicates that the component is present but ineffective. A score of 2 indicates that the component is fairly effective, and a score of 3 indicates that the component is an example of excellent design. The sum of all component scores

for a given app results in a total score that can be treated as an overall rating of the app’s effectiveness. Our completed scorecard can be found in Figure 9 below.

	<b>Runtastic Pedometer</b>	<b>Zombies, Run!</b>	<b>NexTrack</b>	<b>Shape Up Battle Run</b>	<b>Battlesuit Runner</b>	<b>Wokamon</b>
Motivation	1	3	1	2	2	3
Feedback	3	3	1	3	3	3
Gameplay	0	2	0	2	1	2
Sustained	2	3	2	2	2	3
Interface	3	2	3	3	3	2
Learning	2	3	3	3	2	1
Customize	3	3	2	2	1	2
Social	3	2	2	1	2	3
Tracking	1	3	2	2	1	1
<b>TOTAL</b>	<b>18</b>	<b>24</b>	<b>16</b>	<b>20</b>	<b>17</b>	<b>20</b>

**Figure 9: Mobile Fitness Apps Evaluation Scorecard**

The results of our evaluation show that Run! Zombies received the highest total score, followed by a tie for second place between Shape Up Battle Run and Wokamon. These three games can be characterized by their significant gameplay elements, clean interfaces, and high levels of polish. All three of them offer some way for players to connect with others, either through social media or multi-player competitions. Most importantly, we believe that all three are able to successfully motivate players to keep walking and to keep playing. Studying how all six apps are able to achieve their varying levels of success drove our future decisions while designing our own app.

### 3.2 Walking for Fitness Questionnaire to Generate Design Requirements

Unlike other fitness apps, which were designed for a more general audience, ours was targeted specifically at WPI students who take the course Walking for Fitness. To obtain information on this target audience, we created a short questionnaire and distributed it at the start of a Walking for Fitness class. To minimize inconveniencing the students and maximize the chance that everyone would answer every

question, the questionnaire was kept extremely short and essentially consisted of only multiple-choice questions. Responses were kept anonymous. Figure 10 below contains our full questionnaire.

**FitU MQP Questionnaire**

Hello! We are an MQP group that is working to create a mobile phone game that will motivate students to walk more. The results of this questionnaire will help us determine what Walking for Fitness students would like to see in our game. Feel free to email us at [fitu@wpi.edu](mailto:fitu@wpi.edu) if you have any questions or suggestions.

**Age:**                      15-25              26-35              36-45              46+

**Gender:**                      Female              Male

**Mobile Device Operating System:**    iOS              Android              Windows              Other: \_\_\_\_\_

Do you use any fitness apps/games?                      Y / N

Do you use any fitness devices? (FitBit, Nike+, etc.)                      Y / N

Do you listen to music while walking?                      Y / N

Do you prefer to walk in a group?                      Y / N

Would competition motivate you to walk more?                      Y / N

Would cooperation motivate you to walk more?                      Y / N

Does seeing your progress (tracking miles, etc.) motivate you to walk more?                      Y / N

Do you play any kind of video games in your free time?                      Y / N

Do you like when apps or games connect to social media?                      Y / N

**Figure 10: Walking for Fitness Questionnaire**

We received responses from twenty-two students. All of them answered every question, with one exception: one student did not select a mobile device operating system. All respondents were in the 15-25 age range. 36% were female and 64% were male. The gender ratio of respondents is fairly close to that of WPI as a whole—33% female and 67% male—indicating that neither gender is much more likely to take Walking for Fitness (Worcester Polytechnic Institute). Figure 11 below displays a breakdown of the respondents’ mobile device operating systems.

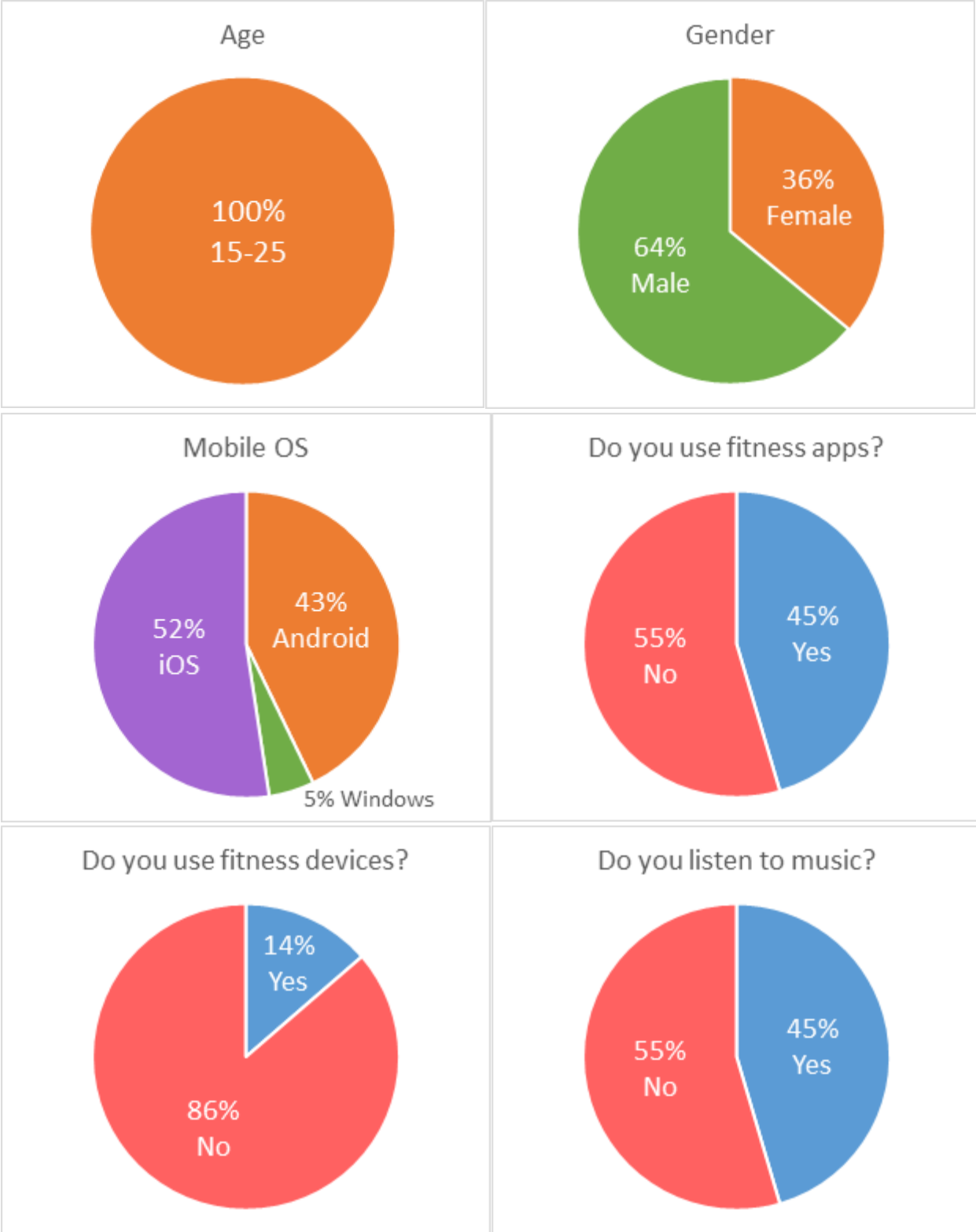
<b>Mobile Operating System</b>	<b>iOS</b>	<b>Android</b>	<b>Windows</b>	<b>Other</b>
Number of respondents	11	9	1	0

