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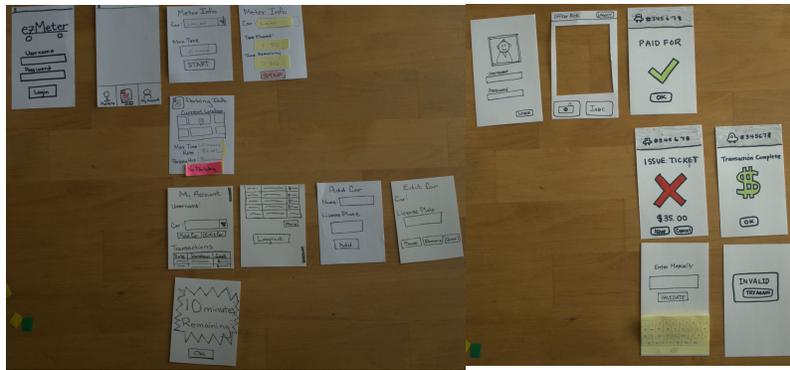
Problem and Solution Overview

The City of Seattle currently uses centralized, receipt-printing, parking pay-stations for 9,000 parking spots around the city. This has resulted in increased paper usage and frustrations due to personal time constraints and vandalism. Our solution, ezMeter, allows drivers to pay for parking by registering their license plate number with a specific duration of time that they would like to park for. After parking their car at any available spot, they can signal ezMeter to begin deducting the parking time that they have registered for using their smart phone or a nearby pay-station. Verifying whether a driver has paid for parking involves a simple look-up to check if the license plate number is associated with a parking time and has the means to pay for the time. This eliminates the need for paper receipts and brings the convenience and ease of payment to street parking.



Paper Prototype Description

Our paper prototype was developed using 3x5 index cards that represented a smart-phone touchscreen. The prototype includes two separate interfaces. One of these interfaces is used by drivers to pay for and renew parking, register a car's license plate with the system, and, finally, to display parking information. The other interface is for parking enforcement officers (PEO) to verify parking and issue tickets. Our interface for the PEO includes a cut-out that simulates the real-time images from the camera that's used to take pictures of license plates. Both of these prototypes are depictions of ezMeter on a smartphone device.



Driver Interface

For the driver interface, we had a main screen that includes a static list of buttons on the bottom and we drew several smaller screens that can be laid on top of the main screen, depending on where the person navigates to (Figure 1).



Figure 1. Driver interface has a three static buttons (on left) and a set of various screens that overlay it.

Login - A simple login page for users of the ezMeter application (Figure 2).

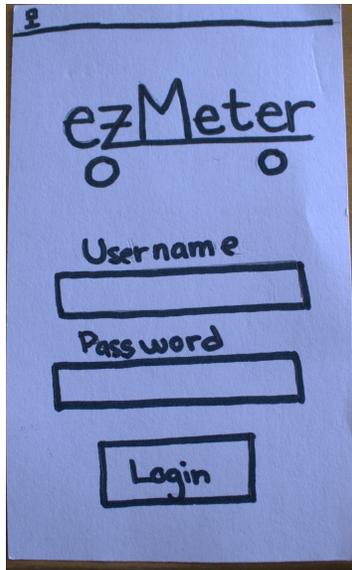


Figure 2. Login screen for ezMeter from the driver perspective

Meter - Main screen that allows drivers to select the vehicle that they are driving and to start or stop paying for parking (Figure 3a). Pressing “start” brings the user to another screen for stopping parking (Figure 3b). When time is about to expire, a notification is shown (Figure 3c).

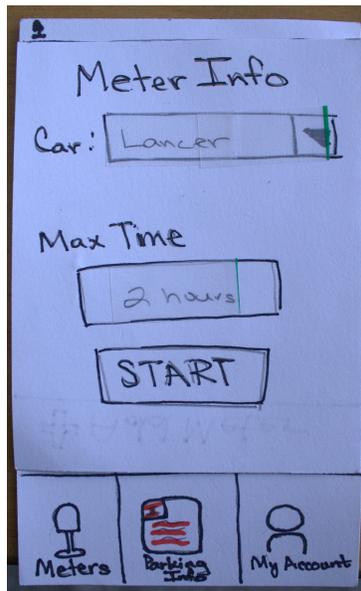


Figure 3a. The initial meter screen which allows the driver to start the meter.

