HIGH PROFILE SMART PARKING SYSTEMS USING MOBILE SENSING UNIT

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Abstract: *In our Day-to-day modern life the use of vehicles has been increasing gradually for cozy transportation... There are too many vehicles on the road and not enough parking spaces. Efficient parking management systems is mandatory in the day-to-day life.*

Use of IOT based parking management system allows for efficient parking space utilization.IR sensors for sensing parking slot occupancy is used along with the Wi-Fi modem for internet connectivity and a microcontroller for operating the system. The various steps involved in the operation are vehicle identification, free slot detection and payment calculation. The cascading classifiers libraries has been implemented for IOT based parking management system. The parking spaces are detected using fixed sensing system. Vehicle identification is carried out using Cascading classifiers , free slot detection is carried out using display and payment calculation is done on the basis of period of parking. Generally vehicle license plate recognition is classified into several tasks which consist of license plate extraction, image region which contains a license plate, character segmentation, and character recognition. Vehicle License plate recognition system is done using Camera mounted over the exposure system. Image of the license plate is captured and the image is processed to extract the license number. The extracted information can be used with or without a database in many applications parking fee payment. Depending upon the extracted information and also the place of parking, the information can be used for appropriate calculation of parking fee depending upon the time period of parking.

Key Words-**Infrared sensors, Intelligent transport systems, On-street parking, Off-street parking, Hidden Markov model, Vehicular adhoc network**

1. INTRODUCTION

A major part of the road congestion in congested areas is caused by the vehicle drivers who are looking for free parking slots in an already congested area. Moreover road safety is also affected because of drivers who are concentrating to find an empty parking space which may also lead to drivers hitting other road users. Researchers at UCLA reported that an average of 30% of drivers struggle to find slot parking of the day. Optimizing parking lots is one solution to minimize this issue. The main reason for this problem is drivers are unable to find an empty parking slot nearby. Drivers concentrate on finding the empty parking slots which are convenient to them instead of driving which puts both the pedestrians and road users in critical situations. Several studies in optimizing parking spaces have been developed, such as mounting ultrasonic sensors in side of the vehicle, using RFID tag. However the accuracy in detecting empty parking areas is not been sufficient for efficient utilization of parking spaces. In this paper we propose a automatic parking system which would require instating

Infrared sensors on the each parking slot. The parking system is suitable for implementing it on both on-street/off-street parking spaces with accurate detection of parking spaces,

PROJECT NAME	YEAR	TECHNOLOGY USED	ACCURACY	ROADWORKS
Detection of on-street parking spaces[1]	2018	Ultrasonic sensor	85%	No
Park net[3]	2010	Sonar	95%	No
Hidden Markov Map Matching[5]	2016	Hidden Markov Model (HMM)	75%	No
CarRank[7]	2015	Carrank algorithm	NS	No

*-NS:not specified

The parking space availability is disseminated to users via a mobile App or a web portal. This can be made available to all vehicle users. This paper makes three contributions to the research in parking space detection. First, it presents a cascading classifiers detection. While the Cascading classifiers number plate recognition has been used before Real-Time Implementation of Indian License Plate Recognition System[8], our formulation is used in some important respects, detailed subsequently. We place particular emphasis on maintaining a principled approach to the problem while simultaneously making the algorithm robust to parking data

RELATED WORK

An overview of existing parking systems and their representative features are explained in this section

One of the most publicized parking projects is Detecting On-Street Parking Spaces in Smart Cities: Performance Evaluation of Fixed and Mobile Sensing Systems which uses supervised learning algorithm to efficiently disseminate information to users regarding parking space. It adopts a wireless sensor network structure which needs to mounted on the side of the vehicle, where the data flows from parking sensors and parking meters to a data warehouse via a wireless network. The parking space availability is disseminated to users via a mobile App or a web portal. The system gives a complete on-street parking solution and provides a range of benefits: easier to find parking, reduced congestion, lower parking rates. However the cost of this project implementation is rather high. Since it is not efficient to mount the sensors on the side of the vehicle.

Mathur et al, pulished a paper which explains about ParkNet, a mobile parking system, which collects information about parking slot as vehicles passes by. ParkNet uses a GPS receiver and an ultrasonic rangefinder.Conducting a one-month of trial runs with three vehicles running in the streets of Highland Park, New Jersey, the authors built a parking map from collected data. In order to achieve better location accuracy, the authors used an fingerprinting approach, using objects on the street to correct GPS errors.

Hidden Markov MapMatching through Noise and Sparseness is an work proposed by Paul Newson, John Krummuses which presents an Hidden Markov Model (HMM) to find the most likely road route represented by a time stamped sequence of latitude and longitude pairs. The HMM needs measurement noise and the road layout network. Test shows how the algorithm fails down as the sampling rate of the GPS is reduced. The map matching used in this process used private datasets for testing, making it impossible to objectively to compare results from different algorithms. However the accuracy of the

algorithm degrades when the location sampling rate decreases and the measurement noise increases.

