Spark - Simple Parking

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1. BACKGROUND

Everyday at UCSD, students waste time searching for an open parking spot. With so many different parking structures and lots, it is very difficult to guess correctly which lot to go to and when. This problem frustrates students, wastes gas, contributes a significant amount to pollution, and can even creates unsafe conditions in parking lots with multiple people, all in a hurry, fighting to find a spot.

We conducted a survey on a sample of 400 students and we found that ¾ of the people spend an average of 15 minutes looking for parking every day. Some systems have been implemented such as in Gilman Parking Structure where each spot is marked as open or occupied with a green or red light respectively and then a head count of the spots is at the entrance of the floors. However, this system hasn't solved the problem because it still requires the drivers to get to the parking structure to know its availability. Our suggested system tackles that exact problem.

2. SPECIFIC AIMS

Our goal is to implement a system to count the cars in each parking structure and display to students in real time, via a smartphone app, the amount of spots available. This will be accomplished by placing sensors at the entrance/exit of each section of a parking structure using an algorithm to tell if a car is entering or exiting, and then updating the app accordingly. Our ultimate goal is to implement this in every parking structure and lot at UCSD. This proposal however, focuses specifically on Pangea Parking structure in Eleanor Roosevelt College, as we intended to use this structure as a test run for this new technology before it goes campus wide.

3. METHOD

3.1. Sensor Operation and Placement

The sensors are comprised of an infrared emitter and receive that detect the cars as they pass in front of them. The sensors emit a high frequency (good accuracy) infrared pulse so that when a car passes in front of them the pulse is reflected off of the metal surface of the car and is bounced back to the receiver. There are a total of four sensors per target area, two (roughly 4 feet apart) on each side of the road. This configuration is beneficial for several reasons. First, it allows Spark to distinguish between a car and a person, as it is highly unlikely that a person passing by would block both sensors simultaneously for as long as a car would. Secondly, since sensors are on each side of the road, it can tell if two cars pass by simultaneously. Finally, by using two sensors and noting which sensor is tripped first, Spark can tell which direction the car is traveling in. Furthermore, our algorithm will check various other conditions such as the time between each sensors being tripped to improve the accuracy.

The sensors will be placed inside of small metal or aluminum boxes attached to a column on both sides *(see supplement)*. This is the most cost-effective option because

placing the sensors on the roof would require a larger amount of sensors to cover the large surface area through which the cars traverse (~ 30 feet).

The sensors will be powered by placing outlets next to them which connect to the general electric system of Pangea. Thus, it would be helpful to take into consideration the blueprint of the structure to know where the electrical cables are.

3.2. User Interface

The app will demonstrate to the user a list of Spark enabled parking structures on campus, along with a number of open spots in each structure. Upon tapping a particular structure, the user would be shown a further breakdown of each type of spot, undergrad spots, grad students spots, and so on, in the structure along with how many open spots there are of each. Finally, the user would have the option to tap a map icon to see where on campus that particular structure is located. The color associated with each respective structure, indicates the availability in those areas.

4. COST

The spot distribution of Pangea includes 3 highly impacted types of spots: on-campus residents S spots, commuter S spots and graduate students B spots.

Every one of these areas of interest will have its own sensors to account for the number of spots available. That will make a total of approximately 6 sensors. Each sensors is composed of 2 sets of emitter/receiver and a small CPU (Raspberry Pi) that uploads the data to the server. Each sensor has a cost of $60 ($30 CPU, 2 x $10 microcontrollers, $5 receiver, emitters, general circuitry). This makes a total cost of about $300-$350 for Pangea.

Additionally, we need to consider the infrastructure needed for the placement of these sensors, such as cable, the outlets where the sensors draw their power from, the boxes where they are placed and a router for internet access.

It is important to note as well that as this technology becomes established and tested, more ways of consolidating the hardware can be researched, further decreasing the cost for future applications. Spark's ability to be extremely cost effective, paves a pathway for this product to be a solution to the parking crisis.

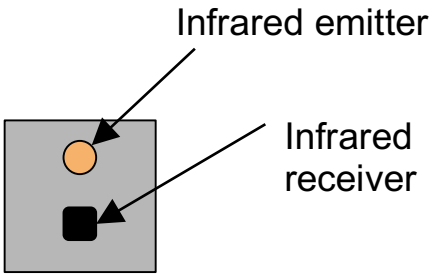
5. QUALIFICATIONS

Our team is comprised of undergraduate engineering students from multiple engineering disciplines. All of the members of our team are currently working in UCSD research labs on a diverse range of topics and have learned the problem solving skills necessary to tackle new challenges. Currently, a working prototype sensor has been constructed, the communication from the sensor to the internet is completed, and the app has been designed and is currently being built.