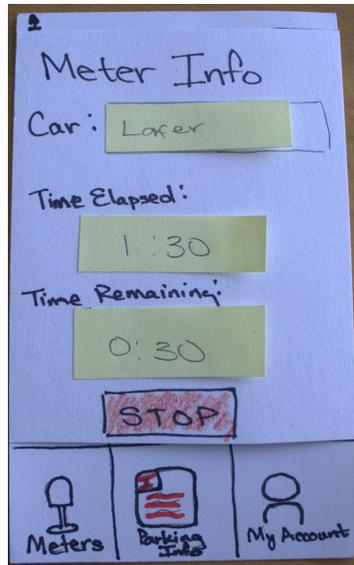


Figure 3b. The meter while it is running. It will state the time elapsed and the time remaining until the maximum is hit.

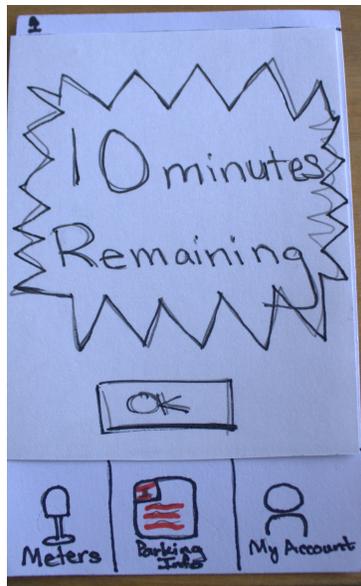


Figure 3c. A ten minute warning screen appears before the maximum time is reached.

Parking Info - The parking information page displays parking restrictions for a particular location (Figure 4).

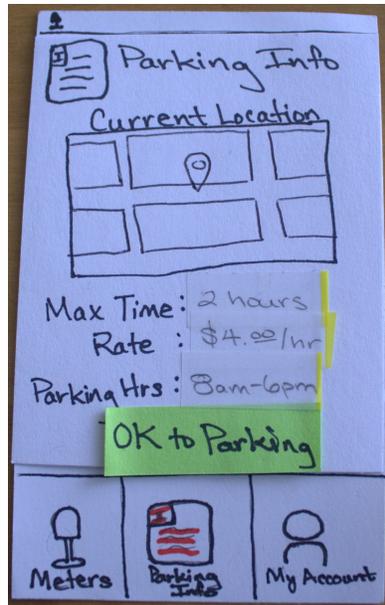


Figure 4. The parking information is presented in a concise layout specific to the location of the user as determined by GPS.

My Account - Allows users to edit vehicles associated with their ezMeter account, as well as to view their previous transactions (Figure 5a). Users can choose to add a car to their ezMeter account (Figure 5b) or edit information for an existing registered car (Figure 5c).

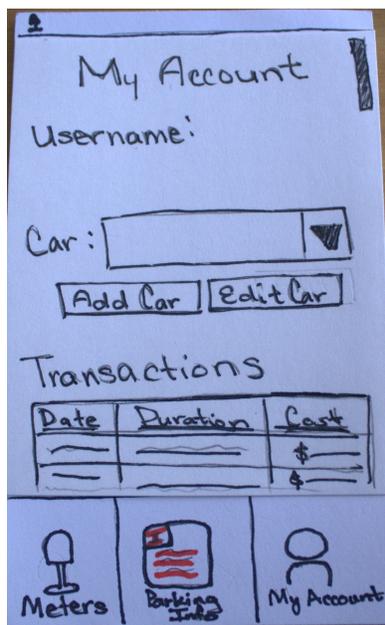


Figure 5a. The 'My Account' button takes you to the part of the driver interface that allows you to view the cars associated with the ezMeter account and the recent transactions.

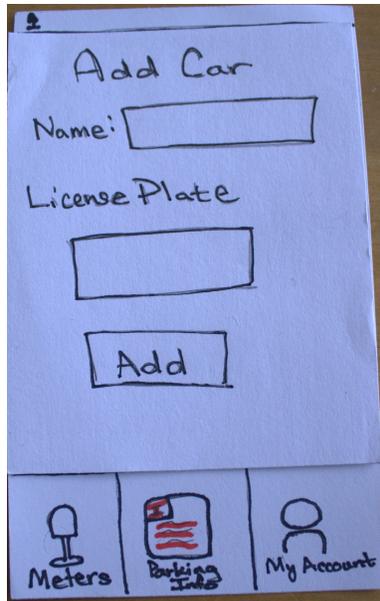


Figure 5b. The 'Add Car' screen is located under 'My Account'.

