

Developing WalklyVenture: A Gamified Step Counter Mobile App

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Abstract

I was inspired to create a gamified step counter app that can make taking walks more enjoyable rather than a chore. Gamification of healthcare and fitness apps is getting increasingly popular around the world. People can be encouraged to become more active by playing games and challenging themselves. WalklyVenture is not a regular pedometer app that tracks one's steps. Incorporating gaming elements into apps can motivate users to move out and about. The purpose of this game application is to get people moving as well as being on a fun adventure based on the game's theme. Unlike other gamified apps, WalklyVenture is more than obtaining badges and achievements. WalklyVenture utilizes gamified features and a game, created through Unity. Ever since the pandemic, lots of people have been staying home or not moving about like before. This app will make a daily walking exercise more fun by incorporating a game into it.

Index terms: health and fitness apps, pedometer, gamification, game elements, mobile apps

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Introduction

Fitness and health apps such as tracking one's steps, weight, calorie intake, and exercise have become ubiquitous in app stores around the world. Many people can monitor their calorie intake, eating habits, amount of steps they have taken, sleep cycle, and so much more. One example of a recognizable app is the Apple Health app which gathers health data from one's iPhone, Apple Watch, and apps already in use. These fitness and health apps allow users to track their health within a phone's reach. As a result, these apps have become helpful since the pandemic has shaped our daily routines into a "new" normal.

The gamification of healthcare applications has become widely used across the world. Games can encourage people to become more active. An example of this would be "Pokémon Go," a game that is based on the Pokémon franchise. Users had to go outside and walk to collect Pokémons, short for pocket monsters, and duel with other players. Another example of a fitness game is the Nintendo Wii Fit, in which players can work towards personal fitness goals. Wii Fit contains yoga and aerobic exercises, which can be done in the comfort of one's home.

According to a new study by researchers at UC San Francisco, the identification of COVID-19 as a global pandemic in March led to a dramatic fall in step counts globally, including in the United States [12]. Within ten days of the pandemic declaration on March 11, there was a 5.5 percent average decline (287 steps) over the world, which increased to a 27.3 percent drop (1,432 steps) within 30 days [12]. These findings have inspired me to develop a gamified step app. Games help make an activity entertaining by providing cognitively and psychologically appealing experiences around health habits or health learning activities, whether it's an intriguing dream, a challenge, or a game that piques curiosity [10]. Applying game design principles to healthcare apps can make daily walks from a chore into a game. I chose to create a

gamified fitness app because it involves both mobile application development and game development.

To develop an app or a game, one must have a process that consists of a structured set of activities required to develop software. This set of activities consists of requirements, design, implementation, testing, and evolution and maintenance [1]. An agile methodology was used, specifically, Scrum, to build the gamified step counter app. I specifically used the ABC-Sprints for game development. These sprints consist of “Alpha,” “Beta,” and “Completion sprints every 2 to 4 weeks [2].

WalklyVenture is not a regular pedometer app that tracks one’s steps. Incorporating a game into health and fitness apps can motivate users to move out and about. The purpose of this game application is to get people moving. This gamified step-up incorporates a Sci-Fi time travel theme that will make walking fun. The app is intended for everyone, young children and up.

History of Incorporating Games into Fitness and Health Activities

Fitness games have been around since the 1980s. In the 1980s, “HighCycle” by Autodesk employed the use of stationary bikes connected to a computer. This is similar to that of Peloton’s stationary bicycles and its use of interactive workouts. The HighCycle tracked information like velocity, distance traveled, calories expended, and more information were recorded and displayed [7]. Another game that demands a high level of fitness to defeat difficult levels is “Dance Dance Revolution,” a game that involves players hitting colored arrows with their feet to musical or visual cues. “Wii Fit,” released in 2007, was the first game to push the boundaries between video games and ordinary physical fitness at the comfort of one’s home. The Wii Fit is estimated to have sold 22.67 million units worldwide as of March 2012, with devices being utilized in households, physiotherapy rehabilitation, gaming rehabilitation, and fitness clubs [7].

A more recent device is the “Ring Fit” adventure in which players will hold a ring-shaped controller and do exercises, at the same time playing a game. “Pokemon GO” used a real-world mapping of a player’s surrounding area in which players must move around to the location of Pokémons. Recently, there has been a rise in virtual reality gaming, specifically with the use of Oculus, a headset that translates movements into virtual reality [7]. “Beat Saber,” a game most notably played on the Oculus, uses a player’s swings and movements to hit incoming boxes that correspond to the music.

These examples have shown how fitness and technology are connected. Video games are enjoyable because they satisfy our needs for achievement and recognition while keeping us engaged at the same time. By turning physical activity into a game in which one can be rewarded and be engaged, exercises can become more enjoyable.

Gamification of Healthcare and Fitness Apps

Games bring pleasant experiences and allow people to immerse themselves in the game itself. Technology has contributed to the rise of gamification. The use of gamification and serious games in health self-monitoring and management has flourished in the healthcare industry. Some gamification features include achievement badges and progress bars. Numerous systematic evaluations have investigated the usefulness of serious games in achieving certain health behavioral changes due to their potential to inspire, engage, and entertain [4].