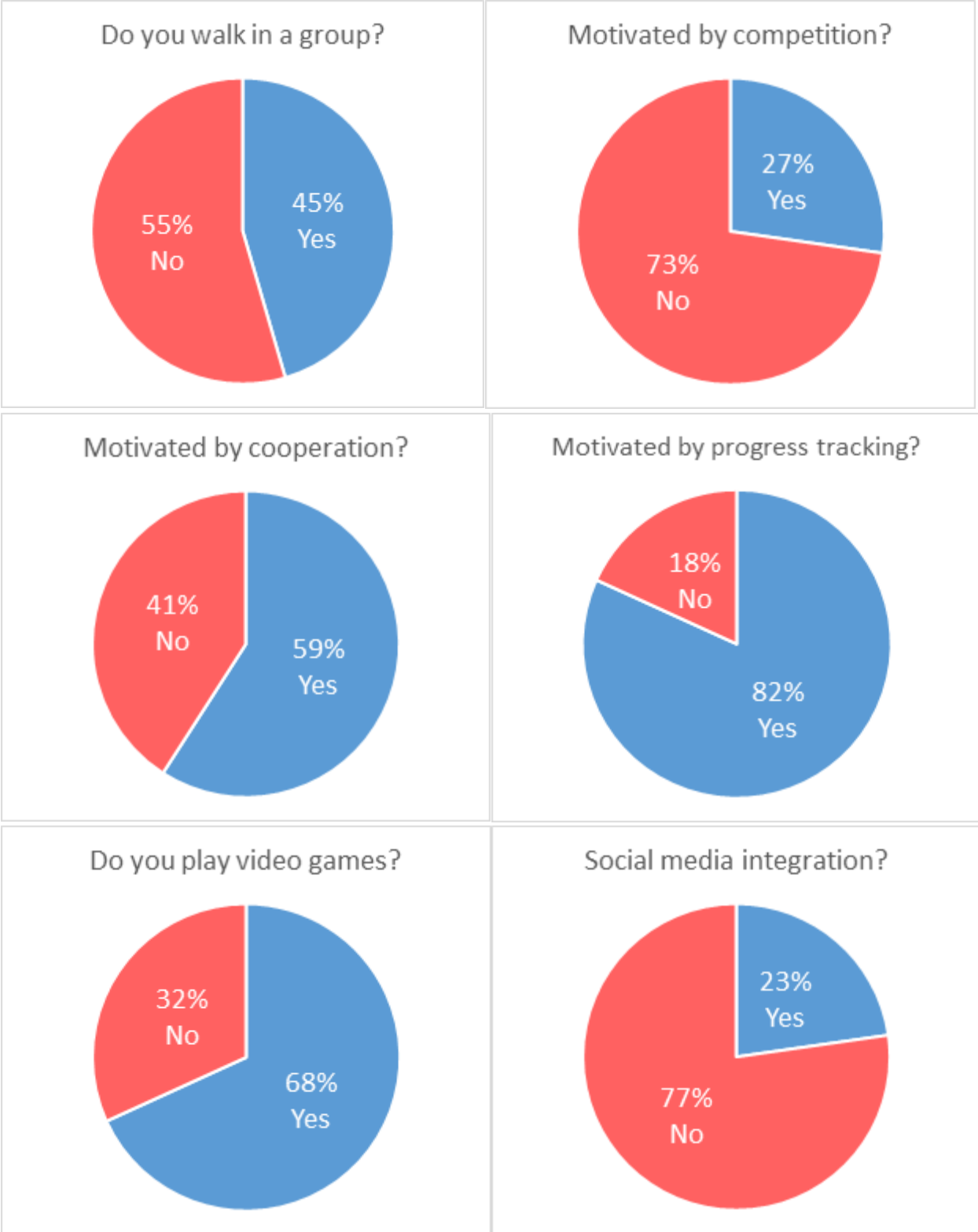
**Figure 11: Mobile Operating Systems of Walking for Fitness Questionnaire Respondents**

The questionnaire results in Figure 11 tell us that approximately 50% of Walking for Fitness students have iPhones and 41% have Android phones. Since these two operating systems dominated the results but neither encompassed a majority of respondents alone, we initially decided to create an app that would run on both iPhones and Android devices. This is one of the main reasons that we chose to build our app in the game engine Unity. In theory, Unity would allow us to eventually port the game to both Android and iOS. During development, we decided to focus on creating a working Android app and never began the iPhone development process. We believe it would likely be trivial, however, for someone with an Apple developer license to port the app to iOS. Figure 12 below displays the results of the questionnaire’s yes/no questions. Figure 13 below displays the all of the questionnaire results visually as a series of pie charts.

Question	Yes	No
Do you use any fitness apps/games?	10	12
Do you use any fitness devices? (FitBit, Nike+, etc.)	3	19
Do you listen to music while walking?	17	5
Do you prefer to walk in a group?	10	12
Would competition motivate you to walk more?	6	16
Would cooperation motivate you to walk more?	13	9
Does seeing your progress (tracking miles, etc.) motivate you to walk more?	18	4
Do you play any kind of video games in your free time?	15	7
Do you like when apps or games connect to social media?	5	17

**Figure 12: Walking for Fitness Questionnaire Results**





**Figure 13: Pie Chart Representations of Walking for Fitness Questionnaire Results**

45% of respondents claimed to already use fitness apps. We found this number to be surprisingly high since we assumed that many students would only take Walking for Fitness for P.E. credit. Our results indicate that a large fraction of them may be genuinely interested in getting exercise by walking. On the other hand, only 14% use fitness devices. This clear preference for mobile apps over specialized devices is part of the reason why we decided against working with such devices for this project.

The vast majority of respondents listen to their own music while walking, so we avoided including background music in our app. We originally planned to include a feature that would allow users to play their own music playlists through our app, but this feature was eventually cut. Even without it, users are still able to switch between our app and their own music player in order to listen to music while they walk.

Only 45% of respondents prefer to walk in a group. 27% believe they would be motivated to walk by competition, and 59% believe they would be motivated by cooperation. The preference for cooperative play led to the idea of group items for our app, items that would offer increased benefits when purchased by multiple players. The idea behind this mechanic was that it would allow players to form mutually beneficial alliances while preserving the competitive race for points. Our current version of the game does not include this feature, but more details about group items can be found in the *Conclusions and Future Work* section of this paper.

82% of respondents believe that progress tracking would motivate them to walk more. This falls in line with our research on how gameplay can be used as a motivator. A visual representation of progress pushes users to achieve even greater successes. Only 68% of our questionnaire respondents regularly play video games. We tried to design our app in a way that would appeal to those who do not play video games as well as those who do. We made sure to keep our gameplay elements relatively simple so the focus could be kept on walking. The questionnaire results also indicate that only 25% of Walking for Fitness students like when apps connect to social media. Many probably see the feature as unnecessary and would prefer to maintain direct control over their social media accounts. Based on this finding, we decided to avoid any social media integration within our app.