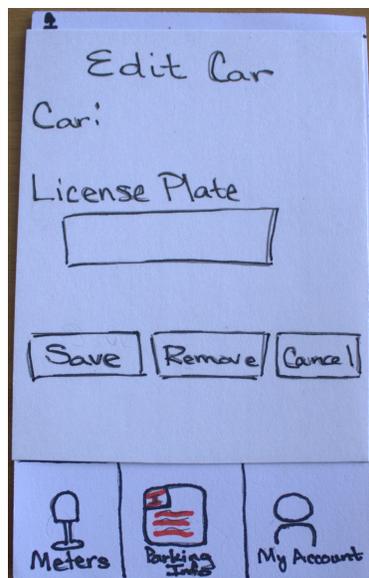


Figure 5c. The 'Edit Car' screen is located under 'My Account'.

Parking Enforcement Officer (PEO) Interface

The navigation for the PEO's user interface builds off of the camera preview screen. We had separate flashcards for each of the different messages that the officer might encounter when verifying a car has paid for parking.

Login - A simple login page for the PEO (Figure 6).

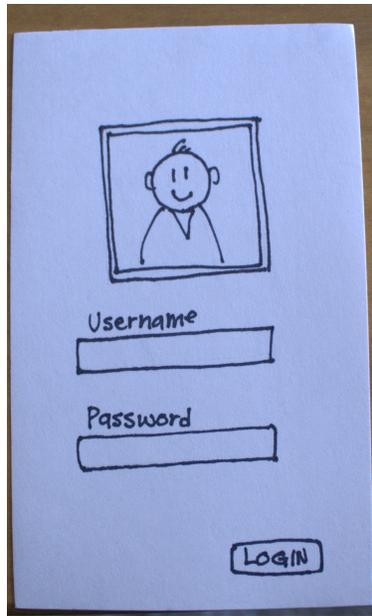


Figure 6. *The parking enforcement officer has a separate login screen that comes with a profile picture.*

Camera - Main screen that the PEO uses to take pictures of license plates (Figure 7), with the camera preview, a button to take a picture, and a button to manually enter a license plate number. We provided a sketch of a license plate for participants to take a picture of.



Figure 7. *The officer is provided with a camera to take photos of license plate. The prototype has a cutout to simulate the live camera.*

Messages - Once a picture is successfully taken, a message verifying whether a car has been paid for will be displayed. If a car has been paid for Figure 8a will appear on the screen, otherwise, the options for issuing a ticket for the illegally parked car appear (Figure 8b, 8c).

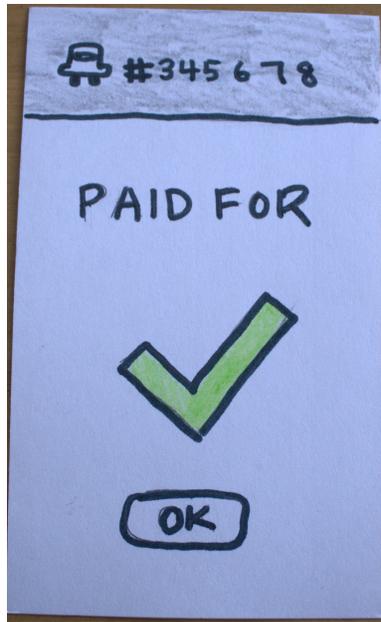


Figure 8a. The officer is displayed this screen when the vehicle he is inspecting is on a current paying meter and has not exceed his parking time.



Figure 8b. The officer is displayed this screen when the vehicle is in violation of parking time.



Figure 8c. When a ticket is successfully issued, the officer receives this screen as a confirmation.

Manual Entry - If a picture of a license plate is not recognized, an error message will be shown (Figure 9a), notifying them that they will need to take the picture again. If the user is unsuccessful after several attempts, they have the option of to manually enter the license plate number (Figure 9b).

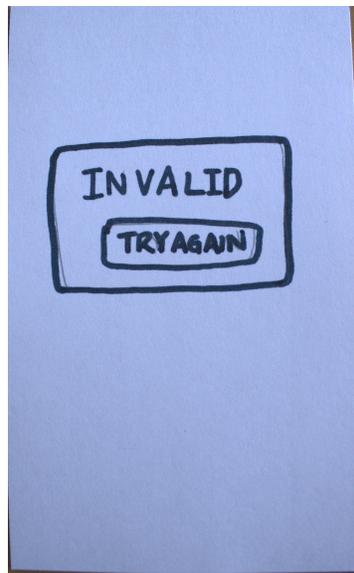


Figure 9a. The officer receives this 'Invalid' message when the application is unable to interpret the photograph of the license plate.