Gamification is a relatively recent concept that focuses on using game elements in non-game contexts to engage audiences while making mundane activities enjoyable. For instance, games may be used to boost learners' learning motivation, games can be used to increase sales involvement, and games can be used to increase the level of engagement of office employees [5]. In this case, we are focusing on the gamification of healthcare and fitness apps.

There is a difference between gamified apps and full-fledged games. Full-fledged games, often known as "games with a purpose," provide pure gaming experiences through gameplay rules, game engines, and mechanics. On the other hand, gamification uses a blend of game mechanics and game design to produce experiences that are evocative of games [4]. Examples used in gamified apps would be points, achievement badges, and leadership boards. Notably, badges can give users information on how to broaden their involvement in the physical activity of their choice.

According to research, including gamification components into online and app-based health care interventions can boost patient satisfaction, enhance the patient experience, and, as a result, improve treatment adherence [3]. This is a result of gamification's way of making activities more pleasant through approaches such as stories, themes, goal setting rewards, challenges, point system, and leaderboard. Studies on the usage of mobile applications for self-monitoring weight reduction show that a trigger (gamification) is still needed to motivate users to keep using them [9]. By incorporating game-like aspects into the design of the software's user interface such as social connectivity and playfulness to ordinary activity, gamification can motivate and retain users' participation in apps. Fitness and wellness apps promote the collection and analysis of data about one's activities, and many of them make it easy to share or compare those behaviors with those of others. For example, FitBit, known for its physical fitness monitors and activity trackers, have leaderboards that allow users and their friends to share each other's steps and can taunt or cheer them on. Companies may use gamified aspects to provide some of the motivators associated with games, such as competition or status possibilities, more attainable objectives, and speedier feedback [10]. In the case of

WalklyVenture, the app is aimed at motivating users to take walks by introducing a Sci-Fi theme, completing levels, and achieving badges.

Healthcare Gamification App Examples

Healthcare games with different audiences have different focuses. For patients, games are primarily focused on cognition, specific illnesses, mental health, social issues, and self-control. On the other hand, games that are primarily focused on the general public include a wide range of issues, including nutrition, safety, prevention, and general health [15]. For example, one gamified mobile health application aimed to promote parents' skills to change the family lifestyle and help healthcare centers to treat childhood obesity [17].

According to an evaluation of the efficacy of gamification for self-care in diabetic patients, gamification offered positive reinforcement as an external motivator and was helpful for self-care promotion [14]. With diabetes management, people display low motivation towards self-monitoring and regimen adherence. In this study, the novelty of even a basic incentives system may have been enough to inspire participants to acquire and practice efficient blood glucose monitoring behavior [14].

Using gamified features to educate about general health can be seen in this one mobile health application promoting oral health in early childhood [13]. The app contained information regarding early childhood oral hygiene. In the gamified version of the app, parents were rewarded when asked questions regarding their child's frequency of tooth brushing and daily amount of sugar intake. If a user gets a high score, the app's background color will change for a week, signaling that you've progressed to the next level. In addition, at the top of the page, a progress bar depicting the scoring process was placed for encouragement [13]. Similarly, in terms of educating general health, a web app aimed to educate sexual health. In Norway [16].

The web app contained gamified features such as avatar customization, achievement-based gifts, interactive avatar, and challenges that can be shared among other users. In one study about applications promoting visual perception skills in children, a reward system, provided a favorable response when a child completes activities and challenges [18]. Educating is one of the many ways in which gamified healthcare apps can be used.

Limitations

Incorporating gaming elements can have positive effects such as motivating and engaging users, but it also has its limitations. Apps that involve one's health data must take into consideration accessing personally sensitive health care information. Transparency and design for appropriate access to personally sensitive healthcare data might influence players' willingness to participate in the game. Therefore, it is the ethical responsibility of the developer to take this into account when creating a healthcare app. Developers must decide who will have access to the data and inform the users of the terms of the access. For example, MoviPill participants could see their data, which was abstracted into emoticons and shared with other players via the mobile interface [10]. This shows that apps are capable of balancing shared data and privacy by abstracting the data when shared with other players.

If the gamified healthcare app is not regularly updated and improved to enhance users' experience, users may find it hard to use the app in the long run. This is one of the weaknesses of gamifying health applications. As a result, some game elements need a particular level of customization to fulfill the application's health goals and be completely tailored to target groups [4]. Everybody has different health and fitness goals. Allowing users to set their goals and preferences allows flexibility in the app.

User experience and user interface (UX/UI) are important when creating an app to maximize and retain user engagement as well as participation. Some game features (e.g., points, badges) didn't have a clear health-driven value in terms of the user's performance and health abilities [4]. This demonstrates how a simple UI with clear instructions may reduce misunderstanding and improve users' gameplay experience.

Methodology: Mobile App and Game Development Research

Software development is an iterative process aimed at producing software that fulfills product goals. To construct a software solution and mobile app for different operating systems, several tools, and programming languages are utilized. A process is a structured set of activities needed to develop software, consisting of requirements, design, implementation, testing, evolution, and maintenance [8]. There are many different types of methodologies ranging from generic process models and agile methodologies.

