Smart Mall Parking Management System Using Image Processing

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Abstract- ***In India, the existing parking lot systems requires the car drivers looking for empty parking slots within the car parking without providing any sort of detailed directions toward the available parking spaces. As a result, drivers tend to waste tons of their time and energy whilst having to navigate through the parking spaces within the car parking without knowing the right direction which would simply cause traffic congestions within. This paper looks into this issue of car parking system in India and eventually proposes an Android-based Car Parking System using low cost Image-Processing. The implementation of Image-Processing into the car parking system enables drivers to receive data on the of empty car parking spaces. The paper sets out to present an intelligent parking management system for empty parking zone detection supported by image processing techniques, that captures and processes the image drawn at parking lot and produces the space of the empty car parking spaces. This paper works on the planning and implementation of Android-based Mall Parking that uses Image-Processing of the parking lot captured in frames from the parking lot's CCTV footage, finding the closest parking lot for drivers.***

Keywords— Python, Image-Processing, Parking, CCTV, Android, Application.

1. INTRODUCTION

In big cities, car parking is considered to be definitive headache. Unorganized parking systems are nothing but waste of time and energy, and they simply cause unnecessary traffic jams. Normally when customers enter a shopping mall, it'll quite probably take them an extended duration to locate free parking slots. After a few of hours of shopping within the shopping mall or center, when they finally are ready to leave, it's just going to be, simply put, a difficult and time-consuming task to relocate their parked car. Not to mention, a longer time is required to wait and pay the parking fees due to long waiting queues and sometimes even traffic jams caused due to unavailable parking spaces in said quadrant of the lot and the driver is forced to reverse the car all through, causing to pay the customers more than what they should. Currently, most of the prevailing car parking systems don't have a working smart parking management system. Most of them are manually managed and, to put it out there, pretty inefficient. The main drawback is the extra time that is wastefully consumed in these parking lots. Customers will keep on circling the parking lot for a few times until they succeed in finding an empty parking slot. This problem more often occurs in urban areas, where there is quite a number of vehicles, which is considerably higher when compared to the supply of parking spaces. These "high on demand" conditions are due to the shortage or, in most cases, the absence of implementation in the various smart technologies that are available in the market today. Various smart parking systems have been created with the customers in mind to make sure that the effort put into finding a free slot in a parking lot can be characterized as smooth. The manual implementations utilized in the old systems are pretty much ancient and, to exaggerate, belong in museums and not in practice. They need to be evolved into either completely or at least semi-automated, computerized smart systems. The parking lot entrances are given controlled access by the gates where the customer has to stop to receive their parking tickets. With the expansion in technology, these systems can be simplified in multiple ways. Nowadays, there are many methods that are utilized for

detecting empty parking slots in parking lots. In this project, a camera module is employed video image detection. Thereby, there's a requirement to create and design such a parking management system that may use a mobile application for tracking the availability of the slots. This application may help in solving the previously discussed problems, by helping the user to locate free parking areas, locate the place of the parked car, and easily reduce the parking fee. Employing a custom-made software, that supports image processing and is capable of determining the presence/absence of a car within the slot is the main goal of this project. The slot status is uploaded onto the database via a Python script and therefore the mobile application will be capable of trans-receiving data to and from the said database. The mobile application runs on android smart phones; it's developed using the Python IDE. Using this mobile application, customer will be capable of locating free parking lots within seconds. The client will merely be capable of using this application only if he/she is present within the mall. Moreover, as soon the client enters the mall through the entry gate, a counter starts calculating the time spent there with regular notifications to remind the user of the parking duration and also an estimated parking fee they may have to pay if they left at that moment, thereby helping the user to keep track of their parking duration and save more than a few bucks. The mobile application is able to interact with the camera modules overlooking the parking slots, thereby enabling the potential of locating free parking lots and also determining the place where a client has parked his/her car. The resulting system solves the issues mentioned above and organizes the parking process. There are several papers that aim to supply a classification of some components for a sensible parking solution.