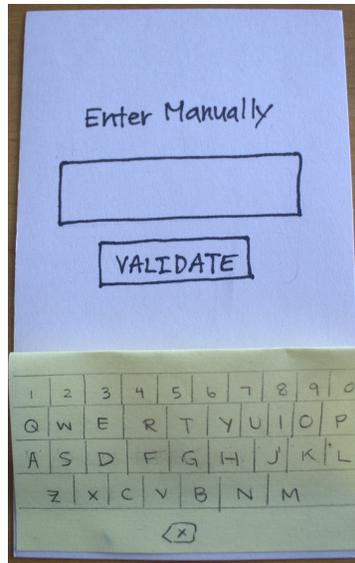


Figure 9b. When the officer needs to input a license plate manually, he is presented this screen. He can submit the license plate by pressing on 'Validate'.

Participants

We visited a couple of local coffee shops to obtain volunteers for our usability testing. The coffee shops we visited were Cafe On The Ave and Starbucks located on the University Way, which we believe was an area that contained a diverse group of people who used street parking. We targeted our participant choices based on age range and found three participants with varying experiences with street parking. Our first participant, Ed, was a young graduate student. Ed had experience with the process of design and provided a lot of useful feedback in terms of what could be improved with our user interface. The second participant of our usability testing was Al, a 49-year-old professional. Al has used street parking several times, including in different cities outside of Seattle. Our final participant was a young undergraduate freshman student studying at the University of Washington named Sue. Although Sue does not have significant background with using street parking, she fits the profile of someone new to paying for parking.

Environment

The usability test took place at the coffee shops that we found our participants in. Each team member was assigned roles for the usability testing. We had one facilitator, one note-taker, and one person acting as the application's computer. We sat as a team around the participant so that we each could observe their actions and interject with comments.

Tasks

Task 1: Starting and stopping the parking meter

Our first task was to observe how people would start and stop their parking meter with our ezMeter system. We described the following scenario to the person:

Pretend that you've already registered a car with ezMeter. You've parked your car at a spot and you want to start paying for parking using ezMeter. Once your time is nearly up, a notification will appear and you will need to renew your parking.

Task 2: Checking the parking information

Our second task was to observe how people would check the validity of a parking spot. We described the following scenario to them:

You've found a parking spot, but you are unsure if you are able to park there or if there are certain restrictions. Use ezMeter to find information about the parking spot.

Task 3: Verifying parking

Our third task was to observe how people would verify that a car has paid for parking while pretending to be a parking enforcement officer. We described the following scenario to them:

Pretend that you are a parking enforcement officer. You want to check if cars on a particular street have paid for parking using ezMeter. The first car you check has paid for parking. The second car has not paid for parking and you need to issue a ticket. You also have trouble taking a picture of the second car's license plate.

Procedure

Our testing procedure began by approaching potential participants that matched the profile that we were targeting. We politely asked each participant if they would volunteer their time to test our interfaces. Once they agreed to, Amanda, our facilitator, provided an introduction of our product to the participant, as well as a high-level overview of how our system works. She also explained each of the tasks one at a time and made sure that the participants understood what they needed to perform. To ensure a more logical flow with our tasks, we asked the participant to perform tasks 1 and 2 together since the two are closely related. Amanda also told each participant that their time is voluntary and stressed that we were testing our user interface and not their ability to perform.

To simulate the normal usage of ezMeter, we made the assumption that the participant had already registered a car with ezMeter and that the participant had already logged in to the system. When the participant began to perform the tasks, Steven, the note-taker, wrote notes regarding both positive and negative feedback for the user interface. As the participant interacted with our prototype, Gary, the computer, would swap and change the paper screens with the appropriate one.

Once each task was completed, we asked the participants for feedback and for any areas where the user interface seemed confusing. At the end of each testing session, we also discussed issues related to street parking and then finally thanked them for their time.

Test Measures

We used facial expressions and their vocal feedback as a test measure for our experiment. If

a participant seemed confused, we would ask them what they were thinking. If they said they were confused by an aspect of the interface or task, we would clarify their questions. There were instances where the participant would stop in the middle of the experiment and express that they did not know how to continue with the task. In this case, we would ask questions to what was causing them confusion so that we could make a note of it in our observations.



Testing Results

Looking at the information that we gathered from our testing (Appendix A), we noticed that there were some common issues that most of the participants experienced with our user interface. On the other hand, we also received praise for some aspects of our user interface.