Figure 14 below summarizes the requirements gained from the questionnaire results. We followed all of these requirements throughout the design process to ensure that our app would cater to our target audience.

Questionnaire Result	Corresponding Requirement for our App
91% have an iPhone or Android phone.	Must be compatible with all modern iPhones and Android phones.
14% use designated fitness devices.	Must not require the user to have a fitness device. A smartphone must be sufficient.
77% listen to music while walking.	Must allow users to listen to their own music while walking.
45% of respondents prefer to walk in a group.	Must allow users to play in a group with their friends. Must not require users to be part of a group in order to use it.
27% believe they would be motivated to walk by competition.	Must not force users to compete with other people. Must provide users with the option to compete with other people.
59% believe they would be motivated to walk by cooperation.	Must provide users with the option to cooperate with other people.
82% believe they would be motivated to walk by progress tracking.	Must provide clear measures of progress that can be tracked over time.
68% regularly play video games.	Must include elements of video games. Gameplay elements must be simple enough to appeal to non-gamers.
25% like when apps connect to social media.	Must not require social media integration.

**Figure 14: Project Requirements from Walking for Fitness Questionnaire**



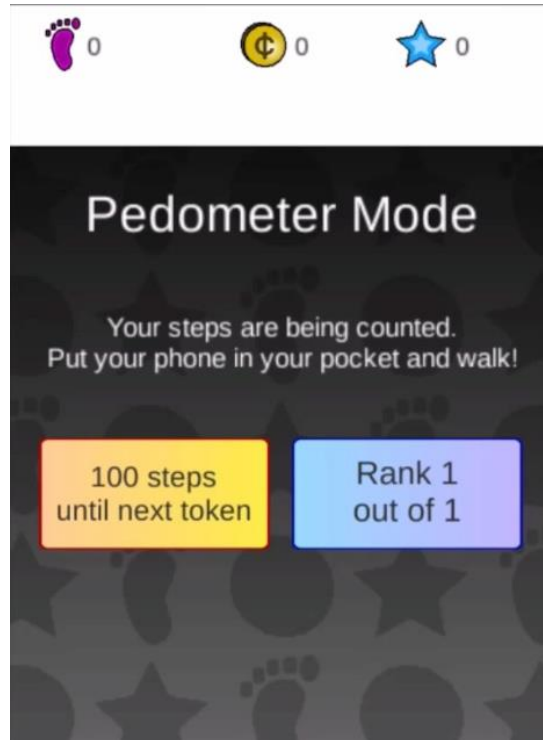
## 4 Game Overview

Our game is a group activity in which players race to earn as many points as possible in a set period of time. Points are earned through various mini-games, which cost tokens to play. Tokens are earned gradually by players as they walk. Tokens can also be spent on various items that have a wide range of effects, from disrupting other players to triggering special events.

At the start of a play session, players form groups. Members of a group compete against each other to earn as many points as possible before the session ends. A play session will usually last for 2 weeks.

### 4.1 Step Counting

Our app functions as a pedometer by keeping track of the user's step count. This is done by polling the device's accelerometer, and checking for sudden impulses in acceleration that indicate a step being taken. A threshold is set at the startup of the app, and as the user walks and impulses are recorded, the threshold will adjust to the user's stride. In a more technical sense, the code will linearly interpolate between the last recorded impulse and the current impulse by the delta time, with a noise filter to eliminate small movements that are the result of activities other than walking. It will then subtract the average of the recorded impulses to find the difference, and if the difference is great enough, it will count a step. This allows the step counter to be used for different stride lengths and pace. The result is fairly accurate, and works for the purposes of our app. Steps will only be recorded while the app is in Pedometer Mode. A screenshot of FitU's Pedometer Mode is shown below in Figure 15. Steps and tokens are automatically incremented as the player walks and their values are visible on the header bar. Pedometer Mode also displays the number of steps needed until the player will receive a token, as well as the player's group ranking. Group ranking is determined by how many points the player has earned compared to their group members.



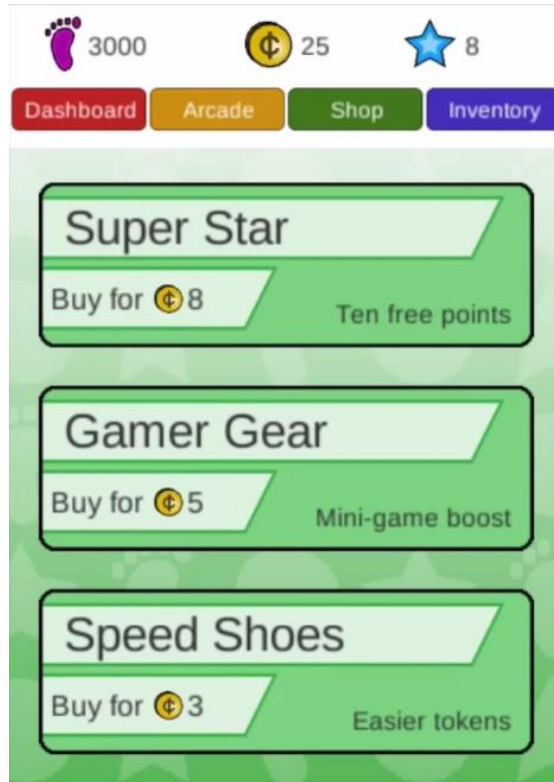
**Figure 15: Pedometer Mode Screenshot**

## 4.2 Tokens

The game includes a system of currency called tokens. Walking a preset number of steps earns the player a token, which can be spent on virtual items or mini-games. At the end of a play session, which will generally last about 2 weeks, tokens will be reset to zero. The tokens are stored in the Parse database as an integer that gets updated each time the database is accessed.

## 4.3 Items

The app's item shop offers a variety of items that can be used to grant benefits or disrupt other players. These items are purchased with tokens earned by walking. Some items, such as the fireball, target a random character and lower their score. Other items protect the buyer from being affected by an opponent's item. A screenshot of the item shop is shown in Figure 16 below. Each item's name is listed with a token cost and a brief description of its effect. Players can purchase items by tapping on them.



**Figure 16: Item Shop Screenshot**

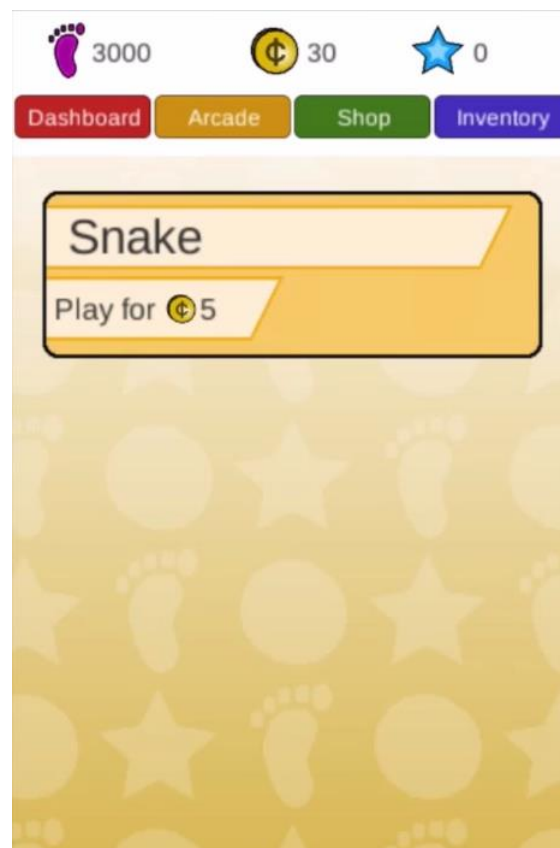
Items are represented as an enumeration in the C# code. Thus, the user's inventory is stored as an array of integers in the Parse database, with each unique integer representing a different item. Our app currently includes two functional items. A Super Star can be bought for 8 tokens and awards the player with 10 free points. Super Stars allow the player to earn points without playing mini-games. A Lottery Ticket can be bought for 2 tokens and has a 10% chance to grant the player 20 free tokens. Lottery Tickets add an element of randomness and risk to the gameplay of FitU. Figure 17 below lists the four items that are currently available from the item shop. More planned items can be found in Appendix B.