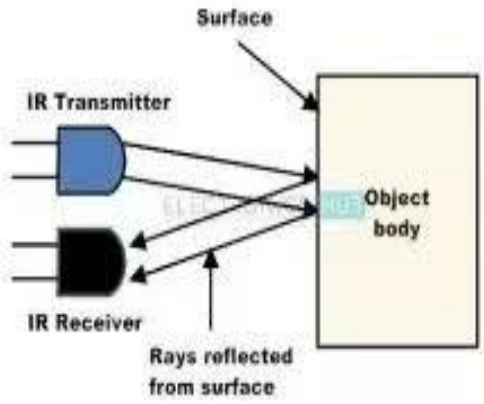
J. A. Khan and Y. Ghamri-Doudane, published a paper which will use an vehicle ranking algorithm "CarRank" for the identification of Information Facilitator Vehicles (IFVs), responsible for the gathering, storing and publishing of urban sensing data. The vehicle first ranks the information associated to it taking into account with the relevance to the users interest. It then considers the associated location-aware information popularity to find its necessity in the network using CarRank algorithm as its vehicle centrality, It is found that CarRank is an efficient ranking algorithm to identify important vehicles when compared to other ranking metrics used in the literature. But however the major problem is if vehicle is not connected in VANET or it is disconnected due to network problem then the CarRank algorithm cannot rank important location-aware information popularity.

PARKING SPACE DETECTION SYSTEM: PROTOTYPE, ALGORITHM AND DISSEMINATION OF PARKING INFORMATION

Firstly, in section III-A the prototype of the parking system is described. In section III-B the techniques of the haar cascade machine learning object detection algorithm are discussed

A. The Prototype System

The prototype kit consists of an ESP 8266Nod connected with IR sensors, along with camera connected to compute system. Each IR sensor is placed in each parking spot to find the occupancy status. It is to be noted that Camera along with the system is not part of the mobile sensing system. It is purpose is to capture the vehicle license plate information in order to find the vehicle owner information. Infrared sensor is set to transmit a short pulse every 150 milliseconds.

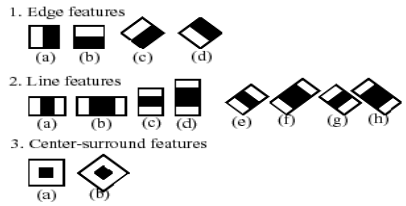


The IR transmitter connected to ESP8266 microcontroller emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the light received by the IR receiver, the output of the sensor is used to find the occupancy. Only data that is found as parked vehicles or empty spaces by the algorithm are sent to the central database. The vehicle license plate detection id done through capturing an image of the license plate by the camera. Then the system would call the haar cascade algorithm api which extracts the license plate information. The information about parking space would be disseminated through the website. The user can park their vehicles in the slots of their comfort.

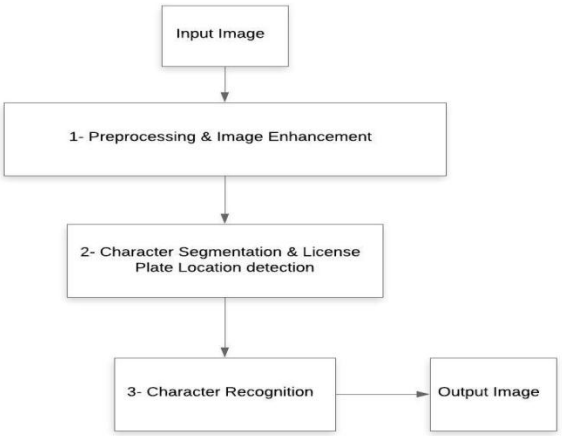
B.*CASCADING CLASSIFIERS*

Cascading classifier is developed to recognize the vehicle license plate. Initially, the algorithm needs a lot of positive images (images of license plate) and negative images (images without license plates) to train the classifier. Then features are extracted from it. For this, Haar features shown in the license plate are used. They are just like our convolutional kernel. Each feature from vehicle license plate is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under the black rectangle. For each feature calculation, the sum of the pixels under white and black rectangles are found out. For larger vehicle license plate image, it reduces

the calculations for a given pixel to an operation involving just four pixels.



During the detection phase, a window of the target size is kept over the input image, and for each sections of the image, Haar features are calculated.
This difference is then compared with the threshold value that separates non-objects from objects. Because each Haar feature is only a "weak classifier" in the vehicle image (its detection quality is slightly better than random guessing) a large number of Haar features are required to describe an object with better accuracy and are therefore organized into ***cascade classifiers*** to form a strong classifier. The classifier will output the results into the accurate vehicle identification.



