SANTA CLARA UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Brett Rimmer, Kyle Felip Mondina, & Jack Davey

ENTITLED

Wage Wizard

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN GENERAL ENGINEERING
BACHELOR OF SCIENCE IN COMPUTER ENGINEERING
BACHELOR OF SCIENCE IN WEB DESIGN AND ENGINEERING

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Thesis Advisors

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Department Chair

Wage Wizard

By

Brett Rimmer, Kyle Felip Mondina, & Jack Davey

SENIOR DESIGN PROJECT REPORT

Submitted to
The Department of Computer Science and Engineering

of

SANTA CLARA UNIVERSITY

in Partial Fulfillment of the Requirements
for the degrees of
Bachelor of Science in General Engineering
Bachelor of Science in Computer Engineering
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ABSTRACT

Wage theft is a tragically common and growing predatory practice among employers, notably within the caregiving industry. With irregular and difficult to document working hours, unclear employment guidelines and classifications, and potentially complex wage calculations, many caregivers, particularly those with limited education or knowledge of the US legal system, are frequently underpaid or otherwise taken advantage of. Among the most vulnerable are undocumented workers, who lack viable options for legal defense in the event of a dispute, risking financial devastation or even deportation in pursuit of justice. To aid in their defense while maintaining user privacy, we propose an application that relies on on-device geofencing and GPS location to automatically record hours spent at a workplace, features an intuitive and simple questionnaire to determine and present individualized employment details, as well as an automated wage payout estimate, to quickly and accurately tell if wage theft may have occurred.

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Chapter 1

Introduction

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 workers in Santa Clara County, and beyond. As of 2021, the Santa Clara Wage Theft Coalition had identified more than 25,000 local wage theft cases across all industries, totalling more than $128,000,000 in unpaid wages**.** 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.

Notably in the caregiving industry, this damaging crime is perpetuated by a lack of regulation, difficulty in tracking hours worked, and the widespread misclassification of employees as independent contractors. COVID-19 has made the effects of wage theft more severe and prevalent, while increasing both the risks and costs associated with their profession. These caregivers, many of whom are undocumented immigrants, lack viable access to legal defense or knowledge of the legal intricacies of employment, and are frequently taken advantage of in the form of under- or delayed payment.

1.2 Existing Solutions

Many of the caregivers we interviewed in our preliminary research utilized 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. In addition to written log keeping, a variety of applications exist today to help individuals record their hours worked through a variety of methods, including geolocation-based, but are typically focused on providing employers and teams with more granular individual employee performance data. Prior to beginning development we reviewed and analyzed a wide range of potential competitor applications, none of which offered protections for the potentially sensitive user data collected.

1.3 Proposed Solution

To aid in users' defense, the mobile application will assist caregivers in identifying their legal employment classification, calculating their owed wage, and recording hours worked in an accurate and convenient manner. Using geofencing technology, we plan to automate the process of clocking in and out of work, while recording a provable log of time spent in the workplace for use in both formal and informal payment disputes. Combined with a function for identifying individuals' employment classifications and associated rights, the application will provide an estimate for wages owed, making it easier to determine if wage theft has occurred. With the release of this utility, we hope to contribute to the pursuit of caregivers' rightfully owed wages, and prevent future instances of wage theft.

Chapter 2

Requirements

2.1 Functional

- The application will provide users with:
    - Automated & detailed work shift logging
    - Basic employment classification info
    - Weekly, biweekly, or monthly estimated expected wage payouts
    - Relevant, reputable, and easily accessible employment info references

2.2 Nonfunctional

2.2.1 Privacy

To maintain user privacy and maximum possible data protection, relevant GPS activity will be processed and stored entirely on device, with data being shared only with specified parties (i.e. lawyers and other legal counsel) at the user's explicit request.

2.2.2 Design Accessibility

As caregivers today work at a wide variety of ages with perhaps an even greater variety of familiarity with digital applications, the application will 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 will 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 will be developed and deployed for both iOS and Android devices, with easily achievable hardware requirements.

