Parking Slot Booking System with Driver Authentication and Accident Mitigation

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Abstract

The need of independence and empowerment has changed the face value of vehicles from luxury to essentials. The increase in number of vehicles on roads has given rise to many problems. Three such issues are Vehicle thefts, fatal accidents and lack of space management especially at parking lots. In this paper we aim to provide a single platform that gives effective solution to the above issues using automation, ensuring both human safety and comfort. Using RASPBERRY PI as an interfacing module and web application we provided Driver authentication, Accident mitigation and a web portal for booking parking slots.

Keywords: RaspberryPi, web application, accident mitigation.

1. Introduction

The emergence of vehicular automation and the development of Artificial Intelligence envisage the distant possibility of even a driver-less vehicle. Having said that, the growing issues surrounding vehicles in urban India are becoming increasingly difficult to be dealt with. Vehicle theft has been a gruesome consequence of the usage of remote-less vehicles and vehicles with an abysmal mechanical security system. It is an ideal stream for electronic insights to chip in, wherein the improvement of the security system could not only aid in vehicle tracking, but also in the prevention of such occurrences. Due to an explosive population density, space management and occupancy has always been a confounding issue. Due to the extreme increase of vehicle production, poor management of parking spaces and slots was always a given. Nevertheless, this issue has been escalated to such an extent that vehicle damages in parking lots have skyrocketed over the years. Adequate planning and tech support will effectively address this problem.

Highways are an integral part of road commutation and transport in any country. It is not a coincidence that most fatalities occur on highways too. While a part of those fatalities is a mere manifestation of misfortune, quite a few of the accidents add to the death toll due to sheer negligence and lack of authoritarian help. A simplistic technological solution can curb the rates of fatality on highways and other rural bypass roads as well. A staggering one of every five motor vehicle accidents take place in a parking lot, and 14% of all claims of auto damage involve collisions therein. One of the major reasons behind collisions, injuries and fatalities that happen in parking lots is the poor management of space. According to an article by USA today date 12 July 2017, Drivers spend an average of 17hrs searching for a parking lot shown in fig.1.

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Fig.1:Bar chat of average searching time for parking lot

The aforementioned legitimate statistics are extremely alarming and a part of those accidents surprisingly occur when one of the vehicles is stationary too. This might look like a minute issue but on the bigger picture, it adds to the fatality rate as well. The inspiration to address this issue has also been drawn from plain observation of how similar problems in other fields of work have been solved by building mobile applications and human resources support.

Road accidents have been a major concern for India. Based on an article from Economic times, a total of 4,67,044 road accidents have been reported by States and Union Territories (UTs) in the calendar year 2018, claiming 1,51,417 lives and causing injuries to 4,69,418 persons. The count of road accidents over years raises an immediate concern to consider the situation. Based on the statistics, it's pretty disappointing to see that deaths of children and adolescents due to road accidents are very high compared to other possible reasons. Aboutfive percent of the country's GDP gets invested in road accidents (statsia.com). That is a lot in the current context of tons of other global priorities. While there has been a paradigm shift in the way infrastructural development has been approached, reducing the effect of the inevitable has been increasingly difficult from a viewpoint of resource allocation and effective communication.

As mentioned above deaths have been increasing due to the lack of medical support. In addition, this has been due to the absence of effective communication and not the availability of medical resources. According to the Emergency Medicine Kenya Foundation, Mr. Gakuru, the former Nyeri governor, who was only 77 days old in office, stayed inside the car's wreckage at the scene of the accident while bleeding profusely and writhing in pain for about 45 minutes with his aides and members of the public struggling to rescue him. Vehicle theft causes logistical conflicts on the whole in terms of identity, and macro citizenship issues. This aspect of vehicle theft is quite generally ignored and hides in plain sight. In the article from Times of India dated 26 Feb 2018, it is stated that Police registered 4,632 cases of vehicle theft and managed to detect only971 cases, which is merely 20.96% in the last seven years.

