# Background Information

The mobility of universities has become more problematic due to the increasing number of students that attend each year. This immobility causes 67% of students and university staff to make the decision to travel by private vehicle [4]. This directly causes the parking on campuses to become congested and troublesome even when there are other alternatives of transportation available.

Most universities’ information and student resources are scattered across various webpages that are often difficult to find and laborious to navigate. Too many institutions have either an incomplete mobile application or none at all. In a world where nearly everything is driven by technology, the majority of college students own a smartphone capable of downloading applications that can be used to benefit their education. A centralized university application is therefore needed so that students can freely navigate and reference important information in one place.

Changing environments and moving far away from home can be monumental for new students transitioning into a university setting. Locations of classes and other various resources can be stressful and hard to find for new students. Over the course of their college careers, only 54% of those students will graduate and receive a diploma in the United States [5]. Reducing the confusion of how and where to find necessary information is paramount to success.

The problem to solve is then threefold: optimize parking, assist newer students, and centralize resources into one usable mobile application. Through the already existing technology and current solutions, a university application is made possible. The software also has tremendous potential to send students push notifications on their devices. This allows university alert systems another method of distribution for the safety of students.

**Current Solutions**

Researchers have already attempted to mitigate the use of personal vehicles on campuses. A case study done at the University of Cantabria in Spain illustrates one possible attack to the problem. Through the analysis of data from preference surveys over the student body population, researchers found an optimal parking fare for the use of parking spots on campus. There exists an optimal price per parking spot that will maximize revenue for the university while influencing students to use more sustainable methods of transportation [4].

Installing monitoring systems for each individual parking space is inefficient and wasteful of resources. Most parking systems today require parking structures to be indoors to apply interconnected sensors, magnetic sensors, and other hardware necessary for an indoor environment. A university in Malaysia has constructed a smart parking system that utilizes computer vision to keep track of open parking spaces in real-time [3]. This diminishes the need for individual parking space considerations as cameras can survey a large area.

*Computer vision* is the use of advanced software that tracks spatial changes in digital format using cameras or other optical sensors. The system uses very lightweight hardware that includes a Raspberry Pi model computer and a camera compatible with the Pi. The proposed system captures images that is processed by the software using the camera and computer. The results are then uploaded to a database where some mobile application can output the results to users who will have real-time access to the parking information [3].

The trend between bundling and unbundling features of major applications has followed both paths as seen by big technology companies in the past decade [6]. For example, the popular social messaging application Snapchat chooses to onload new features instead of unbundling. On the other hand, Google has chosen to offload messaging, productivity, and other aspects of their services into respective single-purpose applications. The argument can be made that the decision for combining or splitting features of an application is dependent on the customer use-case.

Multipurpose applications have everything the user needs in one place while single purpose applications are designed for one thing. Each direction of development has their respective advantages and disadvantages. For example, a multipurpose application grants a unified experience allowing data and features to work interconnectedly together. However, the user interface can become confusing and difficult to navigate. Single purpose applications allow for quick updates because of their simplicity. They also force users to download multiple applications if many components of the service are desired [7].

Google and many other applications have used Google’s map standard development kit. The application programming interface (API) takes care of complicated mapping features such as map gestures, the display of the map, and downloading of data [2]. An *API* is a set of computer functions that developers can use to communicate with some external resource. The interface also communicates with Google Map’s extensive database to accurately represent the layout of the real world. Developers can then make calls to the API to add markers, shapes, paths, and other graphical elements to achieve usability with the map.

**Drawbacks**

Influencing students to use public and built in transportation to navigate campuses lessens the problem. However, there remains a large portion of students who will decide to use private vehicles due to personal reasons and commuting distances. The current solution of raising parking pass prices addresses the number of students but neglects the efficiency problem of parking that busy campuses will still possess.

Live tracking of parking spots using computer vision and lightweight hardware aims to solve this very problem and does it successfully. The cost of a simple computer and camera for each general parking area is significantly less than implementing current methods of tracking parking. The minor issue that arises from this system is the use of another outside application; the goal is to centralize parking resources into one executive location.