Redesigning The Commuter Experience:

CapApp

Commuter Assisted Parking Application

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Redesigning The Commuter Experience at Clemson University

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ABSTRACT

This paper describes the motivation and design of a commuter sourced mobile application that will assist commuters in locating parking at Clemson University more efficiently. The proposed application, CapApp, is an acronym for Commuter Assisted Parking Application. The primary objective of CapApp is to redesign the commuter experience with a socio-technological system to alleviate the pains associated with locating parking. CapApp was developed with design thinking in mind. Design thinking is a tool that is used to achieve strategic initiatives that are driven by the need for innovation [2]. In our development, we seek to innovate and create novel technologies that will provide solutions to common problems. Our design experience included iterations of understanding, observations, conceptualization, validation, and implementation. We believe this design method will offer more solutions to solve common problems more effectively. Our stakeholders (commuters and parking services) were involved throughout the design and testing phases. As a result, CapApp is proposed to enhance the commuter experience through its novel set of features such as: parking check-in, parking check-out, GPS Location Based Service, and an Incentive Based System.

INTRODUCTION

According to a research conducted by the U.S. Office of Educational Research and Improvement, it has been estimated that more than 86 percent of college and university students are defined as commuter students [3]. Being a commuter at Clemson University can be tedious at times. Parking is limited and commuters do not have the intended knowledge of the university's parking policy, which can lead to many difficulties. In our project we propose to redesign the commuter experience by designing a commuter-sourced mobile application. The name of this proposed application is CapApp, which is an acronym for Commuter Assisted Parking Application. This mobile application will utilize the concept of crowdsourcing, which consists of a large number of humans being used to solve a wide variety of problems [2]. The concept of crowdsourcing has been the motivation behind a variety of novel mobile applications for transportation related services that make life more convenient for everyday users. [1]. CapApp will offer features that will allow commuters to check-in or checkout of a parking spot in parking lots to indicate to other commuters where parking is available. The check-in and checkout data will be used to predict parking patterns based on the data received for all parking lots using a probability based algorithm. With commuters being aware of parking availability, this will alleviate the agony of searching for parking in a lot where parking is unavailable. According to previous research conducted by Chen et al. mobile crowdsourcing permits data collection through numerous intelligent probes and performs data collection primarily from the surroundings of people's everyday life, which attributed to the motivation behind our proposed design [1].

The pervasiveness of mobile devices with embedded sensors are capable of providing alluring sensing applications for the collection and reporting of data in participatory sensing environment utilizing the concept of crowdsourcing [5 6]. While many researchers have developed several mobile sensing applications, certain inconveniences hinder people from providing sensing data using their smartphones. [5]. Many researchers have not considered incentive based systems and smartphone users will probably be less likely to participate in sensing tasks without incentive in the real world [6]. In order to attract more users, our proposed application will offer commuters the opportunity to receive incentives for using the application. Our application will also utilize GPS navigation to direct users to available parking, along with the ability to pay for metered spots, and opportunities to become for familiar with parking services policies and procedures.

OBJECTIVES

The goals of this project are to reduce time and frustrations associated with searching for campus parking. Through group observational research, we discovered from our stakeholders a substantial amount of time is wasted trying to locate parking during peak hours. Commuters spend unnecessary time circulating filled parking lots because they are unaware of which lots have high volume before arrival. CapApp was designed with the objective to alleviate users with these types of frustrations. CapApp is a crowd-sourced application; therefore, the more users who utilize the app, the more accurate the data will be to inform parking lot vacancies.

PROTOTYPE

In our initial lo-fidelity prototype testing, users were asked to complete three tasks using the CapApp prototype. Testing the prototype yielded beneficial results. Users experienced the least amount of issues with the simple task of signing up for the application. The variety of login options (Facebook, Google +, & e-mail) was confusing to some. Users experienced the most issues while completing the complex task of locating the incentive points and redeeming an award for points received. It was not clear which button should be clicked to locate awards points. Also, users were uncertain of the purpose of the top right list button until it was clicked. One user assumed the awards would be sent by postal mail because the application used the term "mail" to refer to e-mail. Another user found our app reminders annoying and suggested we reduce the amount of reminder notifications. Most users supported the idea of being provided with an incentive to read and complete a quiz based on Parking Service policies. Overall, the feedback gained was valuable.