Item	Description	Implemented
Super Star	Earn 10 free points without playing a mini-game	Yes
Gamer Gear	Earn 50% more points from your next mini-game	No
Lottery Ticket	10% chance to earn 20 free tokens	Yes
Speed Shoes	Reduces steps needed for tokens by 50%	No

**Figure 17: Items Currently Available in FitU**

## 4.4 Mini-games

Tokens can be spent to buy chances to play one of several mini-games. Playing mini-games grant players points, which are the ultimate win condition for the game as a whole. Mini-games vary greatly and each focuses around different player attributes (timing, hand-eye coordination, puzzle-solving, luck, etc.). The mini-games are intuitive and easy to learn, so that the app is still accessible to a wide variety of users. The ability to succeed at the mini-games will be less important than the number of steps walked, in order to keep the focus on walking. A very successful attempt at playing a mini-game will yield slightly more points than a less successful attempt. Otherwise, the app would reward players who practice the games rather than reward those who walk more. Mini-games are played through the arcade screen, which is shown in Figure 18 below. Players can play a mini-game by clicking on its arcade icon. Token costs for each mini-game are listed under their names. Currently, only one mini-game, Snake, has been implemented. A description of the gameplay of Snake, as well as our other ideas for mini-games, can be found in Appendix A. Figure 19 below lists all of our planned mini-games by name.



**Figure 18: Arcade Screenshot**

Mini-game	Implemented
Bejeweled	No
Breakout	No
Connect Four	No
Cup Shuffle	No
Memory Match	No
Minesweeper	No
Pinball	No
Platform Bouncer	No
Poker	No
Rhythm Game	No
Rock-Paper-Scissors	No
Side-Scrolling Jumper	No
Simon	No
Sliding Puzzle	No
Snake	Yes
Space Shooter	No
Survival Dodger	No
Tetris	No
Tic-Tac-Toe	No

**Figure 19: List of FitU Mini-game ideas**

## 4.5 Events

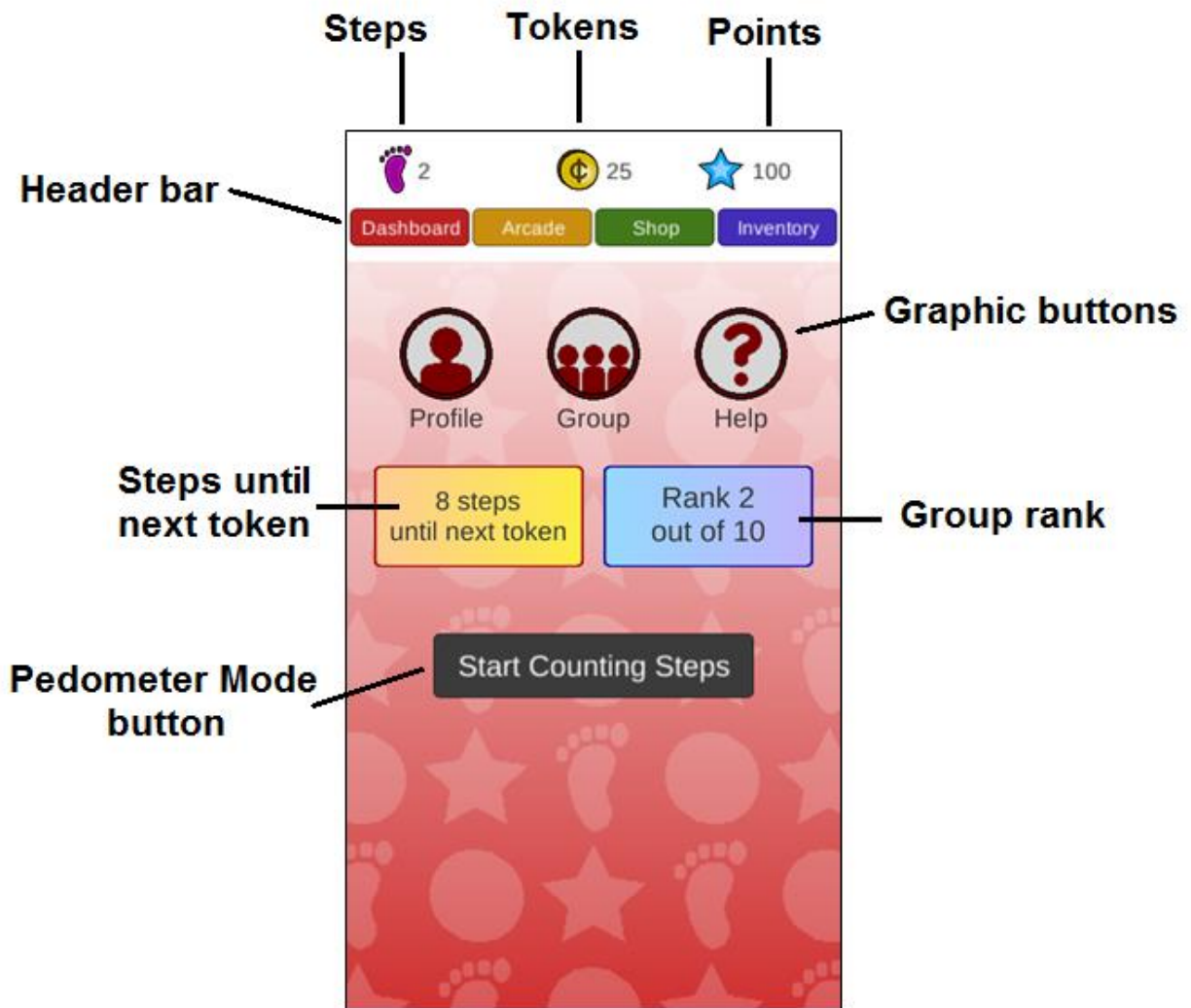
Events were planned to be implemented in FitU, but unfortunately were cut due to time constraints. An event in the context of FitU is a daily variation on normal gameplay. For example: one day may have a Featured Mini-Game, which would reduce the token cost of the featured game so that more users would be encouraged to play it. This would do two things; give incentive to try a different game, and provide users with a cheaper way to earn points.

Events would have to be implemented on the Parse server, so that the app could check for what event is happening at any given time. This poses a slight problem, because it is not possible to write code on the Parse server that would alter the code on the user's device. A way to get around this is to pre-code all of the events into the FitU application, and enumerate them, so that the event would only need to be stored as an integer on Parse. A detailed list of all planned events can be found in Appendix C.

