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Wage Wizard

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ENTITLED

Wage Wizard

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BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND ENGINEERING
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Wage Wizard

By

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SENIOR DESIGN PROJECT REPORT

Submitted in Partial Fulfillment of the Requirements
for the degrees of
Bachelor of Science in Web Design & Engineering
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Wage Wizard

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ABSTRACT

Wage theft is a severe problem in Santa Clara County, with the Santa Clara Wage Theft Coalition identifying more than 25,000 local wage theft cases as of 2021[1]. In this study we will be addressing the issue of wage theft particularly in the Santa Clara County caregiving industry. Wage theft is prevalent in the caregiving industry for several reasons. First, the industry employs many migrant Filipino workers who are unaware of their legal rights and protections or even the fact if they are experiencing wage theft or not. Second, the sizable undocumented portion of these workers are coerced to lower pay and unsustainable working conditions through threat of deportation. Lastly, these workers commonly lack documentation of their work hours which is imperative in proving instances of wage theft in court.

To aid in the defense of these workers in wage theft court cases while maintaining user privacy, we have developed a mobile application that relies on on-device geofencing to automatically record hours spent at a workplace, generate and store logs of work sessions and expected payments, as well as provide access to relevant, reliable, and comprehensible wage theft resources. Our mobile application was developed in close communication and collaboration with workers from the local community in order to better grasp the issue of wage theft as well as capture our project's requirements. Our application was developed with user accessibility and privacy as guiding priorities, to appropriately suit the unique needs of our target user group.

[1] Tayag, Michael & Silver Taube, Ruth & Mondina, Felwina & Nasol, Katherine & Peterson, Forest. (2021). Wage Theft in Silicon Valley: Building Worker Power. 10.13140/RG.2.2.31050.70082.

Acknowledgements

First and foremost, we would like to thank the caregivers from the Pilipino Association of Workers and Immigrants (PAWIS) for providing their valuable time to give us extensive and thorough input, guidance, and feedback. The development of our application would not have been possible without them. We dedicate our project to the brave and hard working migrant workers like them, fighting against wage theft.

Secondly, we would like to thank Professor Ruth Silver-Taube, our contact and coordinator for our sponsor, the Santa Clara County Wage Theft Coalition. She is currently the Legal Services Chair of the South Bay Coalition to End Human Trafficking, Supervising Attorney of the Santa Clara County Office of Labor Standard's Enforcement Legal Advice Line, and lecturer in Santa Clara University's graduate School of Law. Her valuable feedback and guidance regarding the legal dimension on the issue of wage theft was critical to our project.

Finally, we would like to thank our advisors, Dr. Silvia Figueira and Dr. Jes Kuczenski for their continued support and guidance in the development of our project. We would not have been successful in our presentations, documentation, and organization of our project materials without their valuable advice.

Table of Contents

List of Figures

Chapter 1: Introduction

Our team conducted research and reached out to local workers in order to learn of the reality of wage theft in Santa Clara County. A robust understanding of wage theft in Santa Clara County was necessary in order to come up with an effective solution.

1.1 Background

Wage theft, the practice of employers deliberately or negligently paying workers less than what they are owed, is a prevalent and ongoing injustice faced by many workers. Particularly in Santa Clara County, the Santa Clara Wage Theft Coalition has identified more than 25,000 local wage theft cases across all industries, totalling more than $128,000,000 in unpaid wages.[2] The true number of wage theft cases is believed to be far greater, as many workers are unaware that they are being underpaid. The effects of wage theft are felt not just by the families of employees, but the economy of the state as a whole. By hindering the workers financially, their ability to negotiate their terms of employment is weakened, and they are forced to rely on public assistance programs at the expense of taxpayers.

1.2 Preliminary Research

In order to devise a solution for the problem of wage theft, it was necessary for our team to thoroughly understand wage theft beyond surface level data such as facts and figures. We needed to learn about the issue of wage theft from the people experiencing it firsthand. Thus, we reached out to the migrant workers from the Pilipino Association of Workers and Immigrants (PAWIS), a local grassroots organization fighting for the rights and welfare of workers, to conduct anonymous preliminary interviews to learn about their experiences regarding wage theft, and to better understand the prominence and characteristics of wage theft in Santa Clara County. From our interviews, we gained profound insights on the issue of wage theft particularly in the caregiving industry. We discovered that documentation of the working hours was something

[2] Tayag, Michael & Silver Taube, Ruth & Mondina, Felwina & Nasol, Katherine & Peterson, Forest. (2021). Wage Theft in Silicon Valley: Building Worker Power. 10.13140/RG.2.2.31050.70082.

very important for all hourly workers to maintain securely and reliably, as such documents had proven critical in fighting previous cases of wage theft. Despite this, we found that many caregivers in the industry chose not to document their hours, due to lack of awareness of its importance, or because the process of documenting their working hours on paper is cumbersome. Furthermore, we discovered that many exploited caregivers were unaware of their legal rights and protections in the workplace. This is because a significant portion of them are migrant workers who lack familiarity with the complex employment laws and regulations of the United States. As a result, many caregivers are not even aware if they are being properly compensated for their time spent working.

1.3 Existing Alternatives

Some of the caregivers we interviewed reported that some of their employers have timekeeping systems in place. This, however, was inadequate because since the system is owned by the employers, they have the ability to modify the time logs of their employees. To combat this, some caregivers utilize some form of personal recordkeeping to ensure they receive proper compensation, most often a physical journal for logging hours and taking shift notes. While this method can aid in the pursuit of fair compensation, such evidence is often underutilized in resolving disputes due to factors like editability, human error, and the fragility of paper records.

1.4 Existing Solutions

In addition to written-log keeping, a variety of applications exist today to help individuals record their work hours through a variety of methods, including geolocation. Prior to beginning development we reviewed and analyzed a wide range of potential competitor applications.

One of the existing applications we investigated, ConnectTeam[3], has many useful features, but is oriented towards providing the employer with worker information. For ConnectTeam, each employee would use a mobile application to clock in and log activity, while the employer would monitor them using the ConnectTeam webpage. A company choosing to use ConnectTeam could customize their version of the app by selecting which functionalities they needed. ConnectTeam provides a time clock, chat services, a directory, job scheduling, and more. Using these resources, an employer could look at work locations and workers clocked in, create

[3] *Homepage*. Connecteam. (2022, May 23). Retrieved June 8, 2022, from https://connecteam.com/

schedules, message workers, see an overview of a worker's activity, etc. The app is useful for an organization looking to keep track of their workers, but not as useful for an employee looking to keep track of their hours and make sure they are being paid fairly.