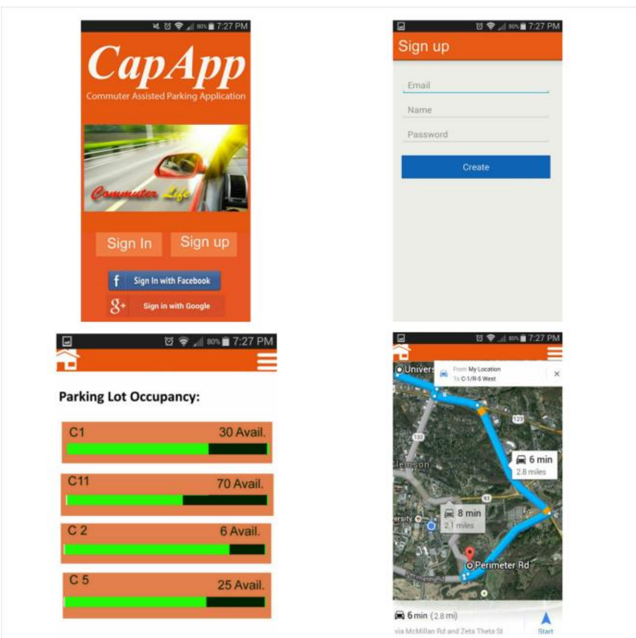

Figure 1. Lo-fidelity Screen Images

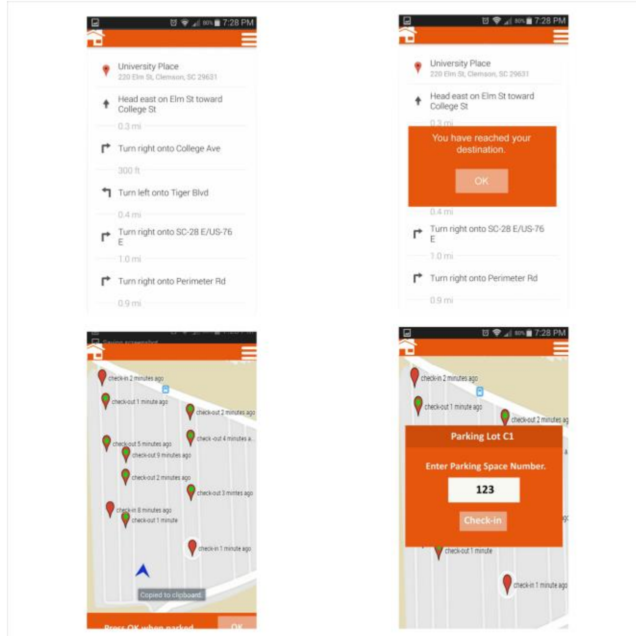

Figure 2. Lo-fidelity Screen Images

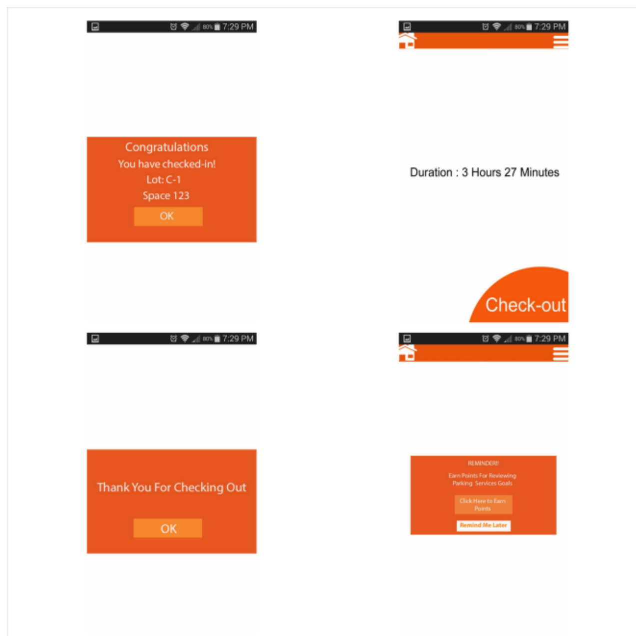

Figure 3. Lo-fidelity Screen Images

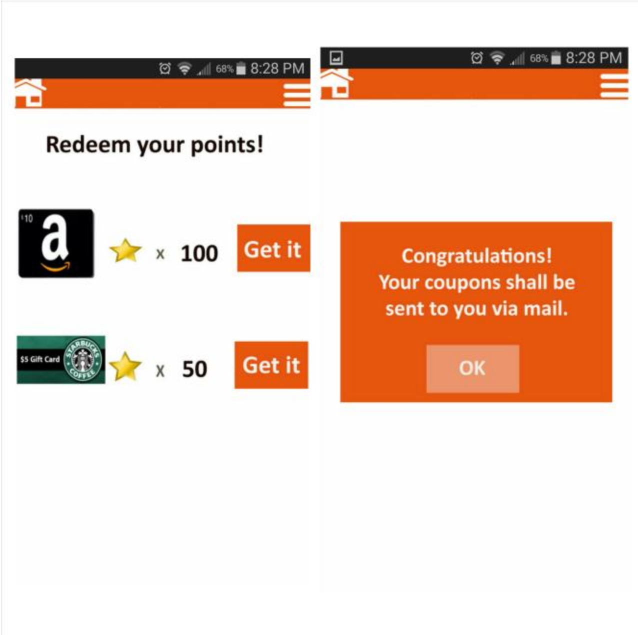

Figure 4. Lo-fidelity Screen Images

With the results from initial lo-fidelity prototype testing of CapApp, design changes were necessary for the next iteration of the mobile application. For the next iteration, we made the decision to change the Incentive Points top right button to a different icon or text that indicates that it is a link for the Points/Awards page. We also decided that we should allow users to login only with Clemson iRoar account credentials, as well as providing better way to ensure users review Parking Services policies prior to taking the quiz. For our incentive based system we decided to have redeemable rewards that can be sent via e-mail and instantly available. Users will also have the option to deactivate reminder notifications.

FINAL DESIGN

Our designed solution was centered on around our stakeholders. A primary feature of this application is to provide commuters with real-time information in reference to parking lot occupancy. In order to calculate the parking lot occupancy, we will be using the concept of crowdsourcing instead of mobile deployed sensors. We believe this solution is more cost effective way to solve our problem. The events of Check-in and Check-out by the commuters will be modelled as Poisson processes. Average arrival rate 'λ'(lambda) will be used to calculate probability of seeing N users in the time interval 'Δt'(delta t) . Apart from showing occupancy, this application will assist commuters with navigation to parking lots and also show the recently vacated spots. With this application, we aim to create a bridge between Parking Services and commuters. We have developed an incentive based system where commuters will get points for reviewing Parking Services policies. These points can be redeemed at our commercial partners. This incentive based mechanism encourages commuters to use the application. The interaction with the application during the driving period is kept to a minimum so that the attention of the driver is not deviated. Based on the suggestions of the users during lo-fidelity prototype testing, we have separated the navigation and parking occupancy functionalities.

EXPERIMENTAL DESIGN

Our experimental design will study the effect of a mobile application that utilizes the concept of crowdsourcing to assist commuters locate parking more effectively at Clemson University. In our experiment we hypothesize that the participants in our experimental group will have a more effective commuter experience by using our application. We propose to use a sample of 30 commuter students. Only students who are be enrolled at Clemson University, commute to campus at least 3 days per week, and have Android based smartphones will be included in our sample. Commuters will be randomly assigned to either an experimental or to a control group.