## 4.6 Interface

The app has a vibrant and colorful header bar at the top of the screen. The header bar displays the number of steps, tokens, and points accumulated by the player. It will also include four buttons that allow navigation between the main pages of the app: the Dashboard, the Arcade, the Shop, and the Inventory. The original design of our header bar also included a menu button that would open up a list of further options, but this was later removed in favor of creating a set of three new buttons on the Dashboard page. This change was made in order to reduce the number of clicks needed for navigation. The header bar is present on all pages of the app other than the mini-games, log-in page, and account creation page. Figure 20 below is a labelled screenshot of the app's Dashboard page.

The Dashboard contains several quick links to pages like the user and group settings. It also displays the number of steps needed to earn another token and the user's ranking relative to the other members of the group. The Arcade includes a clickable list of mini-games that can be played for a specified token cost. The Shop contains a list of items that can be scrolled through and purchased via clicking. The Inventory's layout mirrors that of the shop, but it will only contain items that have already been purchased through the shop.



**Figure 20: Annotated Screenshot of FitU's Dashboard page**

## 4.7 Controls

All controls are handled through the touchscreen of the user's phone. Tapping on buttons drawn on the screen navigates menus, buys and activates items, and plays mini-games. Long menus that cannot be contained on the length of the screen use standard scroll panels so that a user can reveal more options by dragging his or finger up or down the screen. Mini-games all have their own controls that will be handled entirely through the touch screen and are unobtrusive of the game screen.

## 4.8 Gameplay

The gameplay component of our app focuses around two features: mini-games and items. While the player is in pedometer mode, neither of these features will be available. This prevents players from looking at their phones while walking. They will only be able to collect tokens. Afterwards, by turning off the pedometer mode, they may purchase and use items or play the mini-games. Playing the mini-games is necessary in order to earn points and have a chance at winning a session. Each of the mini-games has a very simple, touch-based gameplay. A list of mini-games can be found in Appendix A.

The other major gameplay component of our app consists of items and events. All items may be purchased from the item shop at a specific cost. Strategic purchasing and use of items gives players significant advantages. A list of items can be found in Appendix B.

## 4.9 Art

We chose to make the art for our game minimalistic but appealing. Since our group consisted entirely of programmers with no artists, we simply used the built-in drawing tools in Unity. The interface is clear, colorful, and simple. Items are represented textually in a list that appears in the item shop and player inventory. Mini-games have simplistic sprite-based graphics in a somewhat retro style to convey an arcade game feel.



## 5 System Design

FitU functions as a mobile step-counting tool that tracks a user's progress, and allows them to socialize with other users through competition. By providing a quantitative evaluation of how much the user is walking/exercising, the user will hopefully be motivated to exercise more. The app is designed to be used daily and become a part of the user's exercise habit.

With our limited time to develop the application, we were able to achieve most of what we had envisioned when we began the project. Although some features were cut out or not fully implemented, we believe that we have made significant progress, and FitU is in a good place where it can be expanded and improved later on.

### 5.1 Platform

We aimed to have the game run on all modern Apple and Android mobile phones. More specifically, all mobile devices that run Android 4.4 KitKat and up should be able to run the game successfully. Devices must also have a built-in accelerometer that can be accessed using Unity's Input library, which should work for all modern mobile devices. Currently, FitU will only run on Android devices. However, because we created the app using Unity and used no Android-specific features, we believe that porting to iPhones is a simple matter of obtaining an Apple Developer license.

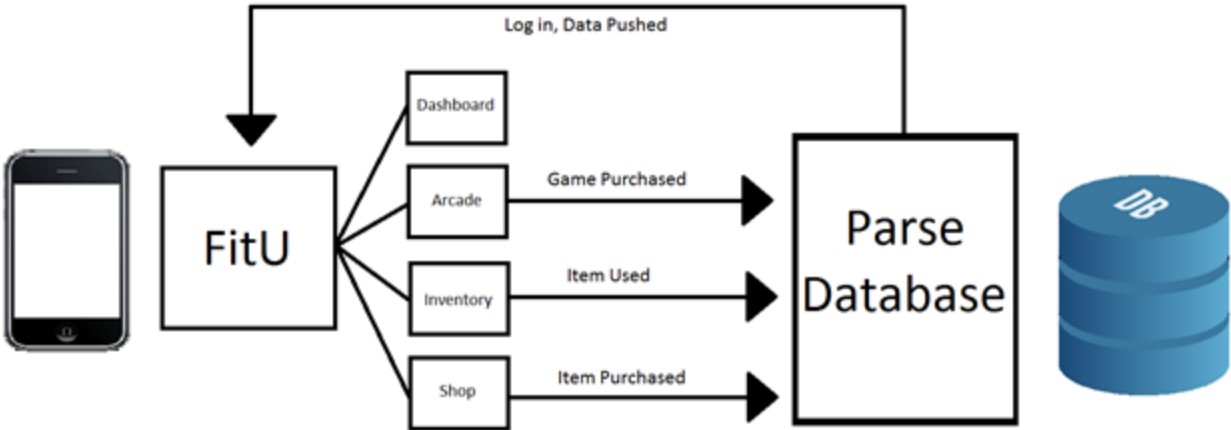
### 5.2 Implementation

The app was developed using the Unity engine. We chose this engine because of its extensive knowledge base, active community, and support for many different platforms. Deploying the app to both iOS and Android is extremely simple. All programming was done in C#, which is a popular and extensive language that is supported by Unity and has plenty of documentation and. Due to the nature of the Android operating system, it is impossible to have an app use the CPU while the phone is locked. This presents a problem, since a user cannot be expected to have their phone unlocked and in their pocket the entire time they are walking and using our application. To circumvent this, we have created a "pedometer mode" within our app which will prevent the phone from going to sleep. This is where all of our step counting will be handled. The step data is stored locally until the user performs an action that requires the use of the database (buying/using an item, playing a mini-game, etc.).

For our database, we utilize a free service called Parse. Parse provides an API to easily store and access data on the cloud. It also has an easy to use web interface to create/drop tables, add rows to tables,

and update the data stored. Data is exchanged between the app and Parse minimally, to reduce the amount of data sent. This is especially important to users who are not on Wi-Fi while using the app, which will probably be the majority of users, as our application requires getting out of the house and walking. Parse does support storing objects, but by forgoing that and instead storing integers or strings, we reduce the amount of data transferred. Figure 21 below describes the interaction between the FitU Unity app and the Parse server.

For details on the implementation of the pedometer, please refer to section 4.1.



**Figure 21: FitU Architecture**

## 6 Testing and Results

### 6.1 User Testing

The overall user experience of our app was tested by a volunteer WPI student. The student is a 21 year old male. The student provided us with the following feedback after a trial run with the FitU app:

- The student was able to create a new account and start playing quickly and easily.
- The multiple currency system was intuitive and served the gameplay well.
- The mini-game Snake was enjoyable and not time-consuming. Most of the user's time was spent walking.
- The step counting seemed to be fairly accurate.

We only tested with one user because the step counting and other computation aspects of the app were able to be self-tested for accuracy. We deemed feedback on the interface from at least one outsider to be necessary. Additional testing would be necessary for a more polished release version of the app.