Iterative and incremental approaches, which feature frequent releases and adaptability in revising, are characteristics of agile methods [1]. Agile methods may readily revise their strategy and adapt to changes. This is quite different from the waterfall method, in which any changes will cause the process to be delayed, costing time and money. According to [6], "Individuals and interactions are prioritized over processes and tools, functioning software over detailed documentation, customer collaboration over contract negotiation, and adapting to change over following a plan." Agile methodologies include Extreme Programming(XP), Cockburn's Crystal Family, Open Source, and Scrum.

This project will be using Scrum, a popular agile method among the others. Scrum was developed in the early 1990s by Jeff Sutherland and Ken Schwaber. When most people think about Agile, they envision breaking down a project's functionality into iterations that last

anywhere from a few weeks to several months. The aim of each sprint in Scrum is to produce a tested, working portion of the system that is ready to be delivered to production [11]. Scrum uses a product backlog to collect requirements and manage the scope of completeness. Each sprint has its own set of items from the backlog. Scrum has a unique approach to teams. There is a Developer Team, Scrum Master, and Product Owner. The objective for this is to maximize efficiency and collaboration among the team.

Scrum is one of the most efficient agile software development methodologies not only in software development but also in gaming. The results demonstrate that agile methods are used more than 10% more in gaming studios than waterfall methods, with 45% of projects utilizing agile practices and 30 % using waterfall, and the rest using various methodologies [1]. This comes to show that more companies are shifting to the Scrum process or a modified version of Scrum that will cater to the preferences of the company.

Specifically, the project will be using “Alpha,” Beta,” and “Complete” Sprints, known as ABC Sprints. The Alpha Sprint is a stage in which the team becomes accustomed to scrum and learns the fundamentals of functionality required in game development, as well as establishing a backlog. Beta Sprint, during which they have already completed a feature-complete game with all of their final assets and are awaiting testing. Completion Sprint, at which point the game is complete, bug-free, and ready to be released [2]. I chose this because this modified version of Scrum is adapted for flexibility and self-controlled time management.

Introducing WalklyVenture: A Gamified Step Counter App

WalklyVenture isn't your typical pedometer app that only keeps track of your steps. Incorporating a game into a healthcare app might encourage users to get up and walk. This gaming application's goal is to get people moving. Since the outbreak, many individuals have

stayed at home or have not moved around as much as they used to. Walking provides several health advantages. This software incorporates a game into a regular walking workout, making it more enjoyable. This app is intended for everyone, young kids and up.

The theme of this app is Sci-Fi time travel which is inspired by the “Back to the Future” movie franchise. The user helps the main character, who travels on a hoverboard, to go through different periods, to get back to the present time.

This is a 2D game. The hoverboard is fueled every 5,000 steps. To receive a badge, a user must successfully finish the mini-game every time they achieve 5,000 steps. When moving to the next time period, the user controls the main character to avoid being hit by items. A user will earn an accomplishment badge if they complete the mini-game.

Users can create a profile and can set their daily goal of steps. The home page displays the step count and the number of steps they have taken so far. The home page will also display their daily goal so that they can see their progress. The user has the end of the day to complete. If the user can't complete the daily goal, every midnight (12:00 AM), it will reset the daily steps. The total steps will roll over until it hits 5,000 steps. The second page is the Game page which shows the user's current level. The next level is not unlocked unless 5,000 steps have been made. Once the level is unlocked, the user can play the mini-game in which the user controls the main character to avoid being hit by objects. The objects' speed will increase to make it more difficult. Once a user completes a level, they move on to the next time period of the storyline.

WalklyVenture System and Design Process

Product Backlog

I built a product backlog for my application as part of my Scrum and agile process. A product backlog is a software artifact that includes specified features, prioritized user stories, a

time estimate for implementing the user story, and the size of the user story. A user story is a broad description of a software feature written from the viewpoint of the end-user. Throughout the software development process, the product backlog is updated and maintained.

ID	Name	Type	Creation Date	US	Size	Priority	Dependencies	Notes
US1	Personal Account	F	2/13/2022	As a user, I want to be able to create an account so that all my data is saved	Medium	High		Firebase
US2	Personalizing User Name	F	2/13/2022	As a user, I want to be able to personalize my name displayed in the app, so that my account feels more personalized	Small	Medium	US 1	
US3	Personalizing Daily Goal of Steps	F	2/13/2022	As a user, I want to be able to set my daily goal of steps so that I am not conscripted to the app's default daily amount	Small	High	US 1	
US4	Changing Personalization	F	2/13/2022	As a user, I want to be able to change my personalization so that in the future, I have the option to do so	Small	Low	US 2, 3	
US5	Navigation Bar	F	2/13/2022	As a user, I want to be able to navigate different screens so that I can easily switch screens at my expense	Medium	High		

Fig 1. Product Backlog

System Design

System design is the process of designing the components, interfaces, and data for a system to satisfy particular requirements. The high-level requirements of a system are analyzed using use case diagrams. When the requirements are reviewed, the capability of a system is in the backlog with the help of use cases. The use case diagram for this mobile application is shown in Fig 2. A use case diagram depicts a system's