Another application we investigated, Harvest[4], is also designed with the employer in mind as opposed to the employee. Harvest is similar to ConnectTeam, but focuses more on payment and cost analysis. Harvest supports time tracking, creates reports and analysis, and handles invoicing and payments. The app provides integrated time tracking and expense tracking to allow an employer to: review past data to improve how they scope and price work, understand which projects are profitable and why, and know when to take on new businesses.

While the existing applications we investigated had great features for documenting the work hours of workers, these applications were employer-oriented rather than employee oriented. ConnectTeam was focused on providing employers and teams with more granular individual employee performance data while Harvest was designed for an employer looking to optimize spending over time. These apps did not answer the needs of our target customers such as keeping track of their own payment in a way that can help them know if they are being taken advantage of or offered adequate protection for the potentially sensitive user data collected.

1.5 Proposed Solution

To help workers in proving cases of wage theft in court as well as providing them with relevant information regarding employment law, we propose a mobile application that automatically documents the work hours of a worker through on-device geofences, calculate an estimation of their owed wages, as well as provide access to relevant, reliable and comprehensible wage theft resources.

1.6 Project Scope

Our project aims to address the issue of wage theft specifically in Santa Clara County, as wage laws differ on a regional basis. Furthermore, wage-thefts laws are very complicated, varying across different industries and respective workers. Throughout this project we choose to study closely the issue of wage theft in the caregiving industry through the experiences of

[4] *Easy Time Tracking Software with invoicing*. Harvest. (n.d.). Retrieved June 8, 2022, from https://www.getharvest.com/

Filipino migrant workers. Thus our application is currently oriented towards their needs and conditions. We aim to expand the project's scope to a broader demographic of workers and industries in the future.

Chapter 2: Requirements

Prior to beginning any level of design or development work, we compiled a set of requirements our solution would need to meet, based on our indirect observations and direct feedback from our preliminary interviews. These requirements were categorized as either 'functional,' relating to the core functionality and features of the application, or 'nonfunctional,' outlining aspects of our design necessary to meet our target users' specific needs.

2.1 Functional

Detailed below are the core functionality-focused requirements our solution must meet based on our preliminary research of users' needs.

2.1.1 Simplified and Reliable Work Shift Logging

Several users communicated with us that a significant number of workers struggle to maintain accurate logs of their hours, which can be essential in a payment dispute. Frequently, this is due to confusion regarding paid shift time, difficulty maintaining records, or simply forgetting to record hours. To mitigate this issue, our application must simplify the process of recording working logs, and store them in a secure and reliable format.

2.1.2 Payment Checking

From the Wage Theft Coalition, we learned that due to confusion regarding worker's rights, schedules, and payment sums, workers are often completely unaware that they are experiencing wage theft. In an attempt to alert users to possible wage theft as early as possible, our application needs to provide estimated wage payouts alerting our users of a potential wage theft cases.

2.1.3 Resources

Above all else, we learned, the lack of awareness regarding wage theft and worker's rights is the greatest contributor to avoidable wage theft incidents. Our application needs to

provide relevant, reputable, and easily accessible employment info references to help educate and support users.

2.2 Nonfunctional

Listed below are the system's nonfunctional requirements, compiled to ensure the usability and effectiveness of our solution.

2.2.1 Privacy

Our application needs to maintain user privacy and the maximum possible data protection. Relevant GPS activity must be processed and stored entirely on the device and data should only be shared with specified parties (i.e. lawyers and other legal counsel) at the user's explicit request.

2.2.2 Design Accessibility

To address the lack of familiarity of our target demographic towards technological use, our application needs to be simple and intuitive to use, with ample in-app guidance provided. In addition to support for system-wide font size adjustment, icons and touch targets need to be large to improve accessibility for individuals with sight or motor limitations.

2.2.3 Compatibility

To reach and impact the largest group of individuals possible, the application must be developed and deployed for both iOS and Android devices, with easily achievable hardware requirements. A sizable number of users within our target market rely on aging smartphone hardware, and our application must provide a stable and smooth experience for all.

Chapter 3: Project Specifications

To ensure our final product would fulfill both the functional and nonfunctional requirements of our users, as outlined in Chapter 2, we relied on the following specifications to inform our design process and guide our operation as a team.

3.1 Use Cases

Below is a diagram of the potential use cases of the application from the perspective of an individual user, as well as the system itself. Uses exclusively available to the user are in blue, with those of the system in red, and shared uses in purple. Users must have the ability to add jobs, start and stop tracking, view and share logs, and access relevant resources. Due to the autonomous aspects of our application, the system itself must also be able to start and stop tracking, as well as continuously determine owed wage.

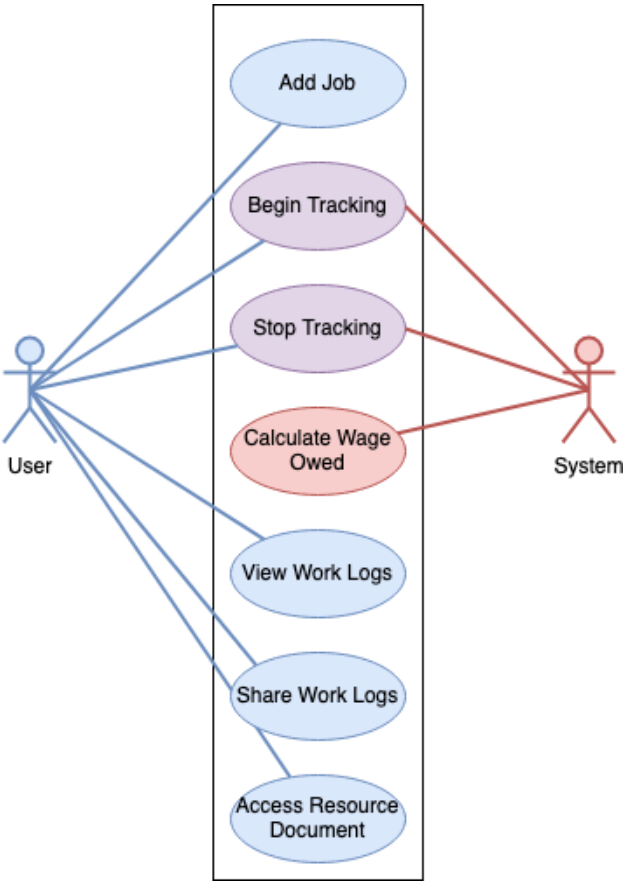

Figure 3.1: Use Case Diagram

3.2 Activity Flow

To depict the sequence of events that occur during the core interactions a user will have with our application – initiating and ending a logging session – the activity diagrams that follow outline the options available to the user at any given time and the potential methods of completing the task

