

Parking Lot Checker

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Introduction

The purpose of the parking lot counter is to keep track of how many spaces are currently open in a parking lot. The idea is to have an accurate ongoing inventory of how full the lot is. There will be the ability to have a display that could be at the entrance to a parking lot that tells whether or not it is full. It will also have a feed that could go to a webpage so someone could check out to see which spots are available in their parking lot.

Target Audience

Potential customers of this would be authorities who are in charge of managing parking lots, such as hotels, casinos, schools, parking division. They could install signs telling whether or not the lot is full. Other potential customers would be anyone who parks in any of the lots where this system is in place. It could be something that is integrated with GPS devices, or with websites like www.mapquest.com.

Need For This Device

In a situation like ISU when a professor purchases a parking permit it allows them to park in multiple parking lots. They are not guaranteed to have a spot in a single lot. With this system they would see the sign at the front of the parking lot telling them that it is full or not. On top of that if they have a GPS or cell phone they could get a real time picture of the parking lot that shows them which spots are open. This way they would know if there are, for example, 2 spots open in the North West corner of the lot. Then they wouldn't have to waste time and gas driving up and down each isle of the lot looking for the open spots.

Related Work

Some parking lots incorporate counting systems for parking lots that simply keep an ongoing total of the number of cars which have entered and exited the lot. All that this allows is to have a sign telling whether or not the lot is full. It has no way of knowing where these cars are parking or which spots are open. The typical way of doing this would be to have a device that the cars drive over and it simply increments or decrements the ongoing total. This is then compared to the capacity of the lot and the sign is turned on if they are equal.

The other way this has been to have gated access to a parking lot. This is very similar to the above approach, except that it also causes more traffic congestion. This method runs into the same problem of only being able to tell if the lot is full or not, it has no way of knowing where the open spaces are. We don't know of any system that attempts to do video analysis on a parking lot to determine which spaces are open.

Previous Experience

Our work in CS401 should give us enough background to do this project. We have experience using openCV to analyze videos and isolate certain parts of them. We also have experience setting up webpage's, so having a mock website that displays the results of our tests will be within our abilities. We think that we will succeed because it seems like we need just need to develop the basic skills we have and apply them to this particular challenge.

Equipment

The equipment we will be using will consist of a camera mounted with a view of the parking lot. For this project we will probably have a computer record a video of a parking lot for a couple hours to test our system. But any potential customer that has a camera setup explicitly for this would be able to implement this and use it with real time monitoring. The video will then be analyzed on one of the computers in the basement of Pearson. Our website will be hosted on a separate computer that is accessible for the results of our tests.

Algorithm

We will first use openCV to determine where parking spots are in a given parking lot. It can do this by looking for the lines on the ground. We will then track cars coming into the parking lot. It will follow them until they stop and it will compare this to an empty image of the parking lot to determine if the spot is full. It will also detect when cars leave their spots. If it detects a car that was parked and starts moving it will scan the spot and determine that it is now open and update the data element that defines how many spaces are full.