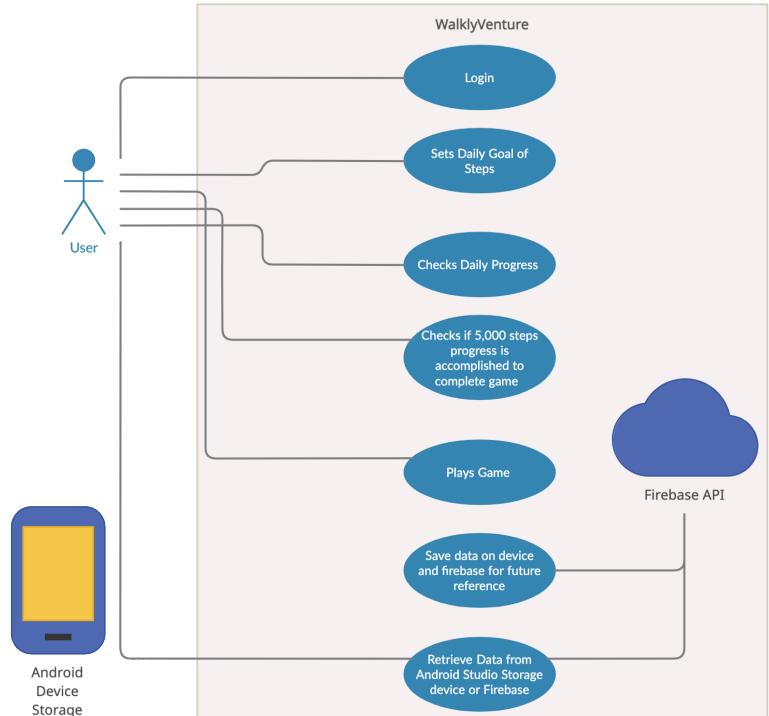


Fig 2. Use Case Diagram of WalklyVenture

top-down viewpoint, which includes the actors who interact with it, the services it provides, and the interactions between these aspects.

An activity diagram, like a UML diagram, visually depicts a series of actions or control flow in a system. Fig 3. shows the activity diagram of WalklyVenture. This activity diagram shows the various activities that the user will follow such as logging in or creating an account, viewing the home page, playing a game, and viewing the profile page.

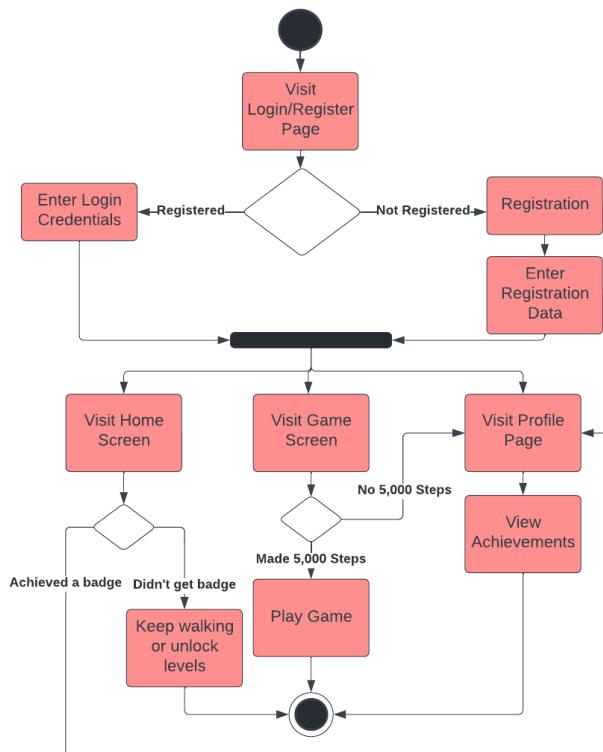


Fig 3. Activity Diagram of WalklyVenture

User Interface Design

Designing the User Interface(UI) is important because it facilitates the interactions of the viewers with the mobile application. Having a good UI helps the user interact with the application and increases the usability of the app.