Chapter 3

Use Cases

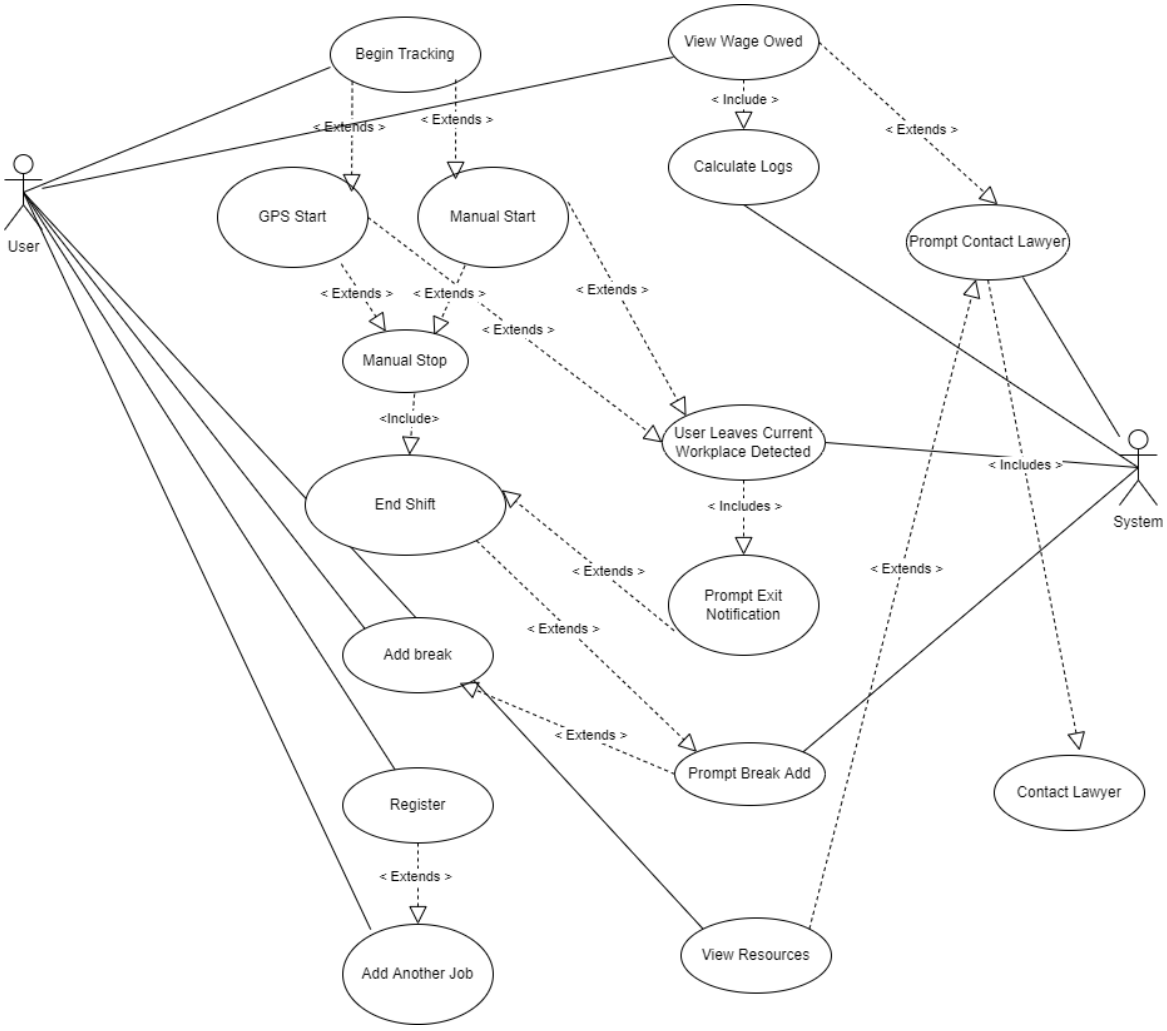

Figure 3.1: Use Case Diagram

Chapter 4

Activity Diagrams

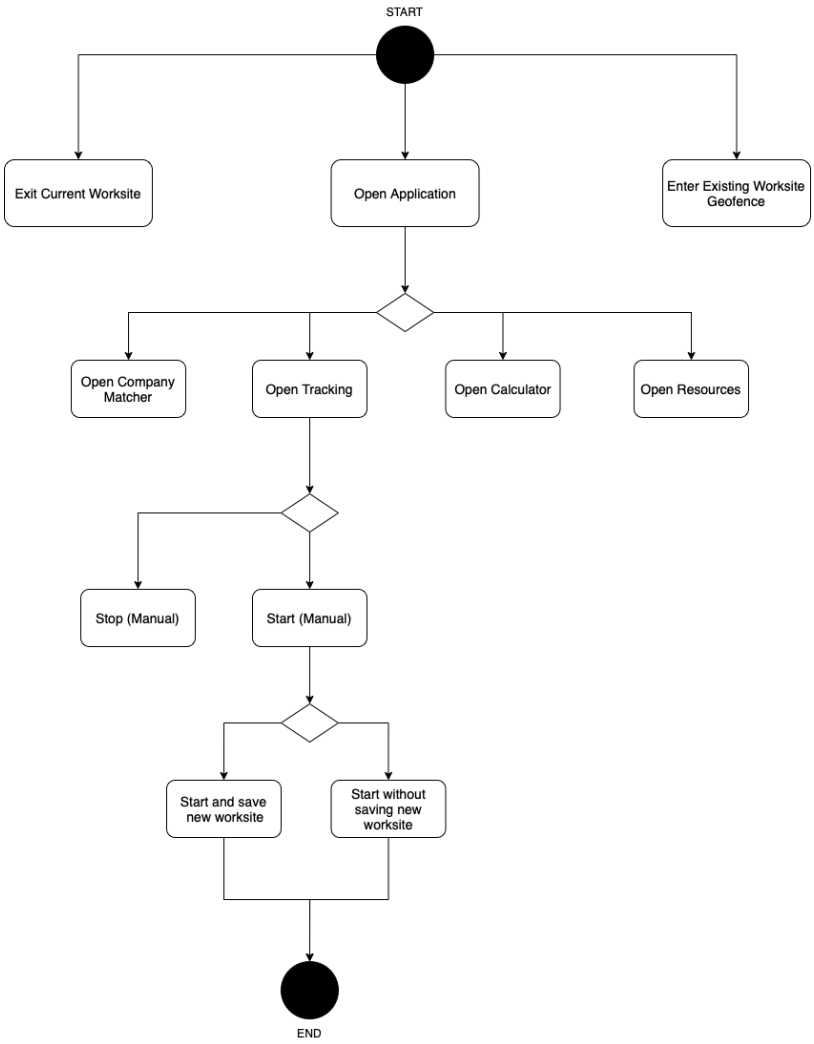

Figure 4.1: Manually start recording session activity diagram

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 recording 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.'