Driver Interface

Process

One common feedback that we received from all of our participants when they were performing the tasks as a driver was that they would have liked to see parking information when they first opened up the application, rather than the screen for starting and stopping the meter. They felt that this process for using the application was more logical in a real-world situation.

Maximum Time

Many participants did not understand what “max time” in our user interface meant. One participant thought that they were able to select their desired maximum parking time, which is not the case. We had to explain to a few participants what the meaning of “max time” was and how that information was obtained.

Renewing Parking

An area that confused some participants was our user interface for renewing parking. When asked to perform this task, some of our participants were unsure how to go about doing so. Many of the participants needed to stop and take some time to think about how to renew parking, which involves stopping the current meter and starting the meter again. One participant was not able to figure out how to renew parking and needed further explanation to complete the task.

Parking Information

All of the participants were able to easily perform the second task of retrieving parking information. One participant gave praise on how easy it was to obtain parking information.

Parking Enforcement Officer (PEO) Interface

Wording and Messaging in the User Interface

A confusion that all of our participants had voiced was the choice of text for some areas of our user interface for the PEO. Two of the participants were confused about the text on the button for manually entering a license plate number, which they interpreted as “IABC,” instead of a cursor followed by the letters “ABC.” One participant suggested that the button should be replaced with an icon of a license plate. Also, some of our participants thought that the error message “Invalid” that is shown when a picture is poorly taken was too ambiguous and did not provide enough information about what was invalid.

Too Little Information

Our participants noted that the parking enforcement officer received too little information while verifying that parking was paid for. For example, one participant mentioned that information about how long a driver parked for could have been shown, which would be advantageous to the PEO. Also, when ezMeter shows that a car needs to be issued a ticket, one participant suggested that it should also provide more information such as whether it was not registered with ezMeter or whether the car simply did not pay for parking.

Taking Pictures

All of the participants understood how to take a picture of a license plate to verify whether a car has paid for parking. The overall user interface for the PEO was easy to understand. However, one participant did mention that the physical motion for verifying parking may not be ergonomic, since the officer needs to bend over to take a picture of a license plate. We can imagine that doing this action many times a day may become exhausting, but without further testing it is difficult to predict the outcome of this motion.

Status

Two participants suggested the information about whether a car has paid or not paid for parking should be shown on the same area as the camera preview. A popup display would be better suited than another separate screen.



Interface Revision Sketches

We changed the driver’s user interface such that parking information will be shown when the driver first opens the application, rather than the screen for starting and stopping the meter (Figure 10). Many of the testing participants we tested the user interface on felt that this ordering was more natural and logical.

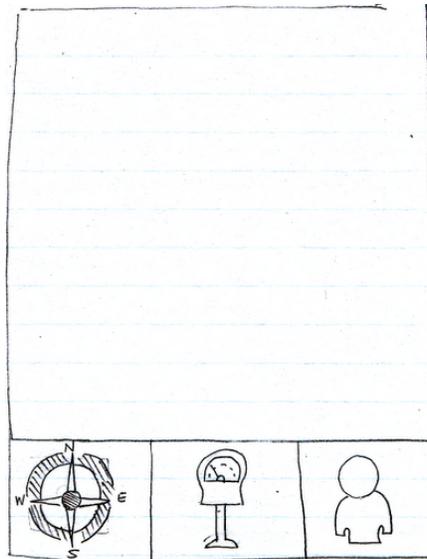


Figure 10. The revised static buttons of the driver interface include rearranging the icons, a new icon for current location-based parking information, and the elimination of text.

Some participants who tested our prototype were confused as to how to restart the parking time in the event that the parking time is about to expire. As a result, we added an additional “restart” button (Figure 11), which eliminates the need to stop the current meter and start a new one.

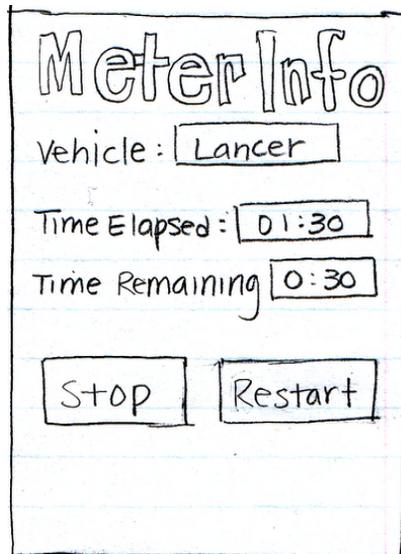


Figure 11. The meter screen when there is an active meter has been revised to include a restart button to clear up confusion.