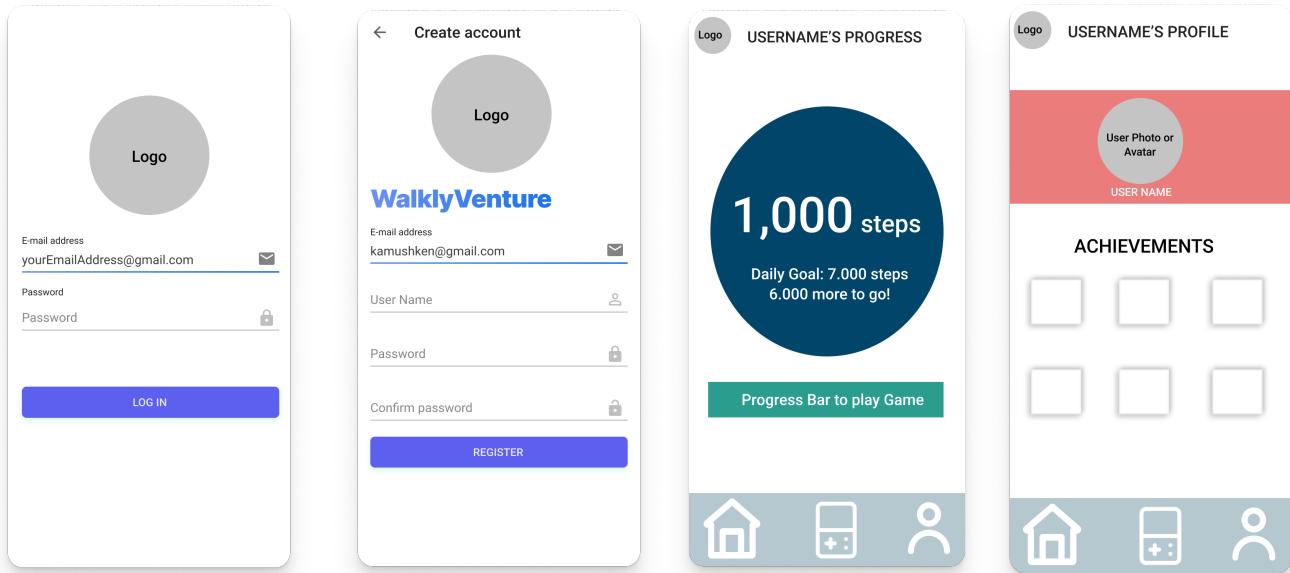


Fig 4. Wireframes for WalklyVenture, created with Figma

I created a UI template using Figma, shown in Fig 4. The initial screen will be the login screen in which the user has to have an account in order to access the application. Login authentication will be implemented with Firebase. The home screen will display the person's current daily steps, remaining steps to achieve based on daily goals, and the progress bar to play the game. The game is designed in a way the user needs to have 5,000 steps to complete each level. Having the progress bar on the home page can visually engage and remind the user. The profile page contains a default profile photo in which the user can replace and the user's name. This profile is dedicated to displaying the user's achievements.

Tools

There are a lot of aspects that are needed to be considered when it comes to building a mobile application. This includes, but is not limited to, design, color palette, logos, graphics, story, music, and coding. The programs that I used to help build WalklyVenture are Android Studio, Unity, Adobe Illustrator, Canva, Unity Asset Store, and Firebase Authentication.

Adobe Illustrator is a graphics editor and design tool that works with vector graphics.

Canva is a graphic design platform that allows users to create social media graphics, presentations, posters, papers, and other visual elements. In Canva, users can use the templates and graphic elements provided in the app.

I designed the logo in a way that gives off a retro feel. I used darker, and more muted colors rather than vibrant colors that would clash. I wanted to emphasize the step counter, time travel, and game by using graphic elements such as feet, hoverboard, clock, and game console. I also used Illustrator to create an ombre background to give a sense of playfulness to the mobile app. I used Canva for visual graphics such as achievement badges and locked badges.



Fig 5. WalklyVenture Logo(left), Launcher Icon (middle), and Home Screen Background(right)

Android Studio is the official Integrated Development Environment (IDE) for Android app development. Android Studio, in addition to IntelliJ's strong code editor and developer tools, includes additional that improve your efficiency when developing Android apps, such as a fast emulator, code templates, extensive testing tools, frameworks, etc. I used Android Studio because I wanted to learn mobile app development. On top of Android Studio allowing the developer to design layouts through XML and create app logic through Java, I wanted to use Android Studio because I learned a lot in my Software Engineering Course.

For game development, I used Unity which is a 2D/3D game engine. I chose Unity because it is a multi-platform environment and has a low learning curve for beginners.

Developing WalklyVenture and Results

First, I came up with a basic premise which is a step counter app that not only provides gamified features but a mini-game as well. I also wanted to provide a story into WalklyVenture to engage the audience. WalklyVenture's story was inspired by *Back to the Future*, a film about time travel. I had always been interested in Sci-Fi themes, and I wanted my app's theme to be time travel. I decided to make a female protagonist because girls are underrepresented in video games and have limited stories. Once I had my theme and main protagonist down, I moved on to building the app.

Alpha Sprint

During Alpha Sprint, I focused on implementing the user interface, login authentication, a functional pedometer, and a bottom navigation bar. This sprint lasted two weeks. I used Firebase authentication so that users can register and log in using their email and password.

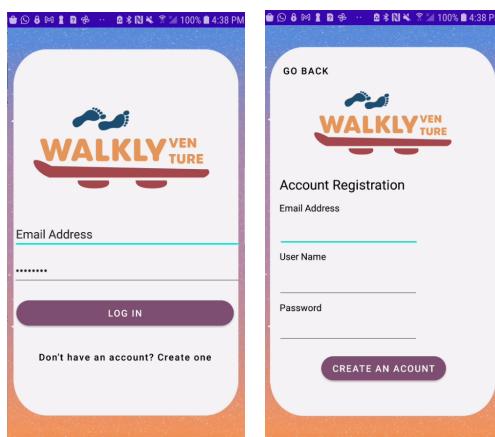


Fig 6. Login Screen (left) and Registration Screen(right)

I created a bottom navigation bar since there is only a main screen, game screen, and profile screen. For the main screen, I had the functional display of the step counter, which updates when the user starts walking. As long as the user does not completely close the

application, WalklyVenture will continue to record the user's steps. I also made sure to display their current steps out of their daily goal so that the user can check to see if they surpassed their daily goal of steps. The user can also update their daily steps using the "UPDATE GOAL" button. This button would update the remaining steps on the main screen and their daily goal on the profile screen. Users can also see their progress bar on the main screen which lets the user visually know how close they are to unlocking a level in the mini-game. As for the game screen, the user's current level is displayed and it also contains an information button that provides users with instructions on how to play the game. For the profile screen, the user's daily goals and achievements are displayed for the user to see.

