WhereTo: A Mobile Platform to Show Parking Availability in a Given Area

Muhammad Ahmad Ghani, John Burke, Haochen Sun, Erick Tomona, Marta Velilla

Abstract—Navigating local parking restrictions and availability in urban and suburban areas, especially in a car-centric society, can oftentimes provoke stress and confusion. WhereTo will be developed as a tool to ease that navigational burden. As an intuitive, real-time mobile platform, WhereTo will connect users with the information they need regarding parking in a given area. The user will input a neighborhood that they want to see parking restrictions for into the application, then, within a minute of their request, they will receive on the user interface a visual mapping of the neighborhood of interest, with all parking restrictions shown. The MVP of an easy to use mobile application that performs the above functions is the project to be delivered. This application will make use of GoogleMaps and GoogleStreetView APIs, as well as independently designed algorithms, in order to gather streets and street images for a desired location. AI object detection models will be used with these images to infer parking regulations on the streets of interest.

Index Terms— Design, Machine Learning, Mobile Applications, Object Recognition

1 Need for this Project

For many drivers, the issue of urban parking availability can often result in confusion and bewilderment. For instance, research has shown that the average U.S. driver when attempting to locate a parking space spends $345 in wasted time, fuel and emissions annually [1]. This indicates that locating parking has become a systemic problem. As a problem it contributes to emissions, waste of fuel, and a waste of time for many people. This is not to mention the traffic it causes. On average 34% of cars on the road contributing towards traffic are doing so in search of parking [2]. All this is to say that as these urban areas continue to expand, there is going to be a continued growing reliance on real-time parking information, in order to successfully navigate the complex web of city streets. This contextualizes the relevance of WhereTo as a tool that can be used to ease the burden of a systemic issue within an automobile-focused society.

The dependance on consistent and reliable parking information grows stronger as cities continue to develop and grow, especially in a car-dominant society. Inside these cities, visitors and locals alike are negatively impacted by the unpredictability of parking. These negative effects lower the standard of living, and if parking availability is vital to an area but not easily found, it can certainly inhibit economic growth and activity.

Confusion regarding parking availability can cause drivers to– purposefully or otherwise– park in locations that are not valid. As a partial consequence of this fact, in 2022, law enforcement authorities in New York issued a total of 8.4 million tickets [3]. Not only is this issuance of tickets upsetting to the drivers receiving them, but the volume of these tickets shows that there is a considerable waste of time, money, and resources of law enforcement agencies in attempting to resolve the issue of parking.

WhereTo will help drivers locate potential parking spots on the street, and reduce the strain and stress of navigating parking in an urban environment. Solving this will help reduce the negative effects of locating parking currently: helping to save money, time, fuel, and reduce stress on the person trying to park their car.

2 Problem Statement and Deliverables

1.1 Problem Statement

Our proposed solution to the issue of parking is to incorporate artificial intelligence models into a software system used to deliver real-time information regarding parking regulations and guidelines to a user.

Our design is a user-focused mobile application called WhereTo. WhereTo will be created for iOS and Android devices. It will give the user the option to enter a location in the form of a neighborhood, and in return, it offers a map as a visual representation of predicted parking availability in the area. AI object detection models as well as connectivity with various Google APIs will be necessary to create this system.

2.2 Deliverables

A front end application that:

1. Allows the user to search for a location or general area that they want parking information about
2. Integrates with a Python API to send location information and retrieve parking availability and regulation information
3. Displays the parking information in a visual manner to the user of the application (ie. a map)

A Python API that:

1. Accepts location information from a user and returns parking information within 1 minute of the request
2. Efficiently and cost-effectively connects to Google API services such as Maps and Street View in order to perform essential functions of the

application

3. Utilizes AI object detection models to determine parking rules of a given location through inspecting its associated images
4. Exhibits efficient algorithm design for image retrieval and street retrieval for a given neighborhood

3 Visualization

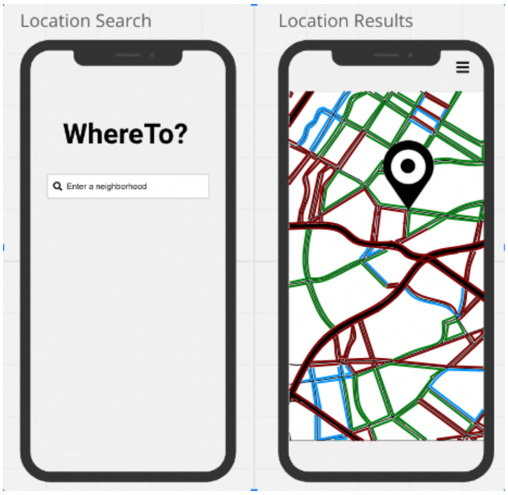

Fig 1. Displays a wireframe design of the mobile application UI

The frontend portion of our application is going to be very simple. The user will be able to enter a location in the form of a neighborhood on the left screen. Once the location's parking information has been returned by the backend, the user will see a screen similar to the right screen, a map containing the availability information of parking in the area. On this screen, red indicates that there is no street parking available, green indicates that there is street parking available, blue indicates that the algorithm is unsure if local regulations allow street parking in that area.