All static information that is shown to the driver is now displayed as plain text or in a bulleted list, rather than in text boxes (Figure 12, 13). This change was necessary because there was confusion about what textual options can be changed or cannot be changed.

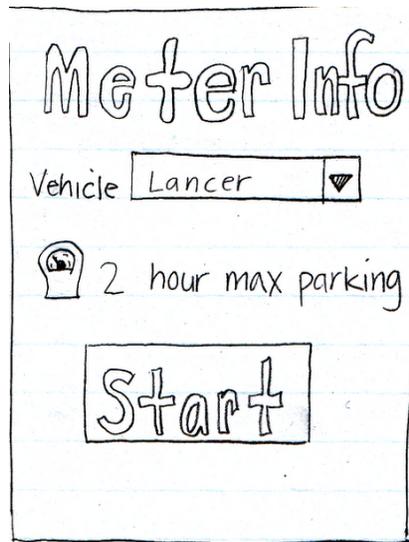


Figure 12. The revised meter screen has messaging changed and also a larger button.

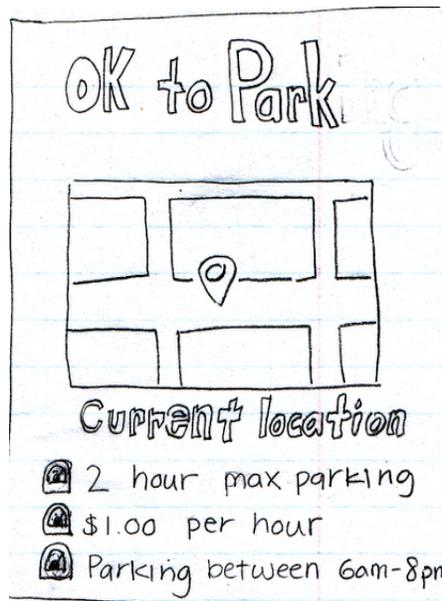


Figure 13. The location-based parking information screen has been cleaned up to be more user-friendly, delivering the most relevant information first.

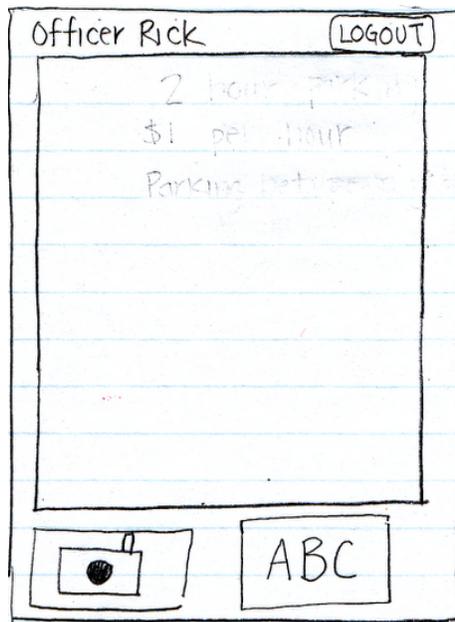


Figure 14. A small modification was made to the PEO interface to clarify the manual input button.

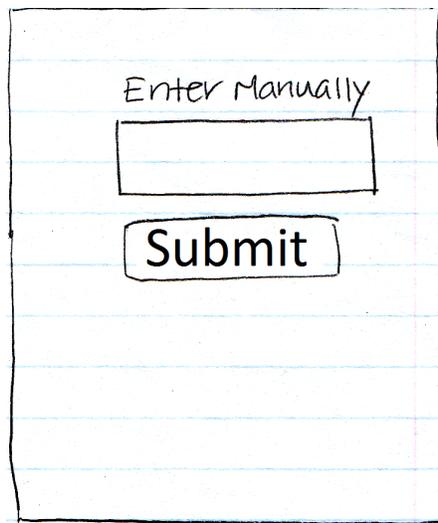


Figure 15. The manual input screen had the messaging changed to be more clear.

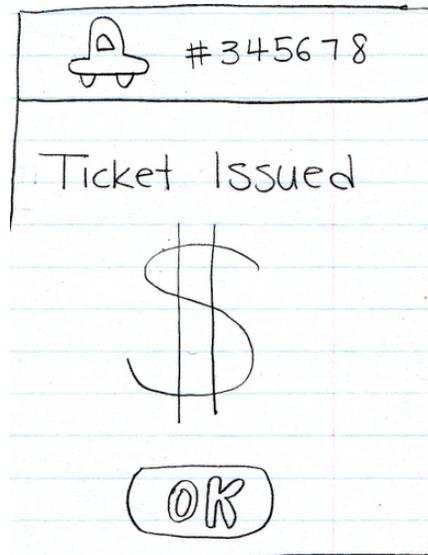


Figure 16. The messaging was clarified on the ticket issuing confirmation screen.