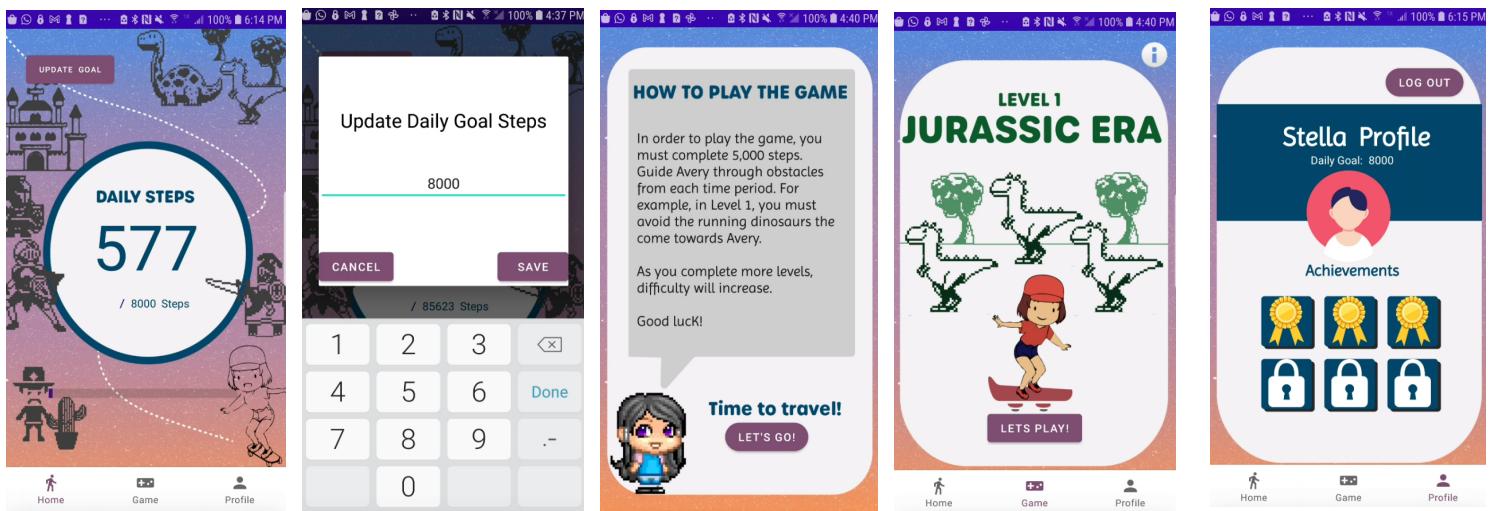


Fig 7. From left to right: Main Screen, Update Goal Pop-up, Game Instructions Screen, Level Screen, Profile Screen

Beta Sprint

During Beta Sprint, I focused on providing functionality to the gamified features like the achievement badges, creating more graphics, an introduction to the WalklyVenture Screen, and developing the mini-game. Beta Sprint lasted two weeks. I created achievement badges based on how many steps the user walked. For example, the first badge is 10 steps and the second badge is 100 steps, etc. When the user achieves a badge, a pop-up would congratulate the user on earning

the achievement badge on the main screen as well as display what the achievement badge is for. When the user goes into the profile screen, the user will see that an achievement badge has been unlocked since an achievement badge image is displayed rather than a locked image. When the user taps on the achievement badge, a pop-up with the achievement badge's information will be displayed. If a user taps on a locked achievement badge, a pop-up will be displayed indicating that the achievement has not been unlocked yet.

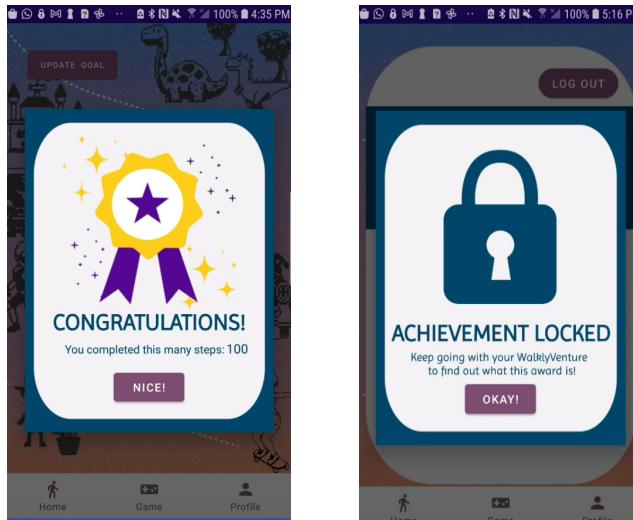


Fig 8. Achievement Pop Up (Left) and Locked Achievement Pop Up(Right)

I realized that I did not have an introduction screen that introduces the story and what WalklyVenture is about. When the user registers an account, they will be shown an introduction screen that covers the beginning of the story of the main protagonist. This introduction screen is important because it gives the user background information on app elements such as the progress bar, achievement badges, and levels.