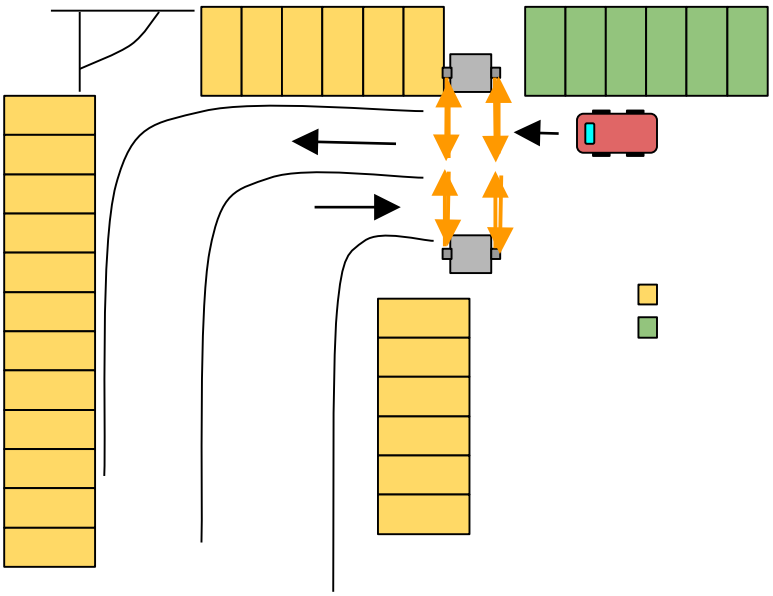
6. BENEFITS

Spark would be well worth the investment for two reasons, first it solves key parking related issues, and second, it does so in a very efficient way. The specific problems that it solves is that it allows students to know where parking is, and go straight to the open spot, instead of wasting time looking for one. This saves the student time and money. Furthermore, even in a situation where no spots are available, it lets the student know to plan ahead and park off campus or take the bus, instead of coming to campus only to be frustrated by a lack of available parking. When the Spark app becomes widely used, that would lead to an decrease in unnecessary pollution and prevent gridlock in the parking structure. Additionally, Spark solves all of these problems in a very effective manner compared to the competition. Spark is efficient, instead of placing a sensor on every single parking space, Spark only puts them at the entrances and exits of each section of the lot. Spark is inexpensive, the sensors themselves are roughly 3 times cheaper than the alternative method of a weight sensing strip. Finally, Spark is student designed and initiated. UCSD has the proud heritage of supporting student in the entrepreneurial endeavors and preparing them to start their own businesses. There would be no better way to accomplish this goal than by improving the parking situation through the adoption of student initiated innovation.

Supplemental Materials

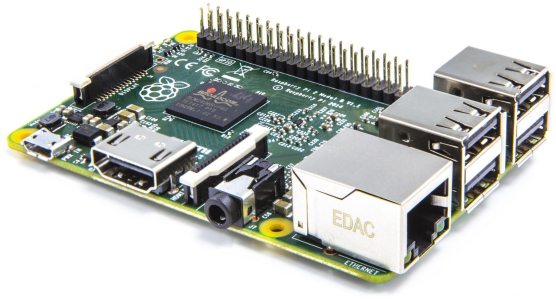


(Figure 1. Emitter and receiver model)

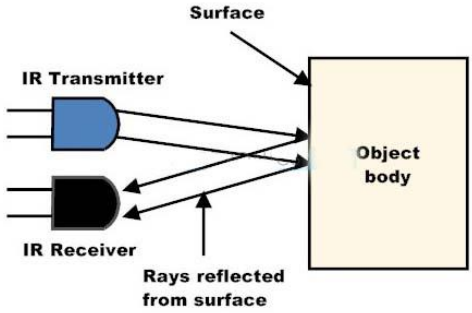


(Figure 2. Sample area of interest between floors 3 and 4 in Pangea)