3.2.1 Initiating a Logging Session

If users should be compensated for time spent in a location outside one of their predefined workplaces, they may wish to manually begin recording a work session. In addition to automatically starting a logging session based on a user's location and workplace geofence, users can manually begin a recording session by pressing the 'Start' button. A geofence with a default radius of 300 feet is placed around the user's current location, and recording will continue as normal until the user exits this area or presses 'Stop'.

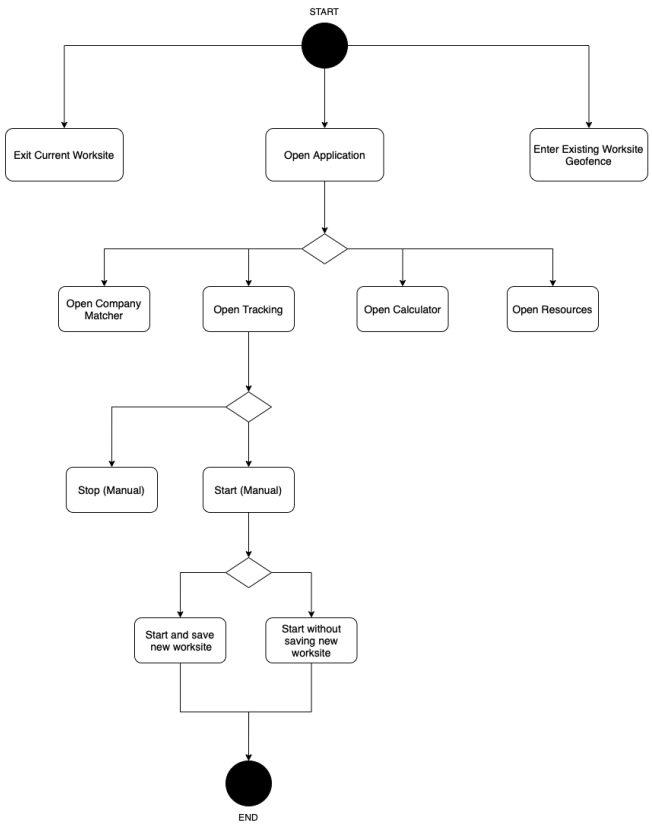

Figure 3.2: Manually start logging session activity diagram

3.2.2 Ending a Logging Session

Equally important in maintaining accurate shift logs, is ending the session at the correct time. To ensure this occurs as reliably and seamlessly as possible, the application will automatically pause the session when the user exits the current workplace. Should they wish to manually end their session and save their log, a user simply opens the application, navigates to the tracking tab, and presses ‘Stop.’ This will securely save a record of the shift on the device, and cease monitoring the device’s GPS location.

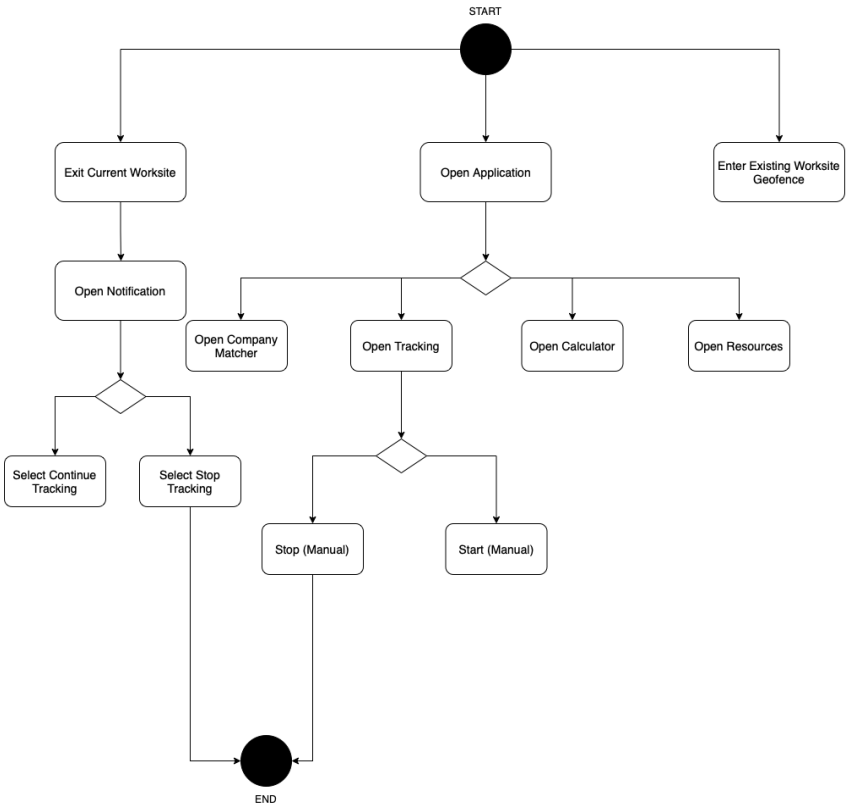

Figure 3.3: Manually stop recording session activity diagram

3.3 Success Metrics

To understand the quality of our design in a quantifiable way, we developed a set of success metrics as indicators of design improvement, or regression, during our usability interviews. Our initial metrics, monitored and prioritized throughout each major development phase, were time and number of taps for a user to complete a given task. While both were

predictably high throughout our earliest test iterations, by integrating user feedback (as described further in Chapter 5,) both were consistently reduced. Application performance plays a critical role in the usefulness of our utility; constant crashing, heavy power draw, and general bugs have the potential to render any application unusable. Both Apple's Xcode and Google's Android Studio development environments presented a variety of options for indicating our application's performance across a range of devices. For both systems, we monitored the number of application crashes experienced by test users across each revision, as well as the percentage of device resources, like CPU, RAM, and battery, consumed by our application. While, again, both metrics were quite high in our initial deployments, we were able to significantly reduce both through bug fixes and implementation of more efficient libraries and methods.