When it came to developing the mini-game, I wanted it to be similar to that of an “endless-runner” game in which it can go on forever, but in this version, the player must reach a “portal” in order to complete the level. First, I focused on implementing game mechanics for the player and obstacles. With the player, I wanted the user to tap the screen to make the player jump

up and when the player isn't tapping the screen, the player goes down. As for the objects, I created different spawn points and spawn times so that it matches each level's difficulty. When the player touches the obstacles, then a game over panel will be displayed allowing the player to either restart or leave the game to try another time. When the player finally reaches the end object, a portal, a finished level panel will be displayed and the user completes the level. I also had to implement a looping background, royalty-free audio as the background music, and assets for the obstacles from the Unity store.

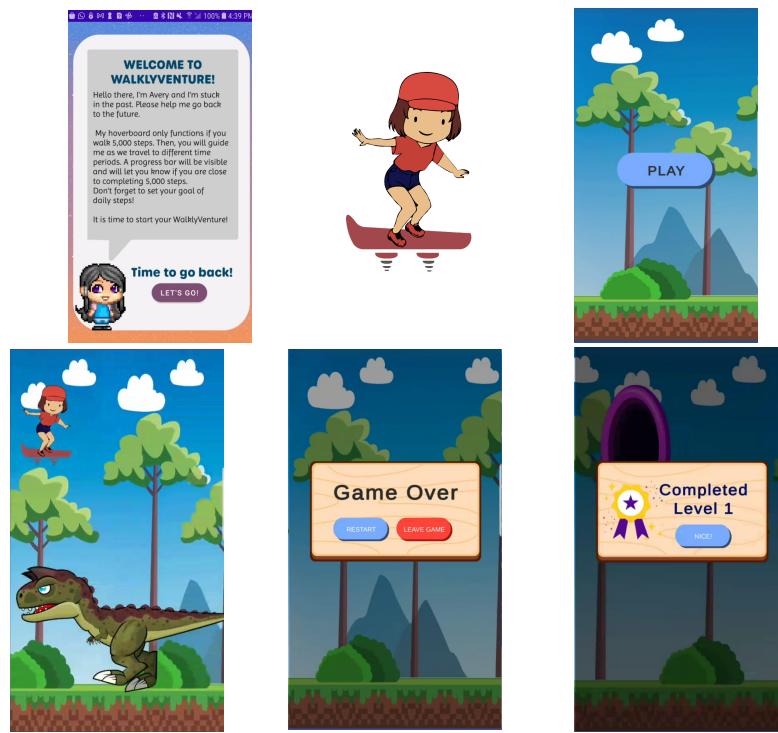


Fig 8. Top Row(left to right): Introduction Screen, Player Graphic, Play Screen of Mini-Game

Bottom Row(left to right): Mini-game, Game Over Panel, Finished Level Panel

Complete Sprint

The Complete Sprint lasted a week. I made sure there were no crashes to the step counter and the game. To test if my application functions properly and smoothly, I would debug using a Samsung S7 Edge as my emulator.

Reflection

Developing WalklyVenture was frustrating, but was very rewarding to see the application successfully run. I have learned a lot when it comes to software engineering, Android app development, as well as game development. I was developing WalklyVenture at the same time I was enrolled in a Software Engineering Course. This was very helpful because I applied the technical skills I learned in the course project to my thesis project. I definitely felt more comfortable using Android Studio along the way. As much as I would have liked to complete at least 3 levels of the game, I was only able to complete 1 level.

I had run into multiple problems in the first sprint. I found the first sprint, Alpha Sprint, to be quite difficult. Android Studio was very new to me. It took a while for me to learn how to properly format the layout for each screen via XML and to provide app functionality. The most difficult aspect is saving the user's data. Every time a user switches the screen, data is lost. For example, the “/ Remaining steps” on the main screen (Fig. 7). The remaining steps would disappear once the user switches to a different screen. I learned that in order to save the data of each screen or in Android Studio's term, “Activity,” one must save it whether be a database or locally. I used Shared Preferences which store data on the device storage. Every time I came across these types of difficulties, I would make sure to take a mental break and come back again.

In terms of ABC sprints, they were very helpful when it comes to deciding what user story to implement as well as what to add and remove. It also helped me keep track of what is left to implement.

Conclusion

The whole mobile application and game development was quite a learning process. I gained knowledge about the software engineering process, Android app development, and game

development. As much as I would have liked to complete the mini-game, I decided to implement one level only. I would continue developing WalklyVenture so that it can be possibly published in Google Play Store. I plan to develop more levels on top of testing the application to make sure that it successfully runs with little to no bugs and on many devices.

This project has inspired me to pursue a career in software engineering. I enjoyed the software engineering process such as creating the requirements, designing the software, implementing functionality, and testing. It was an amazing experience to learn Android development and game development from scratch.