### 6.2 Pedometer Accuracy

In order to mathematically determine the accuracy of our step-counting algorithm, each of us took 250 steps while the FitU app was running in Pedometer mode in our pocket. The first result of this testing was close to ideal; the app logged 237 of the 250 steps, or 94.8%. When our other team member used the same testing procedure, however, the app only logged 43 out of the 250 steps, or 17.2%. This discrepancy could be explained by differences in pocket size or gait. Because FitU was designed to be a game that can be played competitively, this amount of variation between users is unacceptable. The threshold for recording a step can be changed in the algorithm until testing yields desirable results for all users. Another alternative is to use the Google Fit API for step counting, since it has been tested extensively and would yield more accurate results.

## 7 Conclusions and Future Work

Although we are pleased with the product we were able to create during the year, there is still more work that could be done. Additions such as more social features, more accurate ways to count steps, and more game features could really improve the overall quality of the application.

### 7.1 Social

The social aspect of FitU is what separates the app from other fitness games. There are also fitness apps with many social features, but no gamification of fitness. By blending the two, we believe that our app stands out. Of course, there are many more social features that could be implemented into FitU.

Allowing users to connect their Twitter and/or Facebook accounts would speed up the signup process, and eliminate the need to remember a separate username/password specifically for our app. It would also allow the user to find friends who also use the app and join groups easier. Users would also be able to share their scores, steps walked, and other fitness/game data on their social networks to show off their progress to their friends and family, creating a more social environment for the app.

### 7.2 Accuracy

We implemented our own step-counting algorithm in C# for our app. Although ours is fairly accurate, it is inconsistent and some improvements can be made, such as learning the user's stride and then catering the number to each user. Another solution, especially for the Android version of the app, is to implement Google Fit. Google Fit links with the user's Google account, and allows for step-counting in the background while the app isn't open. This means that users would not need to have the app open and in pedometer mode to track their steps. It would also allow for users to create an account and log in through Google Play, rather than going through our own account creation.

### 7.3 Game Features

Although we have a good amount of game features already in the game, there are some that we wanted to add, but had to cut due to time constraints. These features include more mini-games, more items, and events.

Mini-games are essential to the user experience, since they are ultimately the best way to earn points and win the play session in a group. As of now, there is only one mini-game: Snake. Snake is a fun game on its own, but forcing users to have to play Snake over and over to earn points isn't the direction we wanted to go. In Appendix A, there is a detailed list of all the mini-games that we thought about implementing. Realistically, only about 4 or 5 of them should be added, as to not overwhelm the user. Having this small assortment of mini-games would allow the user to make a meaningful choice about how they want to enjoy the app and ultimately win their play session.

Items are another important aspect to the gameplay mechanics. Right now, items simply target another random user in the group. Allowing a user to select the user to target would be ideal, and provide deeper gameplay and strategy. A larger array of items to choose from is another important improvement that could be made. Defensive items, like a shield to prevent being hit by a fireball, would allow users who are leading their play session to strategize between earning more points, and protecting themselves from detrimental effects.

Finally, events were planned to be implemented in the app, but were cut completely due to time constraints. Events are time-based variations in normal gameplay. The way events would work in FitU is that they would be triggered at the beginning of each day, and provide certain effects such as double step counts, bonus points for a certain mini-game, and discounts on items. Events would steer users towards other games and items that they may not have used often, since they will be cheaper/better during that event. Given more time, events could definitely be added in and broaden the gameplay drastically. Appendix C lists possible events that were planned for FitU and could be implemented in later versions.

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## 9 Appendix A: Detailed List of Mini-games

### 1. Snake

The player controls the head of a snake that grows in length as it comes into contact with dots. The game takes place in a rectangular room that is empty except for the snake and one or more dots. The snake is always moving in one of the four main directions, and the player can change the snake's direction by swiping in one of these directions. The game ends when the snake's head comes into contact with a wall or the body of the snake itself. Points are awarded based on the size of the snake when the game ends.

- **Replay value:** Medium-high
- **Game duration:** Medium-short
- **Implementation difficulty:** Easy
- **Main skill involved:** Motor coordination

### 2. Simon

There are four colored panels on the screen. They light up and play sounds in a sequence. The player must repeat the sequence by tapping on the panels in the correct order. Each time this happens, another step will be added to the sequence. The game ends when the player makes a mistake.

- **Replay value:** Medium
- **Game duration:** Medium-short
- **Implementation difficulty:** Very easy
- **Main skill involved:** Memory

### 3. Sliding Puzzle

There is a four-by-four grid of numbered squares on the screen. One square is missing and the others are numbered 1 through 15, in random order. The player's goal is to arrange the squares so that they are in numerical order and the empty square is in the bottom-right corner. The player can slide a square into the empty space by tapping on it, but only if that square was already adjacent to the empty space. There is no lose condition, so points will be awarded based on the number of moves taken to solve the puzzle.

- **Replay value:** Medium-low
- **Game duration:** Long
- **Implementation difficulty:** Easy
- **Main skill involved:** Decision making



#### 4. Rock-Paper-Scissors

There are three icons on the screen, representing rock, paper, and scissors. The player can tap on any of these icons to make a selection. The AI opponent will randomly choose one of these three choices. The winner is determined based on the relationship between the player's choice and the AI's choice.

- **Replay value:** Low
- **Game duration:** Very short
- **Implementation difficulty:** Very easy
- **Main skill involved:** Purely chance-based

#### 5. Tic-Tac-Toe

There is a three-by-three grid of empty squares on the screen. The player and an AI opponent take turns placing their symbols in squares. The player can place a symbol in a square by tapping on that square. The game ends when the player or the AI achieve a chain of three symbols in a row. The type of symbol in the chain determines the winner. If the board is filled but no chains of three occur, the game ends in a tie.

- **Replay value:** Medium-low
- **Game duration:** Short
- **Implementation difficulty:** Easy
- **Main skill involved:** Decision making

#### 6. Rhythm Game

There are four colored circles in a row at the bottom of the screen. Smaller colored circles will fall vertically from the top of the screen. The player's objective is to click on the large circles whenever they are touching a small one. This will play a note and get rid of the small circle. The game ends when one of the small circles reaches the bottom of the screen without being destroyed. The game will get progressively more difficult over time by increasing the speed and frequency of the small circles.

- **Replay value:** High
- **Game duration:** Medium
- **Implementation difficulty:** Easy
- **Main skill involved:** Timing

## 7. Side-Scrolling Jumper

The player character automatically runs from left to right across the ground. The camera is fixed relative to the player character, so the player character will always be located on the left side of the screen. The player can make the character jump by tapping on the screen. Obstacles and pits in the ground will appear, and they must be jumped over with careful timing. The game ends when the player falls into a pit or crashes into an obstacle.

- **Replay value:** High
- **Game duration:** Medium
- **Implementation difficulty:** Medium
- **Main skill involved:** Timing

## 8. Poker

The player is given five cards. Cards are numbered 1 through 6 and do not have suits. The player's cards are shown on the screen, along with a button labeled "Go." The player can select any number of cards by tapping on them and deselect them by tapping on them again. While any number of cards are selected, the "Go" button will read "Replace" instead. Clicking on the "Replace" button swaps out all selected cards for random new ones. After clicking on "Go" or "Replace," the player's cards are compared with those of an AI opponent. Hands are scored and compared using a variation of poker rules. One pair is ranked below two pairs, which is ranked below three of a kind, which is ranked below a full house (three of a kind plus a pair of something else, which is ranked below four of a kind, which is ranked below five of a kind. Points are also awarded for flushes, or sequences of cards.