2. LITERATURE SURVEY

Currently, the PGI systems powered with detection systems are broadly categorized into 4 categories namely the counter-based systems, wired sensor-based systems, wireless magnetic sensor-based systems and the image or camera-based systems. Sensors are placed at the doorways and exit points of the parking lot, that are the counter-based. These systems only acknowledge the users about the count of available parking spaces and doesn’t navigate the users to the available lots which may add difficulty to on-street parking spaces and residential parking. In other cases, i.e.; wired and wireless sensors ensure a high reliability using ultrasonic and infrared properties the need to be implemented in each and every parking lot. This leads to high installation and maintenance costs along with their trans-receiving and processing units. While the sensor-based systems along with camera-based technologies provide twin benefits. This is because they provide general surveillance and can also be used to detect the number of available parking lots. Moreover, this turns to be a cost efficient one while compared to the other systems. Within the literature, different approaches to parking occupancy detection are proposed. Initially we need to calculate the parking lot pixel to that of vehicle by principal component analysis. For this calculation, we need to match the reference images with the input datasets using an algorithm which is taken as a input data. The corners, edges, and wavelet features are used by the Bayesian classifier Tsai train to verify the vehicle detections. This application adopts a combination of automatic feature point detection and color histogram classification. The Car-Park Occupancy data systems essentially integrates advanced image processing techniques together to build a reliable parking occupancy detection system. ParkLotD uses advanced edge-detection features that is used to detect the presence of an object in predefined 3D object space. Huang uses a Bayesian framework that supports three-dimensional model of the complete detail in the parking area for the detection of occupancy of a parking slot. Jermsurawong used a CNN that is intensively trained to detect objects (in this case, cars) that supports visual features that have been extracted from the parking spaces. Postigo analyses the available slots by using simply using a combination of background subtraction and a mixture of Gaussian surfaces. Masmoudi performed a trajectory/path analysis by capturing live videos and simply creating temporal distinguishing the frames of the videos to check whether the parking lot is occupied or vacant. The above-mentioned methods are vulnerable to a unspecified weather variations as they use a mixture of background subtraction and Gaussian blur concepts. The CNN learns a hierarchy of increasingly complex features with the help of local spatial information present in the picture, which makes the process of feature construction automatic. In recent times, frameworks that are based on convolutional neural network based have achieved impeccable accuracy in

image/object classification and object detection. In conclusion, this literature survey shows that CNNs are far better than those of the traditional methods mentioned earlier. The CNN system records read a better peformance in detecting the occupancy of slots. But still, all the mentioned systems can be equipped for fine-tuning the existing or pre-trained networks, which is a further training step that may requires extra effort. Training a binary SVM classifier that uses the extracted features of the pre-trained model and then simply evaluates its performance in determining parking lot occupancy.

3. PROPOSED APPROACH

This part explains the system structure which mainly consists of three parts. Firstly, the parking part which includes camera modules in indoor parking lots and car parking facilities. The cloud which acts as a mediator between the camera module and the user takes up the second part. Finally, the android application that serves as the user side makes up the third part. The functionalities of the system include, but is not limited to, the processing of the camera module's data in the cloud, which displays the car parking spaces and its availability, which results in the potential to navigate the user to the parking slot that is currently available. It makes the driver avoid traffic congestion as much as possible. Furthermore, the system also provides proximity to the user by displaying the nearest lot to him/her. Unorganized parking systems are nothing but waste of time and energy, and they simply cause unnecessary traffic jams. Normally when customers enter a shopping mall, it'll quite probably take them an extended duration to locate free parking slots. After spending a few of hours within the mall or center, when they finally are ready to leave, it's just going to be, simply put, a difficult and time-consuming task to relocate their parked car. Not to mention, a longer time is required to wait and pay the parking fees due to long waiting queues and sometimes even traffic jams caused due to unavailable parking spaces in said quadrant of the lot and the driver is forced to reverse the car all through, causing to pay the customers more than what they should. Currently, most of the prevailing car parking systems don't have a working smart parking management system . The main drawback is the extra time that is wastefully consumed in these parking lots. Customers will keep on circling the parking lot for a few times until they succeed in finding an empty parking slot. This problem more often occurs in urban areas, where there is quite a number of vehicles, which is considerably higher when compared to the supply of parking spaces. These "high on demand" conditions are due to the shortage or, in most cases, the absence of implementation in the various smart technologies that are available in the market today. Various smart parking systems have been created with the customers in mind to make sure that the effort put into finding a free slot in a parking lot can be characterized as smooth. The manual implementations utilized in the old systems are pretty much ancient and, to exaggerate, belong in museums and not in practice. They need to be evolved into either completely or at least semi-automated, computerized smart systems. The parking lot entrances are given controlled access by the gates where the customer has to stop to receive their parking tickets. With the expansion in technology, these systems can be simplified in multiple ways. Nowadays, there are many methods that are utilized for detecting empty parking slots in parking lots. In this project, a camera module is employed video image detection. Therefore, there is a requirement to design such a system that may use a mobile application for tracking the availability of the slots. Employing a custom software, that supports image processing and is able to determine the presence of a vehicle within the slot, which is the main goal of this project. The slot status is uploaded onto the database via a Python script and therefore the mobile application will be capable of trans-receiving data to and from the said database. This mobile app runs only on android devices at the time being; it's developed using the Python IDE.