Appendix

- APK:

<https://drive.google.com/file/d/1DRd5hvukeGNhrlm8omsCuRf4qgSHNXzE/view?usp=sharing>

- Poster:

<https://drive.google.com/file/d/1cVzVjzEE7PcILQRqPBPa2Ff6cl-H7noN/view?usp=sharing>

- Unity Dinosaur Assets:

<https://assetstore.unity.com/packages/2d/characters/dinosaur-park-game-sprites-83739>

- Demo Video: <https://youtu.be/1si-ULAQ9jM>

References

- [1] D. P. Kristiadi, F. Sudarto, D. Sugiarto, R. Sambera, H. L. H. S. Warnars and K. Hashimoto, "Game Development with Scrum methodology," 2019 International Congress on Applied Information Technology (AIT), 2019, pp. 1-6, doi: 10.1109/AIT49014.2019.9144963.
- [2] J. Schild, M. Masuch, and R. Walter. "ABC-Sprints: adapting Scrum to academic game development courses, 2010.
- [3] K. Saric, C. Redd, M. Varnfield, J. O'Dwyer and M. Karunanithi, "Increasing Health Care Adherence Through Gamification, Video Feedback, and Real-World Rewards," 2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2018, pp. 1584-1587, doi: 10.1109/EMBC.2018.8512487.
- [4] L. Sardi, A. Idri, and J. L. Fernández-Alemán, "A systematic review of gamification in e-health," *Journal of Biomedical Informatics*, vol. 71, pp. 31–48, 2017.
- [5] M. Wen, "Applying gamification and social network techniques to promote health activities," 2017 International Conference on Applied System Innovation (ICASI), 2017, pp. 531-534, doi: 10.1109/ICASI.2017.7988474.
- [6] *Manifesto for Agile Software Development*. [Online]. Available: <https://agilemanifesto.org/>.
- [7] P. Kobek and Patricio Kobek (2063 Articles Published), "How video games have helped US workout since the 1980s," *TheGamer*, 10-Mar-2020. [Online]. Available: <https://www.thegamer.com/video-games-workout-exercise-history/>. [Accessed: 06-Feb-2022].
- [8] R. Sean. "INTRODUCTION TO SCRUM AND KANBAN." *Agile SAP: Introducing Flexibility, Transparency and Speed to SAP Implementations*, IT Governance Publishing, 2013, pp. 25–32, <http://www.jstor.org/stable/j.ctt5hh7ss.8>.
- [9] S. Ansong and N. A. Iahad, "A Conceptual Model for Designing a Gamified Intermittent Fasting Mobile App," 2019 6th International Conference on Research and Innovation in Information Systems (ICRIIS), 2019, pp. 1-5, doi: 10.1109/ICRIIS48246.2019.9073629.
- [10] S. Munson, et al. "GAMIFICATION AND HEALTH." *The Gameful World: Approaches, Issues, Applications*, edited by Steffen P. Walz and Sebastian Deterding, The MIT Press, 2014, pp. 597–624, <http://www.jstor.org/stable/j.ctt1287hcd.44>.

- [11]S. Robson *Agile SAP: Introducing Flexibility, Transparency and Speed to SAP Implementations*. IT Governance Publishing, 2013,
<http://www.jstor.org/stable/j.ctt5hh7ss>.
- [12]“Physical activity dropped worldwide during COVID-19, raising concerns for health,”
Physical Activity Dropped Worldwide During COVID-19, Raising Concerns for Health | UC San Francisco, 18-Jan-2022. [Online]. Available:
<https://www.ucsf.edu/news/2020/07/417951/physical-activity-dropped-worldwide-during-covid-19-raising-concerns-health>. [Accessed: 06-Feb-2022].
- [13]M. Zolfaghari, M. Shirmohammadi, H. Shahhosseini, M. Mokhtaran, and S. Z. Mohebbi, “Development and evaluation of a gamified smart phone mobile health application for oral health promotion in early childhood: A randomized controlled trial,” *BMC Oral Health*, vol. 21, no. 1, 2021.
- [14] Y.-L. Theng, J. W. Y. Lee, P. V. Patinadan, and S. S. B. Foo, “The use of videogames, gamification, and virtual environments in the self-management of diabetes: A systematic review of evidence,” *Games for Health Journal*, vol. 4, no. 5, pp. 352–361, 2015.
- [15]N. Sharifzadeh, H. Kharrazi, E. Nazari, H. Tabesh, M. Edalati Khodabandeh, S. Heidari, and M. Tara, “Health education serious games targeting health care providers, patients, and Public Health Users: Scoping Review,” *JMIR Serious Games*, vol. 8, no. 1, 2020.
- [16] Gabarron, E., Schopf, T., Serrano, J. A., Fernandez-Luque, L., & Dorronzoro, E. (2013). Gamification strategy on prevention of STDs for youth. *Studies in health technology and informatics*, 192, 1066.
- [17] L. Afonso, R. Rodrigues, E. Reis, K. Miller, J. Castro, N. Parente, C. Teixeira, A. Fraga, and S. Torres, “Fammeal: A gamified mobile application for parents and children to help healthcare centers treat childhood obesity,” *IEEE Transactions on Games*, vol. 12, no. 4, pp. 351–360, 2020.
- [18] S. Lee, Z. Zhang, and A. Rodriguez, “Resna annual conference - 2018,” *Mobile Applications For Promoting Visual Perceptual Skills: A Systematic Review*. [Online]. Available: <https://www.resna.org/sites/default/files/conference/2018/cac/Lee.html>. [Accessed: 22-Mar-2022].