For our experiment we will use a between subjects design to avoid carryover effects. We believe if we expose our participants to both levels of our independent variable this will cause sensitization effect, which will cause subjects to respond more strongly to either of our independent variables. We will assign participants in the experimental group to download our mobile application to their android-based device. We will provide the participants in the experimental group instructions on how to use our application before the experiment begins. We will provide one training session on the functionalities of our proposed application and answer any questions before the experiment begins. Once participants in our experimental group have completed training they will be asked to use our proposed application on a daily basis for over a 2-week period. Participants in our control group will not be asked to download the application.

In our experiment two dependent variables will be measured. Among these measures will be the time it takes commuters to locate parking on campus and the level of satisfaction gathered from their daily commuter experience. We will measure the level of satisfaction of our participants by having them complete a self-reported questionnaire at the end of each day. The questionnaire will comprise of a 14-20 Likert-Scale questions that will measure satisfaction levels in reference to positive versus negative affects experienced by their daily commute. Knowledge about participant level of satisfaction is important for analysis to determine the effectiveness the commuter experience.

DISCUSSION

Developing the CapApp Android mobile application came with a handful of challenges. Google Maps integration required different dependencies that caused troubleshooting to ensure the import of all necessary libraries. There was a learning curve for MySQL syntax and PHP connectivity. Processing speeds were slow due to coding the app with single threading. Also, connecting Google maps to the database provoked issues. We had to use a JSon Parser to retrieve data from our database and pass the data values to Google Maps API.

In the future, CapApp can be improved based on challenges faced. Suggestions to further develop the mobile application include creating a single point module for database connectivity, multithreading processes, creating an algorithm for detecting parking spaces based on latitude and longitude (eliminating manual parking space numbers), optimizing probability algorithm for maximum accuracy, and creating cache for individual parking history.

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