3.4 Risk Analysis

Based on potential risks we identified prior to beginning development work, as well as significant, possibly recurring problems encountered during development, we compiled a table of risks involved in our project. For each risk, we have identified the occurrence itself, its severity, likelihood of occurrence, and impact on progress, as well as how each may be mitigated.

Table 3.4.1: Risk Analysis

Risk	***Severity***	***Likelihood***	***Impact***	***Mitigation***
Bugs occurring during development	2	0.9	4	Code will be written in a consistent style, thoroughly commented
Development materials lost or deleted	6	0.2	3	Development documents and files will be stored in Google Drive, code will be saved to GitHub
Locally stored user data / time logs are lost	8	0.01	9	Rigorous testing stability testing, remind users to back up their data
Issues accessing GPS reliably	3	0.1	5	Extensive GPS testing, investigate

Risk	***Severity***	***Likelihood***	***Impact***	***Mitigation***
				multiple methods for accessing user location
Team member unable to work due to illness or computer loss	2	0.4	4	Work remotely when possible, access on-campus computers if necessary

By relying on this table of practices throughout our development process we were able to mitigate, or avoid altogether, a host of significant setbacks to our project. On multiple occasions, our adherence to our protocols regarding development code storage and backup prevented the loss of several days' worth of work, which would have been a significant blow to our project timeline and overall team morale.

Chapter 4: Technologies & Tools Used

As with nearly any software project at this or greater scale, our efforts relied on a variety of technologies and tools to support, enable, and share our contributions. Early in our process, we identified and researched some of the tools and technologies that would be critical to our development and success; three key utilities that contributed to our project's completion are outlined below.

4.1 Figma

Prototypes of the key user interfaces for our mobile application were designed using Figma[5], a web-based collaborative graphics editor and prototyping tool. A critical nonfunctional requirement of our application, given the widely varying degrees of digital familiarity among our target user base, was to have a highly intuitive user interface. Figma was critical to the early development of our project, as we needed to be able to quickly produce and refine user interface prototypes based on ongoing user tests and feedback. Moving forward, Figma could also play a role in rapidly testing usability of new features, or support for new device mediums, such as tablets, laptops, or smartwatches.

4.2 React Native

React Native[6] is an open-source UI software framework, developed and maintained by Facebook, for building cross-platform applications. Because of the high volume of both Android and iOS users in our target group, building an application for each platform was a priority, however doing so would not be feasible due to our team's collective limited experience working with either. All of us did, however, have extensive experience working with JavaScript, upon which React Native is built. Developing with React, all team members were able to effectively contribute to both versions of the application, significantly reducing overall development time.

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[5] *The Collaborative Interface Design Tool.* Figma. (n.d.). Retrieved June 8, 2022, from https://www.figma.com/

[6] *React native · learn once, write anywhere*. React Native RSS. (n.d.). Retrieved June 8, 2022, from https://reactnative.dev/

4.3 MongoDB Realms

MongoDB Realms[7] is a highly flexible data storage solution, developed for use with both local and server-based applications, and with support for a variety of programming languages, including React Native. Our application relies on Realms for all user data storage, and it will be integral to future implementation of features like data encryption and secure cloud storage.

[7] *Build faster. build smarter.* MongoDB. (n.d.). Retrieved June 8, 2022, from https://www.mongodb.com/

Chapter 5: User-Led Design

On working on our social-justice-oriented senior design project, we understood that technical prowess alone was not enough to create an application addressing a community issue. Community engagement thus had to be a key component in our project. Throughout the project, our team maintained close communication and collaboration with our target users from PAWIS. In order to do that, we broke our development into three 'waves,' structured around the type of feedback we hoped to receive from our test users. Below is an overview of each of the key phases of testing we conducted.

5.1 Wireframe Testing

After developing our initial wireframes for each primary application interface, seen in Figure 5.1, we began conducting interviews regarding the usability of our application. Although the wireframes lacked content or color at the time, we hoped users would be able to both get a rough understanding of how the application would be controlled and navigated and provide feedback on the usability of our design. Usability testing was highly effective in helping us refine the labeling, sizing, and placement of buttons throughout the interface, as well as adjusting the naming and organization of our primary application pages to be more intuitive and navigable for users.

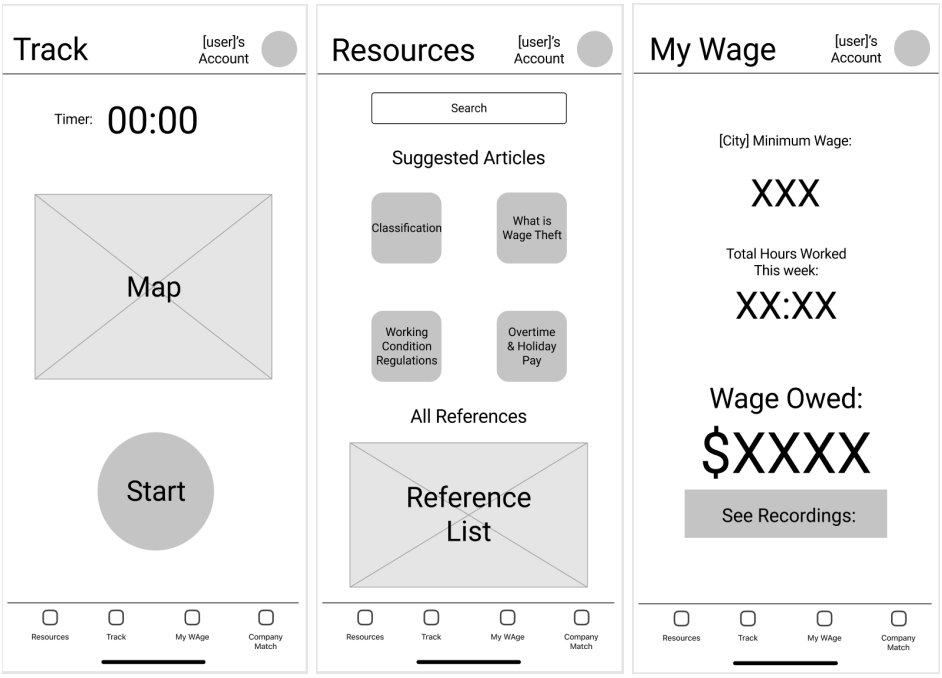

Figure 5.1: Initial Wireframe

5.2 Prototype Mockup Testing

With the feedback gathered from our test users and validation of the overall usability of our interface, we began developing a high-fidelity prototype mockup in Figma, alongside a brand identity and color palette as shown in Figure 5.2. From our initial wireframe, we proceeded to introduce more detailed elements like fonts, branding colors, and a custom icon set. With this second wave of usability testing, we continued to use our interactive Figma prototype to let users directly experience the app, and give feedback on aspects like fonts, icon visibility, and button intuitiveness.