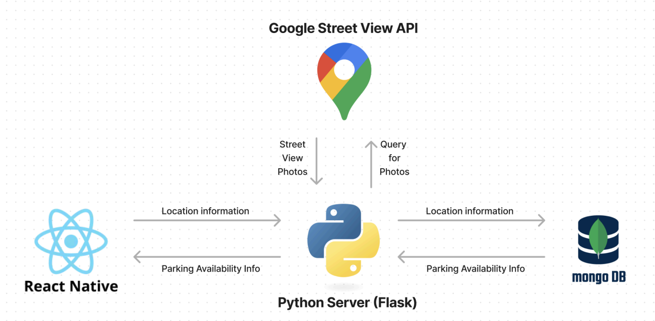

Fig 2. Shows a relationship diagram for the UI, Backend, Google APIs, and our Database

The main functionality of the application will be inside of the Python API which will be constructed using the Flask framework. This API will be called by the React Native UI whenever a user presses search with a location query that they want to find parking information for.

The Python API will check if there is recently computed parking information for the neighborhood in question inside of our database. If there is, this information will be forwarded from the database to our API to the UI. If there is not, the Python API will call the Google Street View API in order to retrieve street images from the location of interest. These images will then be used as input into an AI Object Detection model in the API that will return information regarding the parking rules in the area. A copy of this information will be stored in the database as a cache to stop redundant calls to the AI model. Additionally, a copy will be sent to the frontend to be formatted into the UI.

4 Competing Technologies

There are applications that already exist which assist users in finding or paying for parking. Based on the functions of these competing applications, they can roughly be categorized into two groups: General GPS Applications and Parking Payment Applications. WhereTo is not a direct competitor to either one of these types of applications, but rather will act as a supplemental tool that enhances the user experience and usefulness of both of these types of applications.

4.1 General GPS Applications

Some examples of common GPS applications are Apple Maps, Google Maps, and Waze. These applications all exist both on iOS and Android mobile devices. These applications allow users to search any location that they want and it will tell them how to get there. They allow for users to search for parking in a general area, but the results of such a search only include parking lots and parking garages. GPS applications are most useful when the user knows ahead of time exactly where they want to go. They are not capable of delivering parking information in the form that WhereTo intends to by leveraging AI models.

WhereTo is in a position to be a more useful and user friendly application than these existing GPS applications for finding parking as it will also be capable of delivering street parking information to a user. This informs the user if there could be available street parking in addition to known garages and lots in the area. WhereTo would not aim to replace a general GPS application, but rather be a more efficient and reliable method to find where parking is permitted in a given area.

4.2 Parking Payment Applications

Another type of potentially competitive technology for WhereTo are applications that are designed to help individuals pay for parking using their phone. This group includes applications such as SpotHero and Passport. Applications such as these allow the user to pay for parking in a given location. Additionally, in certain areas, these applications can be used to reserve spots in advance. These spots available for reservation are typically parking spaces within lots and garages.

As these applications do not assist users in finding street parking, WhereTo does not intend to replace or compete with them, but rather assist users in finding potential street parking spots which they could potentially pay for using these parking payment applications, depending on local parking regulations.

5 Engineering Requirements

The following are the requirements specified for the implementation of WhereTo:

1. Efficient Utilization of Google API Services: Ensures the effective and efficient utilization of Google API Services to enhance the application's functionality.
2. Client-Server Architecture for Backend Operations: Implements a client-server architecture with seamless communication between the front-end and back-end components.
3. Scalable Infrastructure: Employ a scalable infrastructure to support the application's growth and ensure it can handle increased user load and data volume.
4. AI-Powered Object Detection Models: Utilize advanced AI object detection models to automatically identify and interpret parking regulations in the specified neighborhood.
5. User-Friendly Input Mechanism: Provide users with an intuitive interface to input their neighborhood of interest, ensuring ease of use and a seamless experience.
6. Timely Information Retrieval: Guarantee that users receive detailed parking regulation information for their selected neighborhood within one minute of submitting their request.
7. Interactive Map Output: Deliver a final map result to the user interface, displaying parking regulations in the neighborhood of interest. This will be done for enhanced user comprehension and convenience.

References

[1] INRIX. (2017, june 12). *Searching for parking costs Americans $73 billion a year*. Inrix. https://inrix.com/press-releases/parking-pain-us/

[2] Hampshire, R., & Shoup, D. (2019, november 21). *How Much Traffic is Cruising for Parking?* Transfers Magazine. https://transfersmagazine.org/magazine-article/issue-4/how-much-traffic-is-cruising-for-parking/

[3] Nir, S. M. (2023, october 9). Parking in New York city really is worse than ever. *The New York Times*. https://www.nytimes.com/2023/10/09/nyregion/nyc-parking-cars.html