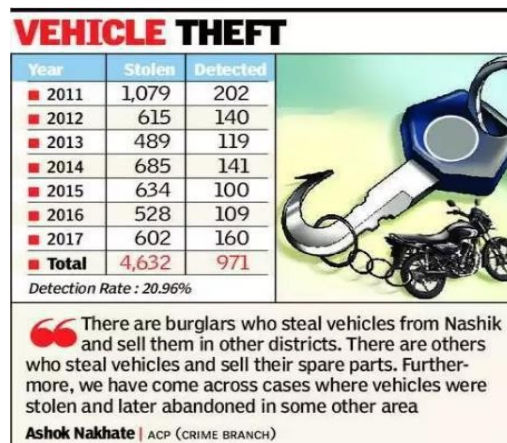The above statement was based on the statistics shown below in fig.2.

Fig.2: Vehicle theft statistics

Studying the internal mechanisms of vehicles helped in the understanding of the automation process of accident mitigation. Building communication technologies which complement the automation system and work well in tandem would definitely provide the right kind of frame work in tackling these issues.

While this paper primarily focuses on cars, the applications of the modules can be extended to other kind of vehicles with minimal economic expense, time and human effort. Initiating a butterfly effect towards nationwide stats and records disrupts a lot of things and hence the primary intention is to tackle the issue right at its source and the root cause, which is to prevent it. Crunching up numbers and statistical background work has been the primary source of drive in terms of developing intentions of working on this particular project. Our studies have only suggested how underrated and under-addressed problems associated of vehicles actually are. It is of the highest priority that negative incidents related to vehicles, which are well within our capacity are reduced as much as possible. The event of a vehicle accident can lead to extreme consequences and often occurs due to various other uncontrollable factors. Nevertheless, the events preceding it and the ones which follow it can be controlled by implementing technological solutions.

M.Ramya,et al [1] implemented the booking parking slot system. A key role has been played by this paper in aiding us to brainstorm a number of possibilities. Raghuveer raibagi et.al [2] has proposed the usage of RFID and Zigbee in this survey paper has made us understand the software aspect of the solution in a very clear manner. However, the hardware was too restrictive and rigid which potentially hinders further exploration and development of integrated solutions to multiple problems using embedded systems, which happens to be our main area of focus and consideration. Shivani et.al[3] implemented a system "The Online Vehicle Parking Reservation System (OVPRS) is a system that enables customers/drivers to reserve a parking space. It also allows the customers/drivers to view the parking status at Kyebando people's park. It was developed because the congestion and collision of the vehicle, the system was developed for Kyebando People's Park located in Kyebando. However, the hardware requirements are way too sophisticated with a necessity of 200GB disk space for server. This, though very precise in approach is not versatile enough to accommodate various kind of devices to use the application/service. The purpose of this paper[4] is to introduce a framework using IoT, which helps in detecting car accidents and notifying them immediately. This can be achieved by integrating smart sensors with a microcontroller within the car that can trigger at the time of an accident. This excerpt of the abstract tells us a lot about the generic approach of accident mitigation but the detection of the occurrence of an accident isn't done by integrating an internal circuit. The inclusion of an accelerometer [5] precisely fits in the purpose of implementing a practical device on ready to use devices. However, due to the demonstrational restrictions, we have adopted another approach using a different set of sensors and circuitry to realize a similar result.

In order to make this happen, three prevalent vehicle related issues are taken into consideration. A systematic approach to vehicle parking in parking lots, effective post-accident communication and mitigation and prevention of vehicle theft. A single step solution to these problems is the potential target. An approach of using a single device (in this case, raspberry pi) to provide an integrated solution and effective space management has been undertaken. This kind of a specific target-oriented approach is of paramount importance in a country like ours as it is increasingly becoming an area of concern for the citizens. Not working on these lines can have terrible adverse long-term effects like civil indiscipline, decrease in health and safety indices, large scale material loss and more importantly a rapid decline in the quality of human life.