Data Structure

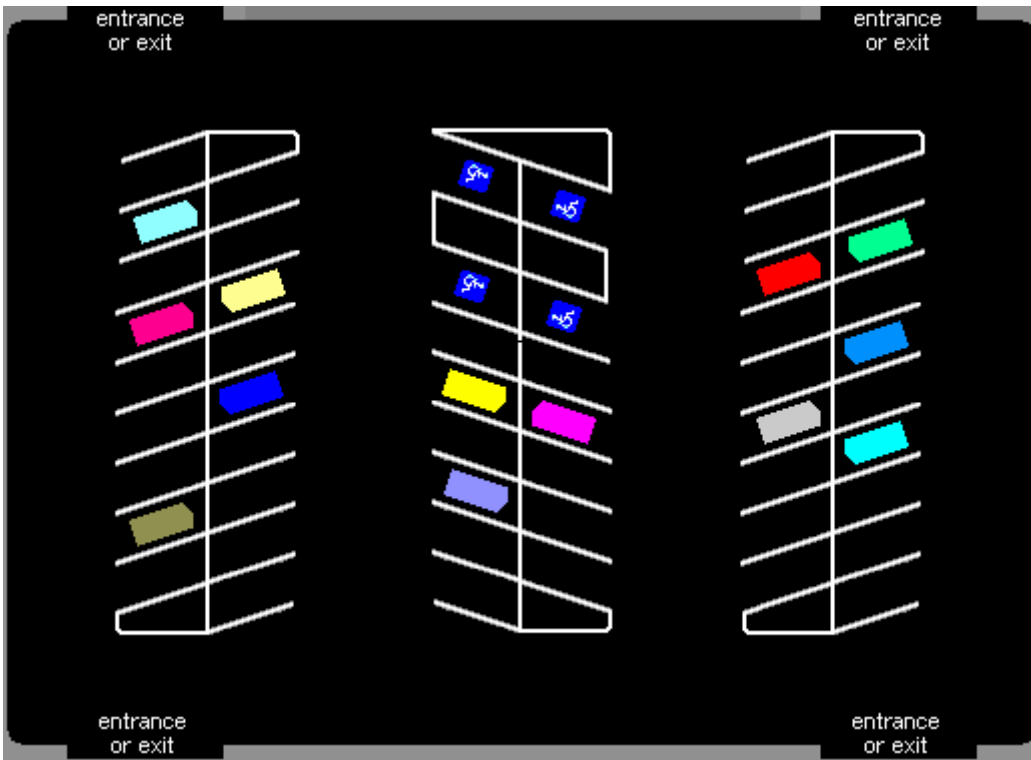
The system will scan an empty parking lot and determine how many spaces are full. It will then create an index of the available spots. Depending on the parking lot it may be a one or two dimensional array of spots that are available. Then when a car parks in a spot the system will detect that and update the data structure so that particular spots' index is switched from open to closed. When it initially scans the lot to determine the number of available spaces it calculates the total number. It also has an ongoing total of the number of open spaces. If a car enters or leaves a parking spot it will increment or decrement the ongoing total. When it finds that the ongoing total and capacity are equal it will send a signal to the sign at the front of the lot and it displays a message saying that the lot is full.

User Interface

There will be a display that is setup just for a sign at the front of the parking lot. This is really simple; all that it will tell people is if there are free spaces or not.



The other display will be outputting a picture of the current status of the parking lot. This would be what people see if they look on their GPS devices or go to the website to check the status of the parking lot that they want to park in. This could be implemented in multiple ways, sort of like googlemaps.com. There could be a visual representation, like the following. Or there could be a “street view” where it is actually a picture of the parking lot.



Mock Setup

This is a sample screenshot of one frame from a video of what our program could analyze. This shows one of the potential problems this system faces. When the viewing angle of the camera is fairly low, some of the cars can be partially obstructed by others. This is an example of a less than ideal viewing angle. The car furthest away is hard to see

and it would be hard to pick up the lines on the ground. Another factor that will affect this is the amount and angle of the sun. In this picture there is quite a bit of glare coming into the shot. That will be another element we'll have to deal with.



Evaluation

We plan to test this first on a small area of a parking lot. Our test lot will have a more ideal viewing angle from the camera so it can clearly see each of the cars. We will test this on a recorded video because we don't have exclusive access to the camera. We will determine if this test parking lot is successful by manually counting the number of cars that enter and exit the lot. If it is successful we will expand and test it on larger parking lots and ones that have less than ideal viewing conditions.

We will evaluate our results by comparing them to manually checking. The biggest problem that we may run into is finding cameras with decent viewing angles. Ideally a top down camera which is mounted in the middle of the lot is the perfect location. This way you can see with absolute certainty where each car is. This setup also allows for the best chance of picking up the lines on the parking lot. The next best scenario is a rooftop mounted camera that looks down at a camera; this could lead to issues with large cars obscuring smaller cars. But we will have to experiment with how robust this system is.