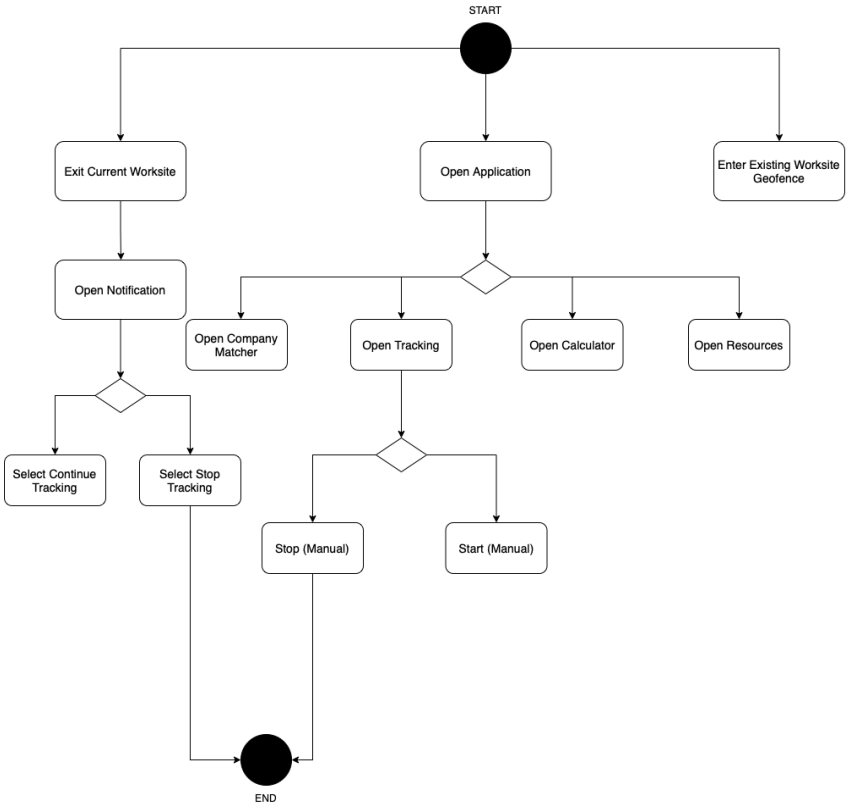

Figure 4.2: Manually stop recording session activity diagram

Chapter 5

Technologies & Tools Used

Figma

Prototyping the user interface for our mobile application will primarily be developed using Figma. Figma is primarily a web-based collaborative graphics editor and prototyping tool. All of our wireframes and prototypes for our user interface will be made in Figma. One of the important features our mobile application needs to have given its target audience is having a very intuitive user interface. Figma is critical to the development of our project as we need to be able to quickly produce user interface prototypes from our constant user interviews and feedback.

React Native

React Native is an open-source UI software framework for developing cross platform applications. We aim to create our mobile application for both Android and IOS users. By using the React Native framework, we can save time by developing the application for both platforms simultaneously, rather than developing separate applications for each platform. We choose this framework given that all of our team members are most comfortable with Javascript, upon which React is largely based and shares many similarities with. Team members have developed web-based applications using ReactJS previously, and are

Chapter 6

Usability Interviews & Feedback Integration

6.1 Preliminary Interviews

Prior to beginning the initial design of our application, we conducted a series of interviews to determine the greatest needs and requirements of potential users. Interviewees were asked about their experiences with wage theft, many of whom unfortunately had multiple experiences to share. When asked what assistance they could have benefited from in preventing or fighting their unfair compensation, multiple interviewees explained that education regarding workers' rights was severely insufficient amongst their coworkers, and that improved access to information detailing their rights and employers' obligations could significantly aid struggling workers. Several interviewees had previous experiences with wage-tracking applications, however none of them continued to rely on such utilities due to privacy concerns, accessibility shortcomings, and limitations in providing useful information.

6.2 Usability Testing

After developing our initial wireframes for each primary application interface, 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 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 labelling, 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.

6.3 Feedback Implementation

Upon completion of each round of either preliminary or usability 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, Ruth Davis, to approve and provide additional insight into. Upon deciding which changes to implement we made the necessary changes to either the wireframe or our documentation, and reassessed the usability of any impacted interfaces through additional interviewing.

Chapter 7

Existing Model

Figure 7.1: QR link to view interactive initial wireframe demo

Chapter 8

Risk Analysis

Risk	***Severity***	***Likelihood***	***Impact***	***Mitigation***
Bugs occurring during development	2	.9	4	Code will be written in a consistent style, thoroughly commented
Development materials lost or deleted	6	.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	.01	9	Rigorous testing stability testing, remind users to back up their data
Issues accessing GPS reliably	3	.1	5	Extensive GPS testing, investigate multiple methods for accessing user location
Team member unable to work due to illness or computer loss	2	.4	4	Work remotely when possible, access on-campus computers if necessary

Figure 8.1: Risk Analysis Table

Chapter 9

Development Timeline

September

- Initial group formation
- Target issue identified
- Project sponsor initial meeting

October

- Conduct preliminary interviews with caregivers
- AWS cost and technical requirements research
- Wireframe design start
- Usability testing wave 1

November

- Wireframe content and branding color implementation start
- Usability testing wave 2
- Pivot to on-device recording only model

December

- Continued refinement of wireframe model
- Design report writeup

January

- Code implementation based on model start
- Initial senior design presentations
- Usability testing wave 3

February

- Begin testing GPS functionality
- Continued interface refinement and testing

March

- Core app development finish
- Project sponsor status update and app demo

April

- Final usability testing and interviews
- Senior Design Conference presentation construction and practice

May

- Senior Design Conference

June

- Final project writeup finished