2. Methodology

Here we have used Raspberry Pi that acts as a mini computer as a base for executing codes. The other components used are Camera module, piezoelectric sensor and SMTP email server. The system uses as user's photo and their email id as a input from the database that has to be updated prior.

Driver Authentication

To achieve this we are interfacing Camera Module with the Raspberry Pi. We are operating the module using the python code that instructs the module to activate when the car is keyed to start. The camera module activates and clicks the picture of the person in the driving seat. This image is stored and compared with the images of the owners that are already present. Here the code allows us to compare the picture with more than one people at the same time. If the picture mismatches with all the images than a mail is sent to the registered email id using SMTP email server with an attachment of the clicked picture. The mail is sent from the company's mail for their records purpose. This data can be used for investigation purpose.

Accident Mitigation

We are using the existing mechanism of the Airbag circuit to achieve this. Airbag triggers whenever there is sudden de acceleration in the vehicle. The raspberry pi senses the trigger of the circuit and sends a mail using

SMTP email server to the registered mail id. We can attach the GPS location of the vehicle at the time of accident that is found using GPS module. The mail alert can also be sent to the nearby healthcare centers for immediate medical aid.

Slot Booking for Parking

Here we aim to create a system where the user can access a web interface to book parking slots in advance. The user can select the desired parking slot and enter the vehicle details including the time slot. An admin provision has also been created in order to provide an overview of the slot timings and scheduling, wherein the necessary changes and the communication with the user can also be initiated and established.

Driver authentication

Recognize and manipulate faces from python or from the command line. It's built using dlib's state-of-the-art face recognition built with deep learning. The model has an accuracy of 99.38% on the labeled faces in the Wild benchmark.

3. Implementation of the system and results

Driver Authentication

Assuming that initially car is locked and driver wanted to open the car door the steps of authentication is shown in fig.3.The whole system is developed using a Raspberry Pi board which act as a small computer . The board is configured with linux based OS raspbian to execute the python code. Python is able to run image processing tools for capturing the image of the driver using pi cam and compare with the existing data base of authorized driver. If the unauthorized driver forced to open the door image of the person is sent to the registered mail id using SMTP server running on raspberrypi.
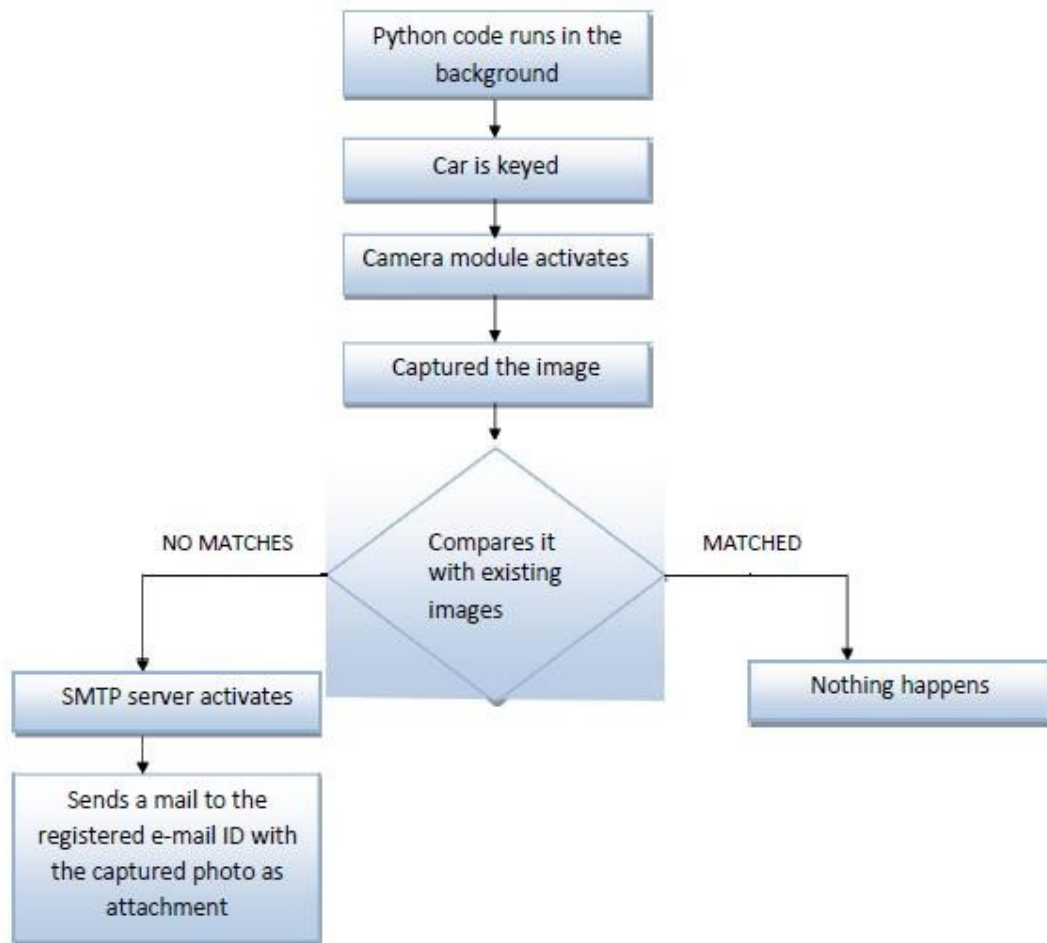