A. Overview

The project comprises of two elemental parts namely the user-interface and the back-end logic to the system. The parking system project had been divided into multiple stages for its efficacy; in every stage, the client is provided with steps and instructions to follow to reach their point with ease. The aforementioned parts are correlated to each other to provide a well-organized system to solve the client's problems. The ticket dispensers at the parking entry takes care of calculating the cars waiting in the queue, clients in the parking lot, clients waiting for a parking lot and those exiting the parking area hence giving a clear picture of the

vacant and occupied slots at each floor to the client. This mechanism abates the traffic at the entrance of the parking area and indicates the available slots in the least occupied floors then and there in a hassle-free manner.

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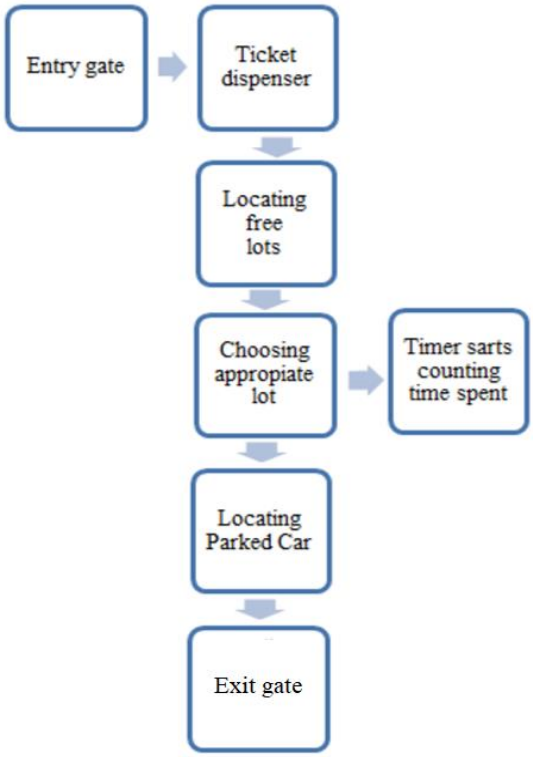
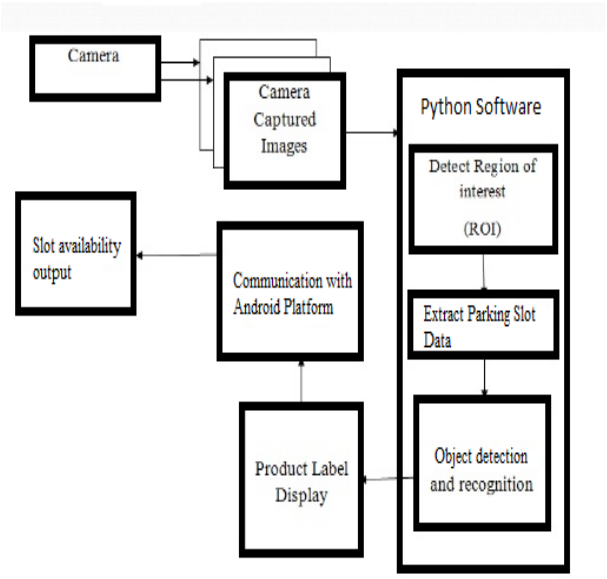
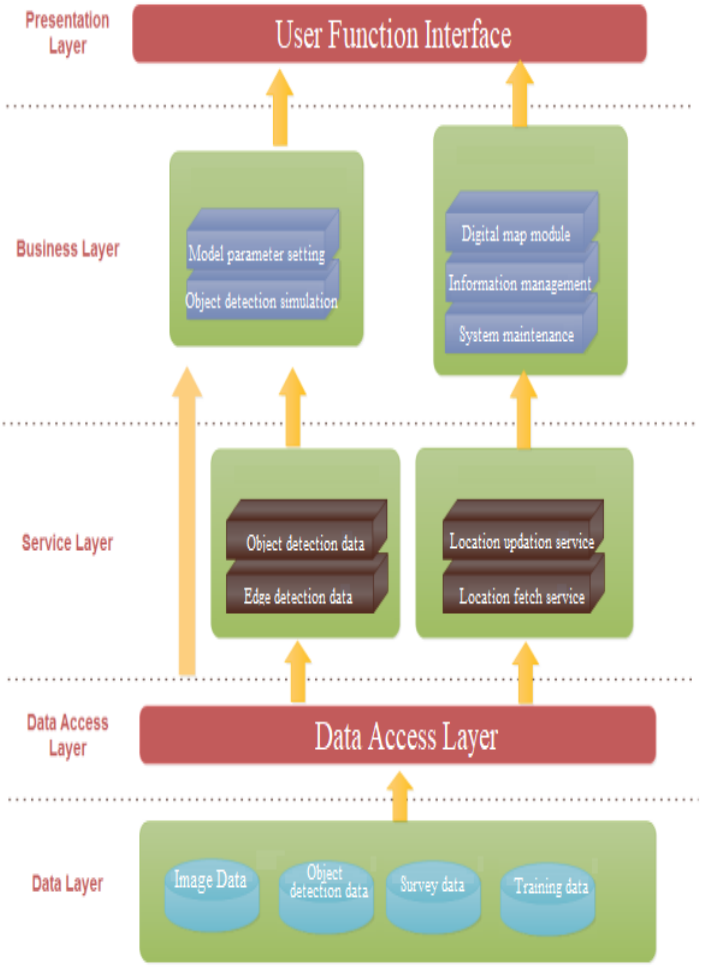
a) Process