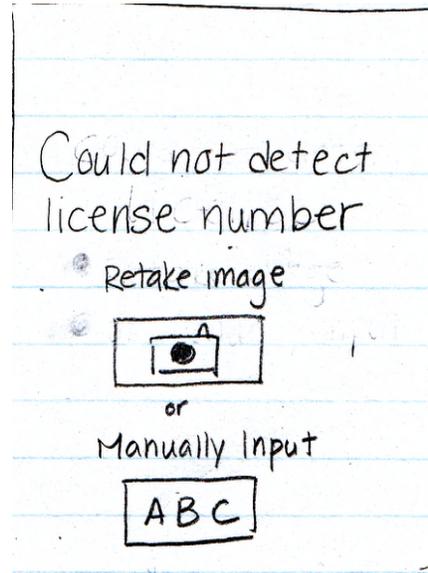


Figure 17. The invalid screen has been revamped to be more descriptive of the issues and provide a clear indication as to what the next steps should be for the parking enforcement officer.



Summary Discussion and Lessons Learned

At the end of each of our usability tests, all of our participants expressed interest and enthusiasm with our solution the current problems of street parking. We received fantastic comments such as, “Oh! That’s nice and simple” and “Oh my gosh! This is so cool!”

However, like many good ideas, the usability tests that we performed also exposed some serious problems with our user interface. We were able to determine several areas that needed improvement. One of the major areas that we need to improve on is the clarity and phrasing of our text labels on certain buttons and screens. Many of the participants also voiced concerns about the ambiguity of error messages, especially in the user interface for the parking enforcement officer. We wholeheartedly agree with their feedback and plan to make the necessary changes in our interface revision.

Another improvement that we will make is that users will be presented with parking information upon opening the application, rather than the screen for starting and stopping the parking meter. All of our participants followed this process of paying for parking when performing the tasks that we gave them and they found this order to be most intuitive, so we plan to make this change in our revision as well.

In addition to receiving feedback about our user interface, we also received comments about using ezMeter to pay for parking. Several participants voiced concerns about the accuracy of the GPS when retrieving parking information, resulting in skepticism about ezMeter as a legitimate solution to the current street parking problems. We believe that this skepticism will be alleviated once the ezMeter system has been used several times in a real environment. One person also informed us about a similar parking system in London, near Westminster. With the system, every parking spot had an ID number and drivers would have to text or call in the ID number as well as their payment info in order to pay for parking. This is an interesting system for further exploration since texting may be a more viable option for those who do not have a smart phone device.



Appendix A: Notes

Participant	Task	Severity Rating	Detail
Ed	1	-	Knows about having to move the car after the max time allowed
Ed	1	-	Understands the drop down to select car
Ed	1	4	Confused by what Max-Time meant and clarification was needed to explain that the max rate was determined by accurate GPS location - Issue: Thought max-time meant how long they were going to park their car - Solution: change "max-time" to "X hours parking zone"
Ed	1	2	Set the time before he hit start, didn't understand that max time meant the timer was going to count up to that time.
Ed	1	3	He thought he could edit max time.
Ed	1	-	We stopped to explain what max time meant and the purpose
Ed	1	-	Question GPS accuracy
Ed	1	-	Likes our timer idea because it means he won't overpay for parking
Ed	2	-	Pressed parking information
Ed	2	-	Parking info is exact as he expected.
Ed	2	3	The title "Parking info" is not clear on the prototype. - Issue: Parking info is not clear on prototype - Solution: Make the parking info icon stand out more
Ed	2	-	Should clarify that the parking information is location specific somehow.
Ed	2	-	Would have hit "Meters" intuitively to find out what the meter information was
Ed	2	-	Suggested that we combine "Meter" and "Parking Information"
Ed	2	-	Thought it would be more appropriate that you check the information before you start your meter.
Ed	2	2	"Meter" v "Meters" - the prototype has an extra 's'. -Issue: More correct is meter -Solution: Change Meters to Meters
Ed	2	-	Would prefer to start with parking info screen