Fig.3: System flow diagram

The images of the owner are stored in the raspberry pi. Here three images are stored which are considered to be known faces. Known faces file - Prachotan.jpg, Sneha.jpg, Sushanth.jpg as shown in fig.4
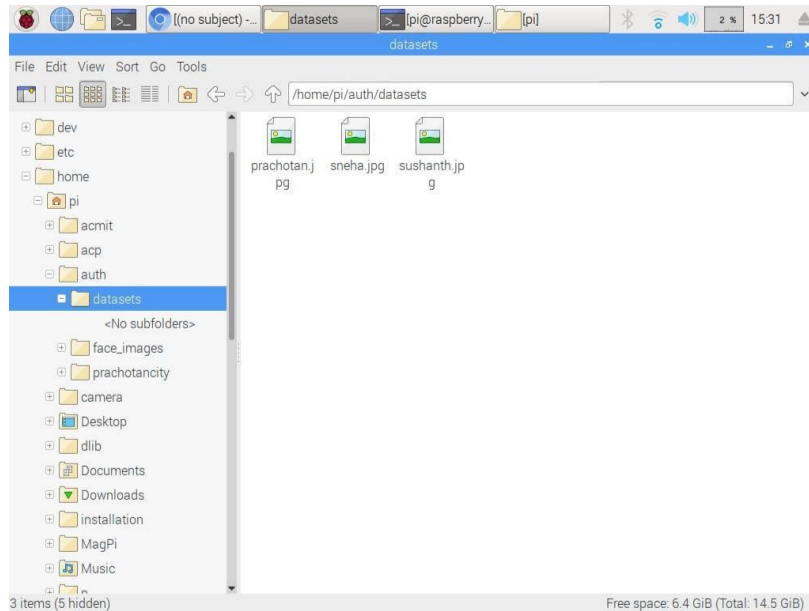

Fig.4: Database of authorized persons

When all the elements in the list are False, SMTP server activates and the mail is sent from the mail account-"projraspberrypi20@gmail.com"to the owner mail account as shown in fig.5.