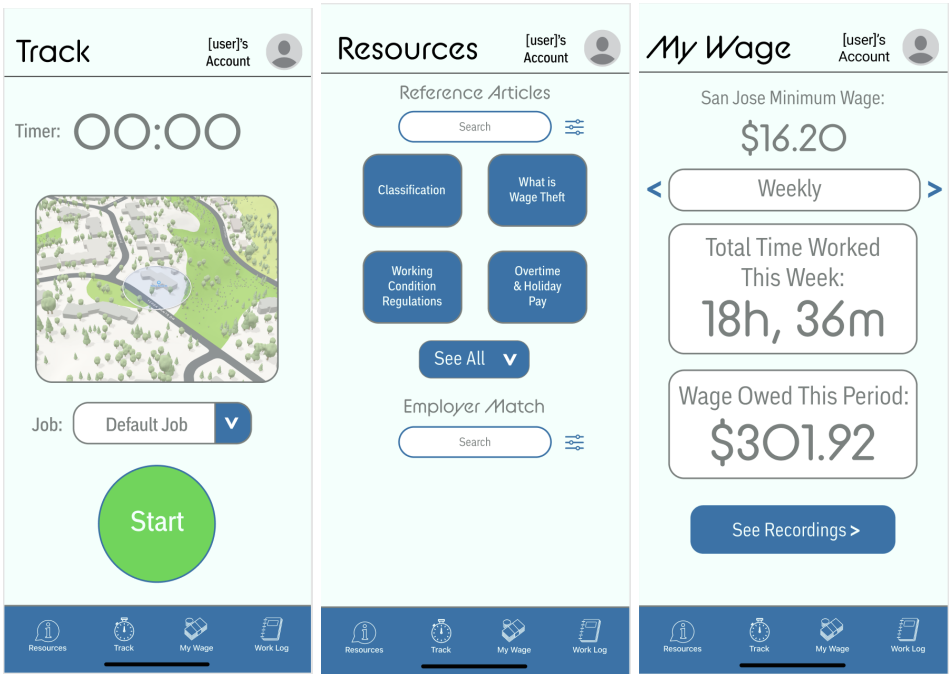

Figure 5.2: Prototype Mockup

5.3 On-Device Testing

With this feedback in hand and a realistic target in mind, we began the development of the application itself using Typescript. Once we had the key pages of the app created and a small set of our desired functionalities built, as shown in Figure 5.3, we began our third wave of usability testing. Unlike the previous rounds of testing, it was not feasible to conduct the third wave of tests virtually, using Zoom, and thus our team went to the homes and workplaces of test users to conduct our tests. It was during this phase that users were finally able to install our application on their personal devices, and use it to create logs. Through on-device testing, we were able to quickly discover and resolve a wide range of issues related to device scaling, content visibility, and performance on older devices. This final testing wave will be ongoing — as we continue to work with the Santa Clara Wage Theft Coalition to refine and extend the Wage Wizard utility, user input will be actively sought and integrated into our design.

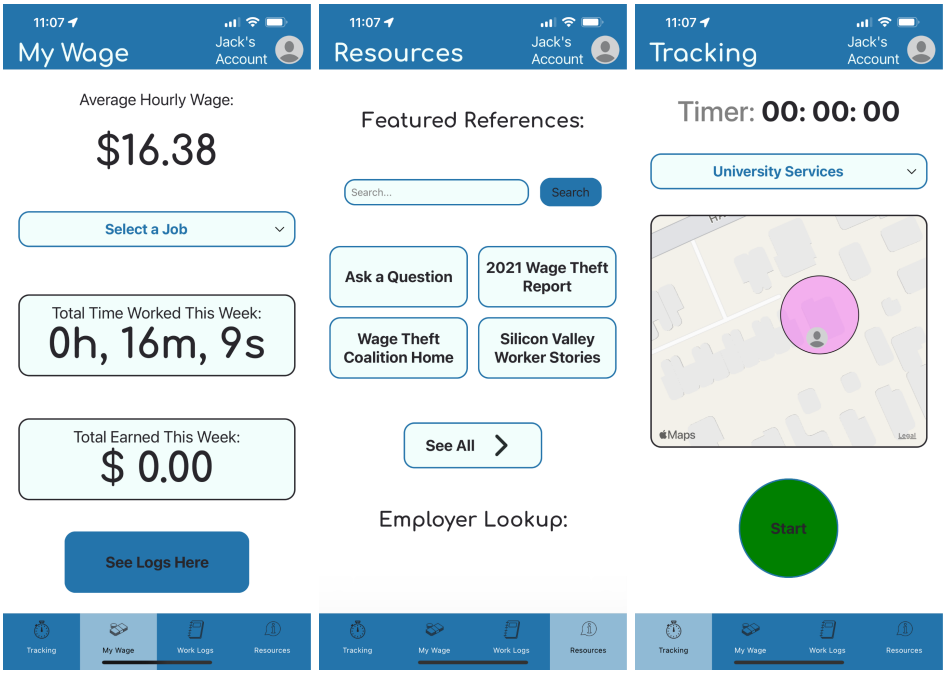

Figure 5.3: iOS & Android Beta

5.4 Feedback Implementation

Upon completion of each phase of user testing and interviews, we regrouped as a team to compare and combine our collected notes, and ranked the necessity and urgency of each piece of feedback. For requests from interviewees that could considerably alter functionality and / or development time we met with our project contact, Prof. Ruth Silver-Taube, to ask for her approval and feedback. Upon deciding which changes to implement, we made the necessary changes to either our design or documentation, and reassessed the usability of any impacted interfaces through additional interviews.