C.*FARE COMPUTATION ALGORITHM*

A whole parking period includes three phases: entering, parking the vehicles, and leaving. Initially, the parking space is vacant, and the values of entry[],time are the entering

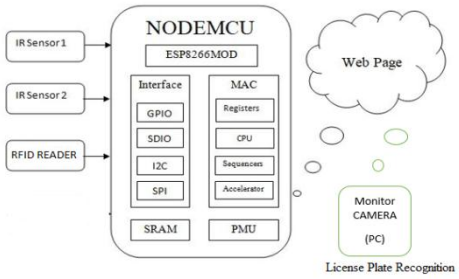
vehicles license plate number, entry time of the vehicles. Then a car enters the parking space and finds for an parking spot. After the car parks in the parking spot, the IR sensor would update the parking slot occupancy status and the parking space is occupied then when the car is leaving the parking space and IR sensor would again update the parking slot information . Finally, the parking space is vacant, and the values of entry[],time recover to the initial values. On leaving the parking spot, amount would be calculated based on the period of parking, and the entry time of vehicles.

Algorithm for fare calculation

Input: entry[i], entering time of the vehicles, amount
Ouput:parking fare of the vehicles
for i in range(len(entry)):
if entry[i] == number:
index = i
stop = timeit.default_timer()
now=datetime.now()
current_time=now.strftime("%H:%M:%S")
print"Current Time =", current_time
duration = int(stop - start)
print"Total time = ", duration
if duration < 20:
USERS[j] -= 50
print "Total amount (in seconds)", USERS[j]
if duration >= 20 and duration < 40:
USERS[j] -= 100
Print"Totalamount(inseconds)".USERS[j]
if duration>=40
USERS[j]-=150
Print"Total amont(inseconds)",USERS[j]
Break

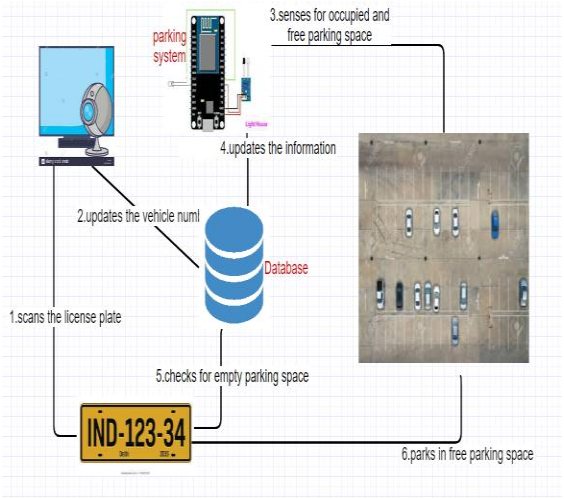
Based on the occupancy and need for parking space,the parking fare can also be changed through cloud.

SYSTEM ARCHITECTURE



The NODEMCU ESP8266 is an Important part in the parking system.IR sensor would emit and find whether any vehicle is present based on the intensity of the light it received. It then sends the data to NODEMCU ESP8266 where the whole process takes place. The microcontroller Node MCU will make decisions based on data send by the sensor.

Depending upon the parking slots, number of IR sensors are placed in parking slot which are then connected to Nodemcu esp8266 microcontroller.



The process flow starts when users enter into the parking space, the vehicle license plate image captured by the camera of the parking system, the system would get the vehicle number from the image by using the api.On the other hand IR checks the occupancy status and updates the slot status. It disseminates the information to the user through website or portal. User can park their vehicles based on the information from portal or website. The parking fare would be calculated using both the entry time and period of parking of vehicles in the slot.

RESULTS

In these experiment, the results were based on efficiently finding a parking space for an Vehicle user, the systems ability to identify and recognize the vehicles license plate number precisely and accurately and to calculate the accurate fare for each vehicle based on the parking time. Cascade classifier is used for precise vehicle license plate detection. The images containing standard number plates were extracted from the images subjected to the detector and were used for number plate recognition and determining its accuracy. The time taken for recognition of license plate was 2 sec with overall system accuracy of 95% for images containing standard number plates captured from front side i.e. 90 degrees angle. Following Table summarizes the accuracy of detector for the acquired images with different angles.

Camera Position	Total Images given as input	Number plate detected	Accuracy of detection
Front position	300	285	95
Elevated position	200	175	87.5
Azimuth Angle	100	85	85

CONCLUSION

In this paper, an efficient, fast and portable system is proposed which can efficiently allows users to find a parking space and utilize the parking spaces. this system **can** be used in high congested parking areas like malls, convention centers which efficiently shows the free hassle-free parking slots to users to park their vehicles. The system uses cascade classifiers for efficient identification of vehicle number and it is also

cost efficient than the existing method,even it retrieves the empty parking information quickly. The proposed parking system saves time and also reduces the man power than the existing method

Interms of future direction and work, further enhancement can be made by displaying the occupancy status in Lcd displays. Even RFID tag can also be used for vehicle identification instead of vehicle plate recognition using camera as it will reduce the time usage in vehicle identification. Even amount deduction can also be made from the RFID tag instead of manual amount collection.

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