Ed	2	-	His thought process for parking was - Check for parking info - Go to Meter - Select his Car - Start
Ed	3	-	Took a picture
Ed	3	1	Think the “check mark” ought to be contained within the camera view screen as opposed to taking up the entire screen to hiding the camera and manual input buttons
Ed	3	-	Understood the manual input button’s concept
Ed	3	2	Thought that the cursor was weird for the input - this is because our drawing wasn’t clear
Ed	3	-	Issued a ticket
Ed	3	3	“Validate” and “transaction complete” - the wording is weird. Should be “ticket issued” and “submit/check”
Ed	3	2	Icon for manual input should include a picture of the license plate to be more clear
Ed	3	-	Taking a picture might be awkward for the officer because he has to bend over
Ed	3	-	Consider how is it best for the officer to get a hold of the license information
Ed	3	-	Why not take a picture of a card or car on the car that is associated with ezMeter (like good to go passes)
AI	1 & 2	0	Initially thought the app was for finding parking even after we explained that it was just for paying for parking.
AI	1 & 2	-	Clicked Parking information to get the parking info.
AI	1 & 2	-	Found parking
AI	1 & 2	0	Expects screen to tell him if it is OK to park immediately.
AI	1 & 2	-	Suggests that we move the “OK to Park” to a more prominent spot
AI	1 & 2	-	Makes sense overall
AI	1 & 2	-	Parks and hits Meters
AI	1 & 2	-	Understands the car name is meant to be meaningful.
AI	1 & 2	-	Doesn’t want to have to do the math to figure out what time the parking expires, so showing the end time would be nice before he hits start...
AI	1 & 2	-	Amanda then explains that by hitting start, there is no need to calculate the end time because you just hit end whenever you are done parking if it’s before the max time.
AI	1 & 2	-	This led to AI saying “oh! That’s nice and simple.”
AI	1 & 2	3	Renewing Parking: - Issue: didn’t know how to renew parking

			- Solution:
Al	1 & 2	1	Not clear how to extend time
Al	1 & 2	-	After explanation, understood
Al	1 & 2	-	Thinks he would forget to stop the meters. Should create an alert to tell users of the application that they need to stop their meter when they are near the location that they parked.
Al	3	-	Would only like to see the exceptions
Al	3	-	Wants the fewest steps possible leading up to issuing a ticket
Al	3	-	Doesn't want to know if a car is valid.
Al	3	-	We explained that our application required the PEO to take a photo to validate parking
Al	3	-	He understood that hitting the "camera" button takes a photo.
Al	3	-	Thought it would be useful for the application to inform the PEO how much time is left on the person's meter so that they would know when to come back and issue the ticket. This would be a business advantage for the PEO.
Al	3	2	We need to clarify the wording of "Invalid": - Issue: Error message is ambiguous. Not informative to what the problem is. - Solution: Output clearer error message
Al	3	-	After he got "Invalid" typed in license plate, he typed in the license plate and hit validate
Al	3	-	Wants to know why the car is in violation. by this he wants to know if the persons meter just expired or if the person was purposefully negligent and didn't bother to pay
Al	Other	-	Talked to us about his recent trip to London, near Westminster where he encountered a similar pay-to-park system
Al	Other	-	Said it was similar and every parking spot had an ID number
Al	Other	-	Drivers would have to text or call in the ID # as well as their payment info in order to pay for parking.
Al	Other	-	Believes texting is a more viable option because its more widely used
Al	Other	-	PEOs in this town also have a device that they use to confirm car tags
Sue	1 & 2	-	Clicking parking information
Sue	1 & 2	-	"Oh my gosh... This is so cool."
Sue	1 & 2	-	Goes to meters
Sue	1 & 2	-	We had to explained the car name situation

Sue	1 & 2	3	Max-Time is confusing
Sue	1 & 2	-	Is it for the meter or the desired time that the parker wants to use
Sue	1 & 2	-	Likes the idea of having the alert to tell her that her parking is almost up
Sue	1 & 2	0	No idea how to renew time but figured that she would just stop the meter and start it over again.
Sue	1 & 2	-	Feels kind of guilty for not moving her car
Sue	1 & 2	-	Doesn't have a smart phone...
Sue	3	3	Not sure what "IABC" means
Sue	3	-	Understand the "OK"
Sue	3	2	"Try again" - thought it meant to take a photo again to make sure it's paid for, did not get that it meant that the camera couldn't read the license plate.
Sue	3	-	Understood manual entry
Sue	3	-	Issued a ticket quite enthusiastically
Sue	3	-	Transaction complete - believes that money is somehow deducted from the car
Sue	Misc	-	Likes the application and would use it herself. Some of the messaging wasn't clear.