Chapter 6: Development Timeline

To ensure progress was maintained at a steady and manageable pace, we constructed a timeline of major milestones to achieve, and strove to closely adhere to these deadlines throughout the duration of the project.

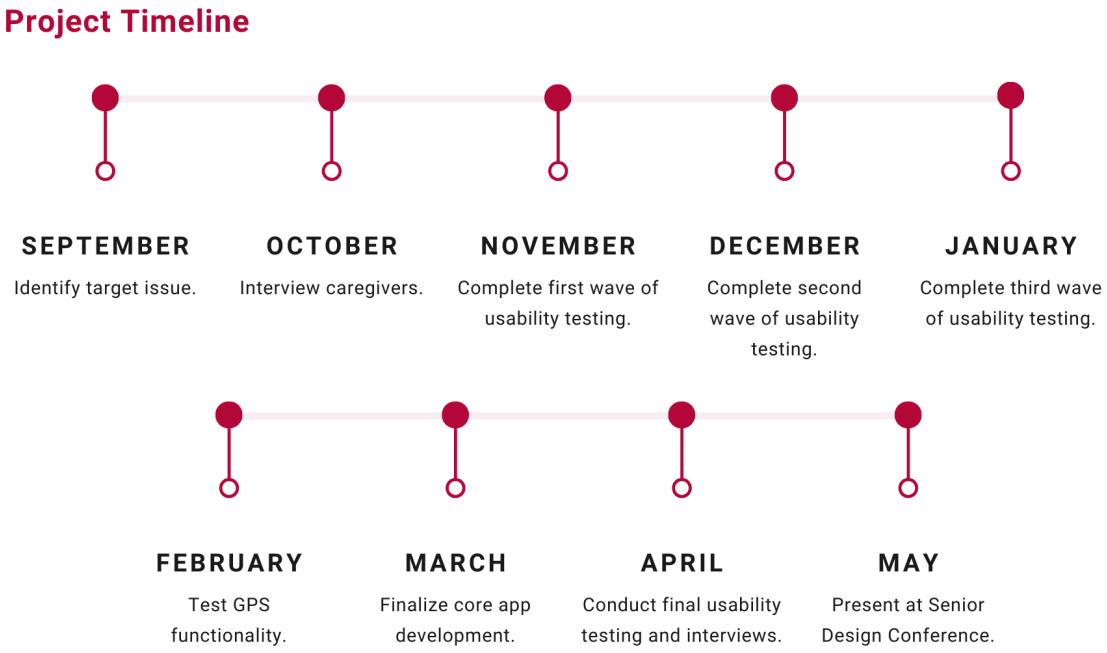

Figure 6.1: Development Timeline

Chapter 7: Societal Impact

As with any engineering endeavor, our project has the potential for societal impact across a vast array of elements. Below, we have identified the areas in which we believe our application will have the greatest level impact.

7.1 Ethical & Social

In developing our senior design project, we incorporated the six ethical frameworks of SCU's Markkula Center for Applied Ethics into all aspects of our project: rights, justice, utilitarian, common goods, virtue, and care lenses. With these six lenses, we analyzed the problem posed by Santa Clara County's wage theft pandemic by exploring what ethical impacts it has had on our community. During our time working on our project, we made sure that our design process followed ethical guidelines and respected the rights of our target users. The Rights Approach outlines the belief that "humans have a dignity based on their human nature or on their ability to freely choose what they do with their lives". We understand that under the Rights Approach, our customers have the right to demand from us, the engineers, a "product safe to use and effective at completing its expected tasks". To follow this approach, in our engineering design, we gave utmost importance to ensuring that our product was what our customers, the workers, desired. Before attempting to create the very first wireframes of our application, we reached out to local Filipino caregivers for extensive interviews, where we made an effort to identify and understand the difficulties they face as a result of wage theft, while getting to know the users we were intending to help. We wanted our design to be people-centered and to adapt well to the constraints and concerns of our potential end-users. In Rafael Guerrero's paper, "A Framework for Ethical Decision Making in Problem Definition & Project Selection", he states that engineering that takes into account the Rights Approach "is about realizing where the rights of others are impinged upon in society and considering how technology could be used to allow people to better enjoy these rights". In choosing our senior design project, we identified that many caregivers' right to fair wages was being impinged upon. Unfortunately, in Santa Clara County, such a right is difficult to enforce in the caregiving industry, due to poor regulation and oversight. By developing an application that helps combat wage theft as our senior design

project, we hope to help provide the enforcement to the positive right of a fair wage, and to raise awareness for the pandemic of wage theft in our local community.

One way we chose to analyze the social aspects of the problem of wage theft is through the Common Good lens. The common good is an idea that generally means having the social systems, institutions, and environments on which we depend work in a manner that benefits all people. Establishing and maintaining the common good often requires work and the support of many people and systems. According to Rafael Guerrero, "Design decisions that address the common good are sensitive to the dynamics of society and recognize that the effects of deploying technology will propagate across different communities and demographics." When we analyze an issue using the common good lens, we are encouraged to consider the welfare of others. In the instance of caregiver wage theft, the workers we wish to protect happen to be a combination of many vulnerable groups. The caregivers that will be using our app almost all belong to one or more of the following groups: undocumented immigrants, minorities, non-English speakers, and the elderly. Undocumented immigrants are among the most vulnerable people due to the nature of their status. By providing caregivers with technology to combat wage theft, we not only can improve the living and working conditions of them and their families but also the health and wellbeing of the elderly in our local community. The complex wage theft epidemic can be clarified by using the virtue lens. The virtue lens offer a unique insight into the relationship between the actions and character of the individual. An employer deliberately mistreating their workers without breaking any codified laws or rules, for instance, may avoid condemnation through deontological or utilitarian perspectives, yet their actions still determine their virtue (or lack thereof). There exist two types of employers which our project is designed to protect against: those who abuse their workers out of negligence, and those who abuse workers out of deliberate greed, or malice. In either scenario, virtues of integrity, care, and honesty are absent in place of animosity and deception, deeming either scenario virtuously unethical. Similarly, individuals choosing to ignore (or even contribute to) the struggles of migrant workers when given the opportunity to do so fail to exhibit virtues of care and compassion, neglecting any drastic conditions they or their families are potentially facing.