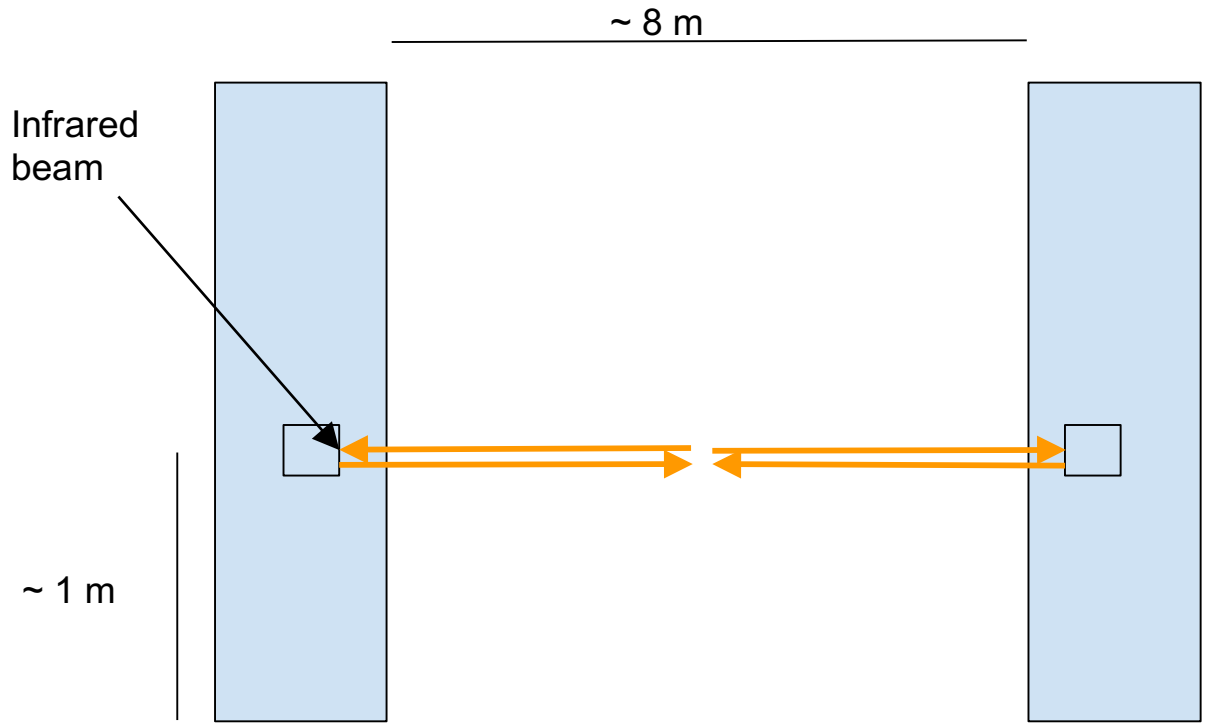
CPU (Raspberry Pi)



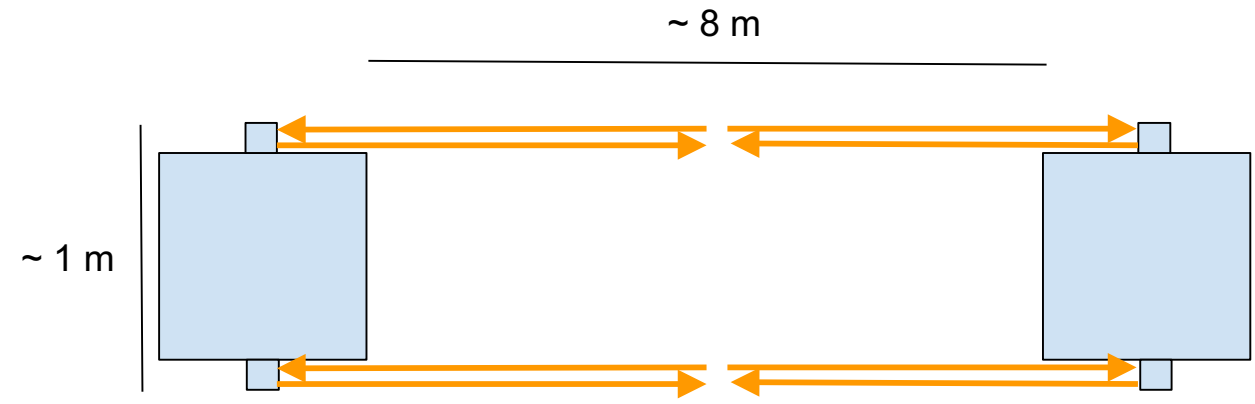
Infrared System diagram



FRONT VIEW



PLANAR VIEW



SAGITAL VIEW