- **Replay value:** Medium
- **Game duration:** Short
- **Implementation difficulty:** Medium-hard
- **Main skill involved:** Decision making

## 9. Cup Shuffle

Three cups appear on the screen, one of which is shown to contain a coin. The cups will move around quickly for a while and then stop. The player must guess which cup contains the coin. The player wins by guessing correctly and loses by guessing incorrectly.

- **Replay value:** Medium-low
- **Game duration:** Short
- **Implementation difficulty:** Medium

- **Main skill involved:** Eye tracking

## 10. Space Shooter

The player controls a spaceship located at the bottom of the screen. Asteroids of various sizes come raining down from the top of the screen. The player's objective is to avoid the asteroids for as long as possible. The player can move the spaceship left or right by sliding along the bottom of the screen. (The spaceship will follow the player's finger.) The player can also shoot a laser by tapping the screen. Lasers can destroy asteroids, but larger asteroids require multiple laser hits. Points are awarded based on time survived and number of asteroids destroyed.

- **Replay value:** High
- **Game duration:** Medium
- **Implementation difficulty:** Medium-easy
- **Main skill involved:** Motor coordination

## 11. Survival Dodger

The player controls a red circle by dragging it around the screen. The game takes place in a rectangular room. Blue circles will enter the room through the walls and begin to move in lines, bouncing off of any walls they bump into. The player's objective is to keep the red circle from touching and blue circles for as long as possible.

- **Replay value:** Medium-high
- **Game duration:** Medium
- **Implementation difficulty:** Easy
- **Main skill involved:** Motor coordination

## 12. Breakout

The game takes place in a rectangular room containing a ball, a paddle, and a formation of blocks. The player moves a paddle horizontally by dragging it across the screen. The ball is constantly moving in a straight line, and can bounce off of anything else in the room. The room has no floor, and the game ends if the ball falls past the paddle and touches the bottom of the screen. By moving the paddle under the ball as it falls, the player can bounce the ball upwards into the blocks. When the ball touches a block, the ball will bounce off and the block will disappear. The player wins if the ball destroys every block in the room.

- **Replay value:** Medium-high
- **Game duration:** Medium-long

- **Implementation difficulty:** Medium-easy
- **Main skill involved:** Motor Coordination

### 13. Pinball

The screen shows a standard, simple pinball machine with two flippers near the bottom, several bumpers near the top, and a launcher on the right side. A ball can be launched from the launcher by dragging downwards and letting go. Tapping on the flippers causes them to activate, flipping upwards for a brief period of time. When the ball collides with a bumper, it will earn the player points. The objective is to collect as many points as possible before the ball falls through the gap between the bumpers.

- **Replay value:** Medium
- **Game duration:** Medium-short
- **Implementation difficulty:** Hard
- **Main skill involved:** Timing

### 14. Minesweeper

The screen shows a grid. A few random squares on the grid contain mines. Tapping on a square either uncovers a mine or a number. Numbers indicate the number of adjacent squares that contain mines. The player's objective is to uncover all of the numbers without uncovering any mines.

- **Replay value:** Medium-high
- **Game duration:** Medium
- **Implementation difficulty:** Very easy
- **Main skill involved:** Decision making

### 15. Memory Matching

The screen shows a few rows of cards with pictures on them. After a few seconds, the cards will flip over and the pictures will no longer be visible. The player must match pairs of cards by tapping on them. Once a matching pair is made, those two cards will disappear. The player wins by matching all the cards correctly. If an incorrect pair is selected, the game ends.

- **Replay value:** Medium
- **Game duration:** Medium-short
- **Implementation difficulty:** Very easy
- **Main skill involved:** Memory

## 16. Tetris

Colored blocks of various shapes slowly fall from the top of the screen. The blocks are all made up of a few squares, and they will always be aligned to a grid. Blocks will stack on top of each other. The player can move the falling block to an adjacent column on the grid by swiping left or right. The player can rotate the falling block by tapping on the screen. Once an entire row of the grid has been filled, its contents will be cleared out and everything above that row will fall. Points will be awarded based on the number of rows cleared. The game ends when a block stops falling but extends above the top of the screen.

- **Replay value:** High
- **Game duration:** Medium-long
- **Implementation difficulty:** Medium
- **Main skill involved:** Decision making

## 17. Connect Four

The screen shows a grid with six rows and seven columns. The player and an AI take turns placing differently-colored coins into the grid. Coins will fall from the top of a column until they reach the lowermost unoccupied space. The player wins by forming a chain of four of their coins in any direction. If the AI forms a chain of four first, the player loses. If the board is filled with coins but no chains of four are created, the game ends in a tie.

- **Replay value:** Medium-high
- **Game duration:** Long
- **Implementation difficulty:** Medium-hard
- **Main skill involved:** Decision making

## 18. Bejeweled

The screen shows a grid filled with differently colored gems. Players can swap any gem with an adjacent gem by tapping on the two. When a vertical or horizontal chain of three or more gems has been formed, all gems in the chain disappear. The game includes a time limit. Points are awarded based on the number of chains formed and the number of gems in the chains. If there are no possible ways to form a chain of three or more, the grid will reset and fill with new gems.

- **Replay value:** Medium
- **Game duration:** Medium-long
- **Implementation difficulty:** Medium-easy
- **Main skill involved:** Decision making

## 19. Platform Bouncer

The player character starts on the ground and is constantly bouncing. The screen contains an arrangement of platforms that can be phased through from the bottom and bounced upon from the top. The player can move the character by tilting the device to the left or right. The character will wrap around the screen horizontally. The objective is to continue to bounce upwards for as long as possible. The screen will follow the character and there will always be more platforms to bounce on. As platforms disappear past the bottom of the screen, they will be deleted. The game ends when the character enters a freefall. Points are awarded based on the maximum height reached by the character.

- **Replay value:** High
- **Game duration:** Medium
- **Implementation difficulty:** Medium-easy
- **Main skill involved:** Motor coordination

## 10 Appendix B: Detailed List of Items

### Passive Items

Once purchased, passive items will be immediately sent to the player's inventory. Their effects will be activated automatically when the appropriate circumstances occur. Multiple copies of any passive item may not be purchased by an individual player. Passive items may disappear from the player's inventory after a specified period of time passes. They can also be manually discarded through the inventory screen.

#### 1. Shield

Blocks the effect of one harmful item, then disappears.

- Shield blocks the effects of the following items:
  - Pickpocket
  - Item Thief
  - Fireball
  - Meteor
  - Banishment
  - Thunderstorm
  - Thunderbolt
  - Income Tax
- Shield has no set time limit. It will not automatically disappear from the player's inventory.

#### 2. Peace Treaty

Blocks the effect of all harmful items, but also prevents you from using harmful items.

- Peace Treaty blocks the effects of the following items:
  - Pickpocket
  - Item Thief
  - Fireball
  - Meteor
  - Banishment
  - Thunderstorm
  - Thunderbolt
  - Income Tax

- Peace Treaty prevents you from using the following items:
  - Pickpocket
  - Item Thief
  - Fireball
  - Meteor
  - Banishment
  - Thunderstorm
  - Thunderbolt
  - Income Tax
  - Blue Bomb
- Peace Treaty has no set time limit. It will not automatically disappear from the player's inventory.