7.2 Social

Wage theft is a significant social issue in Santa Clara County as it affects many people in the community. Aside from the workers who are directly impacted by wage theft, the workers' families, their clients, and all taxpayers are affected by widespread wage theft. One of the motivations of our project was to hopefully create a positive ripple effect on the community by addressing the welfare of the workers suffering from wage theft.

7.3 Political

Despite the issue of wage theft being widespread and severe in our local Santa Clara County, it is not widely visible among the general public. This is further the case for the rights and welfare of the exploited migrant workers in the caregiving industry, especially the undocumented, who tirelessly toil not only for their families in their home countries, but also for the health and wellbeing of our elders in our care homes. We discovered that current laws and policies do not adequately address the tragic circumstances of wage theft, as the caregiving industry is currently under-regulated, and migrant undocumented workers suffer from discriminatory laws, leading them to live in fear of deportation from the U.S Immigration and Customs Enforcement (ICE). We hope that our project will raise awareness of the issue of wage theft and how it affects undocumented migrant workers, to hopefully bring about future political policies and advocacy to address their situation

7.4 Economic

The issue of wage theft is a significant economic issue. Aside from harming the workers and their families, wage theft diminishes the collective bargaining power of workers and lowers their hourly wages. This affects our economy as it forces affected workers to rely on increasingly strained public assistance programs at the expense of taxpayers. Furthermore, wage theft deprives the workers and their families of just compensation for their work, which otherwise could have contributed to our economic growth and reduction of economic inequality.

7. 5 Health and Safety

Wage theft poses a severe danger to affected migrant caregivers as it forces them to work for long, unsustainable hours and multiple shifts and often to take on multiple jobs, at the expense of their health and safety. This has a ripple effect on our local community, as the health and safety of our elders in care homes are also affected. Fatigue diminishes the quality of care they are able to provide

7. 6 Manufacturability

Our product does not need to be manufactured as it is a software.

7. 7 Sustainability

Our product will be viable and useful for a reasonable amount of time as we plan to continue to improve our software as well as maintain it.

7. 8 Environmental Impact

While our product lessens the need for paper, as a mobile application, it has some environmental impacts. Our software is dependent on its mobile hardware whose extraction of its raw materials may have negative effects on the environment such as mining.

7. 9 Usability

Usability is critical in the design of our product as it is one of its key non-functional requirements. Our user-interface is straightforward, easily learned, and easily used by the end user.

7. 10 Lifelong Learning

This project inspired us to study new material. Everyone in our team did not know the development technologies used in our project and thus had to learn them all to create our product.

7. 11 Compassion

Our project was primarily motivated by the awareness of and sympathy for the suffering of the workers struggling with wage theft and the desire to relieve that suffering. Compassion was deeply ingrained in this engineering project.

Chapter 8: Results

After fulfilling the application requirements and specifications from both the apple and android stores, we were able to publish our application to both the stores in a beta state. Our application has implemented the most prioritized features our stakeholders asked, namely, automated work shift documentation using geofencing, wage pay out estimation, and wage theft resources.

8.1 Location-Based Tracking

Our application's most prioritized feature is its ability to automatically record how long a user stays within a defined location. As shown in Figure 8.1, after a user has selected a workplace to track their hours, the map in the tracking page will show a circle surrounding the perimeter of the workplace they defined as well as where the user is currently at. For the marker that indicates where the user is currently at, we used the user's profile icon because the initial marker, a pin, confused one of our test users in a usability test .

Using the mobile device's GPS, the application detects when the user enters the perimeter which then starts the timer as shown in Figure 8.2. In order for the application to have integrity of the user's proof of time in a certain location, the timer in Figure 8.2 cannot be initiated by the user interface and can only be triggered when the user enters the defined perimeters. Once the timer starts, the user then has the option to either pause the timer, take a note, or stop tracking the location. The ability to pause the timer was added following the suggestion of our lawyer stakeholder to model the event when a user is taking their break at work. Both our lawyer stakeholder and our target users asked us to provide the application user the ability to be able to take notes on their work session as they stated that these notes are vital in documenting details of a wage theft instance in court.

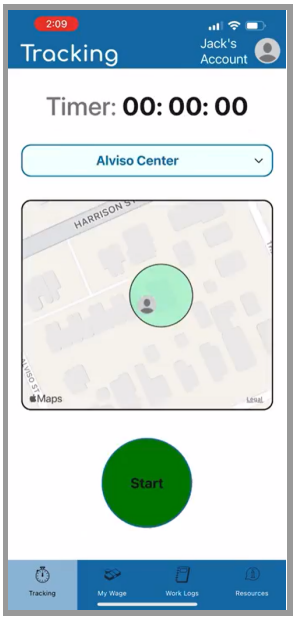

Figure 8.1

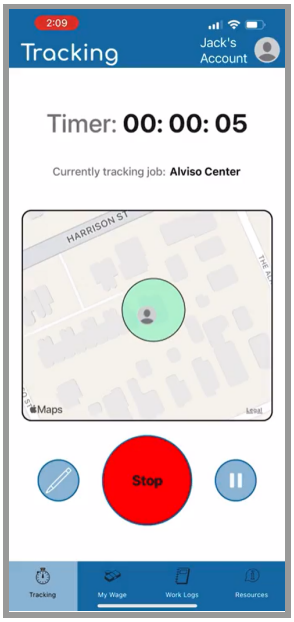

Figure 8.2

Once the user leaves the defined perimeter, the application stops the timer and then generates a log shown in Figure 8.3. These logs are identified by the date, time, and location of their recording. Upon clicking an individual log, the application displays the important details of the session as shown in Figure 8.4.