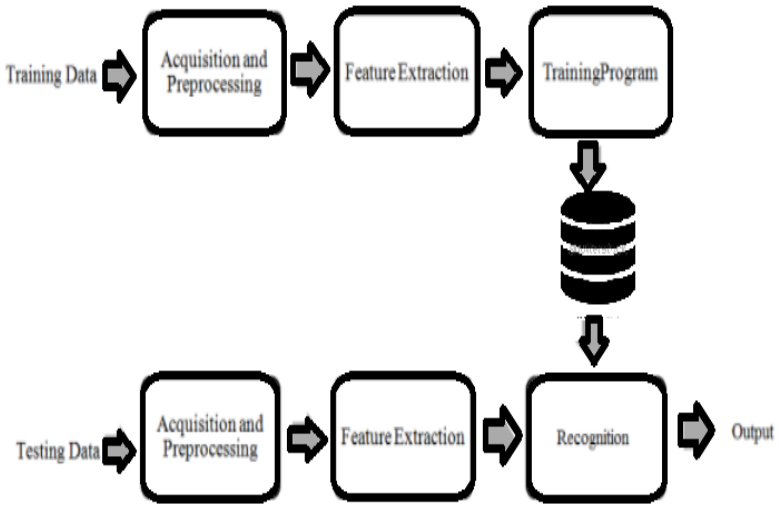




b) Architecture diagram



c) Methodology



The training/testing data is fed to the training model which extracts all the in-view parking slots and then runs these splits parts of the image to the training program. This allows the data to be processed allowing the output data to be generated via the aforementioned android application in the user's mobile phone.

4. RESULT

In this document, we have devised and assessed a parking status detection technique which employs CNN that indicates the vacancy in a parking slot directly on board of a Raspberry Pi camera. Each of them is positioned in such a manner that it can overlook about 50 parking slots simultaneously. A dataset, CNR Park comprising images of true parking area captured by smart cameras were created, in order to evaluate our technique. This dataset is made available for improving and analyzing the new methods for parking occupancy detection. Furthermore, we made a comparison between our technique and other advanced approaches supported shallow machine learning techniques, and reevaluated the PKLot dataset, which is a massive, publicly available dataset of parking zone images and time-lapse videos. From the experiments, one can conclude that CNNs tend to be efficient and can reduce the occurrence of the addressed problems. They indeed, possess high accuracy. While testing our method with a prototype captured by the camera-module, which may be located in a different zone. The results showed that CNN seems to have a effective generalization capability in predicting parking status, which was confirmed when the system was tested on a dataset that was entirely different from that of the initial training dataset. This technique is also advantageous to non-standard parking behaviors, like cars occupying multiple parking lots, in such cases all the slots occupied by that vehicle are classified busy. Nevertheless, a detailed analysis of the working in non-ideal situations viz., night or snowy conditions, is left to future work. To conclude, the Parking Management System may be the prototype of a different, next-gen parking and event management system that comprises of a mobile web-based application and database. Our project aims on reducing the complexity in the parking area and conserce a lot of otherwise wasted time. Additionally, based on different geographic terrains the Parking Management System might be installed accordingly.

5. CONCLUSION

In this document, we have devised and assessed a parking slot availability detection technique that employs CNN which indicates the parking slot's vacancies directly from the camera module to the cloud-based database. Each of them is positioned in such a manner that it can overlook about 50 parking slots

simultaneously. A dataset, CNR Park comprising images of true parking area captured by smart cameras were created, in order to evaluate our technique. This dataset is made available for improving and analyzing the new methods for parking occupancy detection. Furthermore, we made a comparison between our technique and other approaches have quite supported shallow machine learning, and they have re-evaluated the PKLot dataset. The PKLot dataset is a massive, publicly available dataset of parking zone images. From our experiments, we can conclude that convolutional neural networks are efficient and can reduce the occurrence of the addressed problems. They indeed, possess high accuracy. While testing our method with a prototype captured by a camera placed in a different zone the results showed that convolutional neural networks tend to have a good generalization capability in predicting parking status, which was proved when the system was tested against a dataset which was entirely different from that of the initial training dataset. This technique is also advantageous to non-standard parking behaviors, like cars occupying multiple parking lots, in such cases all the slots occupied by that vehicle are classified busy. Nevertheless, a detailed analysis of the working in currently untested situations, such as dark nights or extreme snowy conditions, is left to future work.

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