### **3. Event Blocker**

Each time that a harmful Event begins, this item has a 50% chance to protect you from its effects.

- Event Blocker has a 50% chance to block the effects of the following events:
  - Lazy Leech
  - Sales Tax
  - Make Friends
  - Closed Shop
- Additionally, if the player would have lost a point from a Sprint Time event, Event Blocker has a 50% chance to block this effect.
- Event Blocker will automatically disappear from the player's inventory after 72 hours have passed.

### **4. Token Vault**

Protects your tokens from being lost or stolen.

- Prevents loss of tokens that may result from the following items:
  - Pickpocket
  - Income Tax
- Token Vault will automatically disappear from the player's inventory after 72 hours have passed.



## **5. Pro Gamer**

Points earned by playing mini-games are multiplied by 1.2.

- Pro Gamer will automatically disappear from the player's inventory after 24 hours have passed.
- The multiplier is applied upon exiting a mini-game. It rounds down to the nearest point.

## **Targeted Items**

Once purchased, targeted items will be immediately sent to the player's inventory. To activate their effects, the player must select and use the item from the inventory screen. The player will then be prompted to select a target from a list of all other players within the group. Targeted items disappear upon activation.

### **1. Pickpocket**

Steals 1 to 3 tokens from a target player.

- Tokens stolen are subtracted from the target player's count and added to the user's count.
- If the target player has fewer tokens than the number this item attempts to steal, all of the target player's tokens will be stolen. If the target player has zero tokens, this item will have no effect.

### **2. Item Thief**

Steals a random item from the inventory of the target player.

- If the target player's inventory does not contain any items, Item Thief will have no effect.
- The item stolen is added to the inventory of the user. If there is no space available in the user's inventory, Item Thief will delete the item from the target player's inventory, but the user will not receive the item.
- Only one copy of any passive item or group item may be stored in a player's inventory. When item thief tries to steal a passive or group item, it will only be added to the user's inventory when another copy of that item does not exist in the user's inventory. Otherwise, the item will be deleted from the target player's inventory but the user will not gain an item.

### **3. Fireball**

The target player loses 1 point.

- If the target player has zero points, Fireball has no effect.

#### **4. Meteor**

The target player loses 2 points.

- If the target player has zero points, Meteor has no effect. If the target player has fewer than 2 points, Meteor sets the target player's points to zero.

#### **5. Banishment**

The target player cannot purchase group items for a period of time.

- Prevents the target player from purchasing the following items:
  - Thunderstorm
  - Thunderbolt
  - Income Tax
  - Blue Bomb
  - Lottery
- The effects of banishment fade after 24 hours.

### **Group Items**

Once purchased, group items will be immediately sent to the player's inventory. When the first copy of a group item is purchased, a timer will begin to count down. If other players purchase the same item, the timer will not be affected. When the timer runs out, all copies of the group item will be activated, but its effect will only be applied once. All players who purchased a copy of the group item are immune to its effects. Multiple copies of any group item may not be purchased by an individual player. Group items disappear upon activation.

#### **1. Thunderstorm**

Targets a number of random players equal to the number who purchased the item. Those who purchased the item cannot be targeted. The targeted players all lose 1 point.

- Activation timer counts down from 6 hours after the first player purchases this item.
- If the number of players who purchase this item is greater than the number of players who did not, Thunderstorm will target all players who did not purchase it.
- If all players purchase this item before the activation timer runs out, Thunderstorm will have no effect.

## **2. Thunderbolt**

Targets a random player who did not purchase the item. That player loses 1 point for every player who purchased the item.

- Activation timer counts down from 12 hours after the first player purchases this item.
- If all players purchase this item before the activation timer runs out, Thunderbolt will have no effect.

## **3. Blue Bomb**

The player who currently has the most points loses 1 point for every player who purchased the item. If the player who has the most points also purchased the item, it will have no effect. It cannot be blocked by any items.

- Activation timer counts down from 12 hours after the first player purchases this item.

## **4. Income Tax**

All players who did not purchase the item lose 25% of their tokens.

- Activation timer counts down from 12 hours after the first player purchases this item.
- If all players purchase this item before the activation timer runs out, Income Tax will have no effect.
- Amount of tokens lost is rounded down to the nearest token.

## **5. Lottery**

One of the players who purchased the item will randomly receive the total sum of tokens spent by all who have purchased it. If only one player purchases this item, it will have no effect and tokens spent will not be returned.

- Activation timer counts down from 24 hours after the first player purchases this item.

# 11 Appendix C: Detailed List of Events

## 1. Featured Mini-game

One mini-game will cost half as many tokens to play as usual.

- By default, lasts for 24 hours. When it ends, a different mini-game will be featured. Generally, one instance of this event will run at all times.
- The cost of the featured mini-game is rounded up to the nearest token after the multiplier.

## 2. Double Points

Earn two points when you would normally earn one.

- By default, lasts for 1 hour.
- The multiplier is applied upon exiting a mini-game. Stacks with the effects of the item Pro Gamer.
- The multiplier is applied to players who would normally gain one point from a Sprint Time event. Players who would normally lose a point from the Sprint Time effect still only lose one point.

## 3. Double Tokens

Earn two tokens when you would normally earn one.

- By default, lasts for 6 hours.
- Applies to tokens earned by walking.
- Applies to the winner of a Lottery but does not affect the cost of entering.
- Applies to random tokens gained through the TGIF event whenever both events are running simultaneously.
- Does not apply to tokens stolen using Pickpocket.

## 4. Lazy Leech

Players will gradually lose points while they are not walking.

- By default, this event starts at noon and lasts for 8 hours.
- For each hour this event is running, all players who do not walk at least 250 steps will lose a point.

## 5. Sales Tax

Items will cost 3 tokens more than usual while this event is in effect.

- By default, lasts for 24 hours.

## **6. Item Sale**

Items will cost 3 tokens less than usual while this event is in effect.

- By default, lasts for 12 hours.
- The minimum price for any item while Item Sale is running is 1 token.

## **7. Buy One Get One Free**

Purchasing a targeted item will cause players to gain an extra copy of that item.

- By default, lasts for 8 hours.
- If the player does not have sufficient inventory space for the extra item, the extra item will not be added to the player's inventory.

## **8. Sprint Time**

This event lasts for a certain period of time and tracks players' steps walked during this time. Once it ends, the bottom 50% of players lose a point and the top 50% gain a point.

- By default, lasts for 24 hours.
- Only steps that have been taken since the event began will affect the outcome.
- For groups with an odd number of players, the player ranked in the middle will be considered a member of the top 50%.

## **9. Make Friends**

Only group items can be used or purchased for a period of time.

- By default, lasts for 12 hours.
- Passive items will remain in effect, but targeted items cannot be used.

## **10. Closed Shop**

No items can be purchased for a period of time.

- By default, lasts for 8 hours.

## **11. TGIF**

Players will occasionally earn random tokens.

- By default, lasts for 24 hours every Friday, starting at midnight.
- For each hour this event is running, each player who walks at least 250 steps will have a 50% chance to earn a free token.