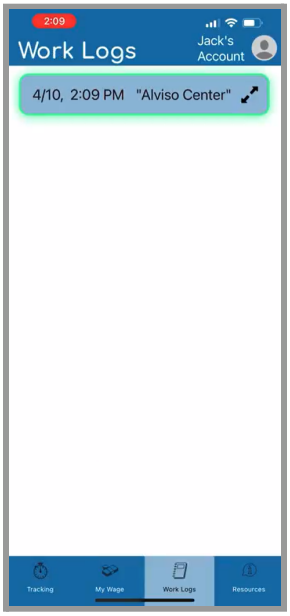

Figure 8.3

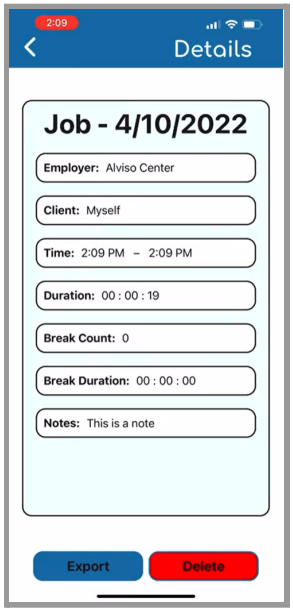

Figure 8.4

The details displayed on each log were selected from our interviews with our target user and our lawyer stakeholder based on what information was necessary in court to prove instances of wage theft. Our application's features of recording time spent on the workplace through the device's GPS and generating corresponding detailed logs answer our project's requirements to have a simplified and reliable work shift logging for the user.

8.2 Wage Payout Estimations

Based on the hours recorded, the application can generate a wage payout estimation based from a user imputed wage as shown in figure 8.5. While the estimation is very rough as it simply multiplies the user given wage amount with the recorded time at the workplace and does not take into account the complexities of wage laws such as meal break subtractions and overtime rates, the application provides provides an adequate baseline to alert the user if they are suffering from a severe wage theft case as their given payout would be drastically lower. This application features fulfill our project's second functional requirement

8.3 Wage Information and Resources

One of our application's main pages provides information and resources regarding wage theft to help educate the user regarding wage policies and laws as shown in figure 8.6. The information in this page is provided by our sponsor, the Santa Clara Wage Theft Coalition. This feature addressed the issue that a significant portion of our target users are migrant workers and are thus unaware of their legal rights and protections in the workplace regardless of whether they are documented or not. This feature fulfills our project's third functional requirement.

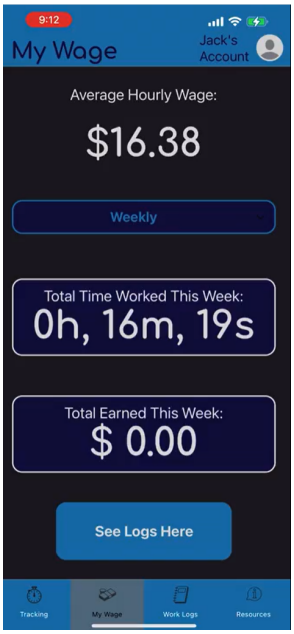

Figure 8.5

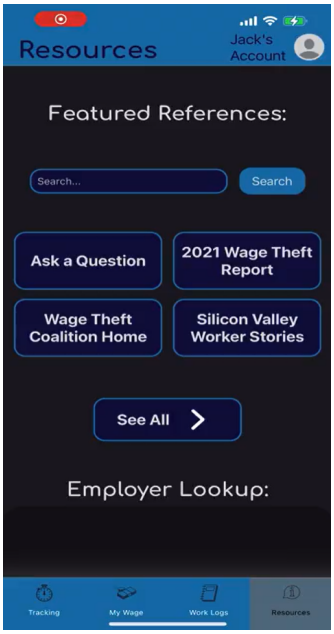

Figure 8.6

8.4 Intuitive and Simple User Interface.

Fulfilling our non-functional requirement that our application be simple and intuitive to use to address the lack of familiarity of our target demographic towards technological use, our application's user interface was designed to be easy to understand. Based on on-device tests, our target users take less than 6 taps at maximum to get to different features of the application. The wordings and labels in our current application were selected based on our numerous user tester interviews. Icons and touch targets are large to improve accessibility for individuals with sight or motor limitations. Any confusing icons were replaced with more clear and straightforward applications.

8.5 Security and Privacy

In order to ensure user privacy and maximum possible data protection, all data generated by our application is not sent to any server. Worklogs generated by the tracking feature are encrypted and stored on the device locally using MongoDB Realms. Work logs can be shared with specified parties (i.e lawyers and other legal counsel) but only at the user's explicit request

8.6 Cross Platform

Our mobile application is available for both Android and IOS devices. Application has met the requirements from both Apple and Android to be published as a beta release. Apple and Android platforms were chosen as the majority if not all of our currently selected target test users have either both platforms.

Chapter 9: Conclusions

Throughout working on this project, our team encountered and overcame many obstacles and challenges in creating an application through close collaboration with our stakeholders. In the end, not only did our team gain a profound understanding of wage theft, but we were also able to create a mobile application that can combat it. Our team however believes that in order for our mobile application to reach its full potential, further development and refinement is still needed.

9.1 Obstacles and Challenges

There were multiple major obstacles our team encountered in working on our project. Prior to beginning, our team had limited experience developing mobile applications – let alone mid-scale cross platform apps – requiring significant research and practice before we could begin development efforts. Requirements were not initially defined and known and had to be researched and captured through frequent communication and feedback with our target users. Application code had to be flexible and adaptable to address corrections and feedback of the application from our test users. Lastly, testing the application had logistical challenges as the team had to conduct the third wave of tests in person.

9.2 Outcomes

Our senior design project produced a working and viable mobile application that can help its users combat wage theft. Our application is available from both the Apple and Android store in a beta state. Our team was able to gain profound and concrete insights about the issue of wage theft particularly in the caregiving industry through collaborating closely with local workers from PAWIS. In addition, our team was able to use the knowledge we gained from the workers in applying our engineering skills taught in our school to create a viable solution in addressing and combating wage theft in our local community.

9.2 Recommendations & Next Steps

Ownership and maintenance of the mobile application will be transferred to our sponsor, the Santa Clara Wage Theft Coalition. While we were able to produce a working application, some features remain unrefined and thus needs continued development. Beta-testing is currently limited to a few test-users and thus needs to be expanded to incorporate even more perspectives. We also hope to serve more workers and industries beyond caregivers in the future, eventually adding support for all hourly professions.

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Appendices

1. **Link to Git Repository**

   https://github.com/jackcdavey/WageWizardApp

2. **Link to Figma Prototype**

   https://www.figma.com/file/CqdbGMuJI5xAoDhXdBh2Py/Wage-Wizard-Wireframe-v1?node-id=2%3A6