Related works

**Parking lots Space Detection, Qi Wu and Yi Zhang.**

The researchers use a multi-class SVM (support vector machine) to perform binary classification of parking lot spaces, and eventually improve their accuracy using an MRF (Markov random field). For setup images are normalized based on predefined parking spaces and segments of three parking spaces are extracted. These three spaces are classified using three bytes representative of a space being occupied or not, so that successive images may have their overlapping spaces compared for accuracy. Conflict in the overlapping spaces was resolved using the MRF to improve the final result.

**Vacant Parking Space Detection in Static Images, Nicholas True.**

True creates a vacant parking space detection (VPSD) system that uses color histograms, k-nearest neighbor (k-NN), SVM and vehicle feature detection together to perform classification of parking spaces. The downfall for the feature detection is that it is very slow, as he maintains a set (vocabulary) of features to compare new images to, which grows as new images are classified. This system is also working in parallel to the color histogram model, while the k-NN and SVM work on their own. Ultimately the SVM was the far superior classifier, with the highest accuracy and the fastest runtime.

**Digital Image Processing Techniques for Object Detection From Complex Background Image, R. Hussin et al.**

This one is both painful and funny to read.

The researchers outline their method of recognizing target features in still images via color processing and circular edge detection using the Circular Hough Transform technique (CHT).

**Intelligent Parking Space Detection System Based on Image Processing, R. Yusnita et al.**

This group of researchers approach the problem by first painting a large brown circle in the center of each parking space. This allows them perform image segmentation and detection based on anything that is different within the boundary of a parking space by comparing it to the empty space with the brown circle. A shortfalling of this method is that they're only able to analyze a few spaces per camera as they require a clear overhead shot for their comparisons. It's unclear if they could normalize off axis segments if they were to try covering more ground with their single camera.

**Intelligent Parking Management System Based on Image Processing, Hilal Al-Kharusi, Ibrahim Al-Bahadly.**

**Abstract**

In our world, as connected as it is there is still the problem of searching for available parking in busy lots. While other teams have approached this problem they have gone no further than testing and developing a method by which the problem could be solved. In addition to solving this problem ourselves, we also take the logical next step by creating the system that will be the platform to disperse the information to the target users.

**Introduction**

Imagine the commute to your school or office. That last part of the drive, where you spend your time circling a parking lot searching for a free spot is coming. And wouldn't it be nice if you could pull up an app to just see in real time where you could find available parking? That is exactly the problem we approach. Using a CNN running on a cluster we have locally available, processing live images based on data we had previously classified and trained it with, we can then send it's determined choices to an overlay layer in an app we developed that is available to anyone visiting our campus. Our goal was to produce a system that could constantly and accurately monitor our parking lot to determine the availability of parking spaces.

**Conclusion**

This paper presents our method to distinguish occupied and vacant parking spaces in a highly trafficked parking lot of use to us.with further efforts towards the original goal, we could improve accuracy of our CNN and expand the size of the area we can cover.