The details of the mail are as follows:

Subject - Car authentication

Body - The stranger image is attached

Attachment – The unknown image
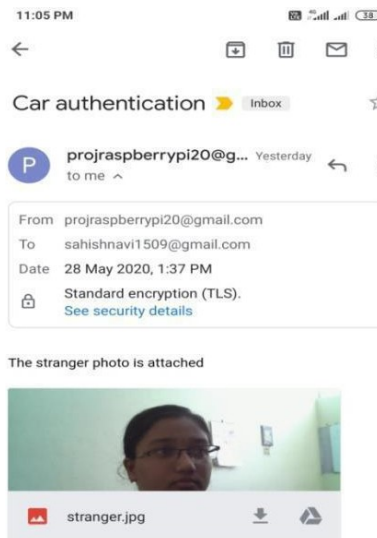
Fig.5: Mail received for authentication

The company can have a record of all the mails sent with the time and date and respective mail ids of the owners of their vehicle.

Accident Mitigation

To integrate the application of accident mitigation along with the authentication is shown in fig.6.In this application one of the digital pin is connected with the vibration sensors. When accidents occurs an airbag circuit is triggered to get open and immediately send the location of accident to the registered mail through the SMTP server. The location information is obtained using GPS receiver communicating in UART mode.
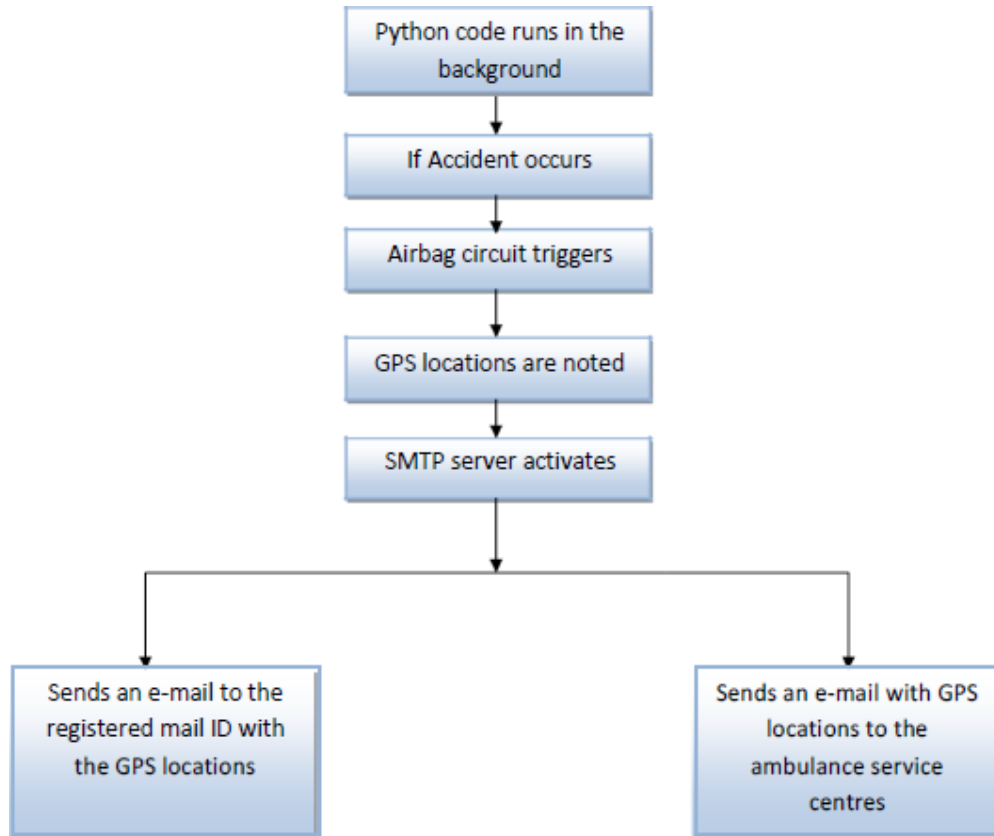
Fig.6: Flowdiagram for accident mitigation SMTP server activates and the

mail is sent from the mail account-is shown in fig.7.

"projraspberrypi20@gmail.com" to the owner mail account.

The details of the mail are as follows:

Subject – Accident alert

Body - An accident occurred to the vehicles at locations-
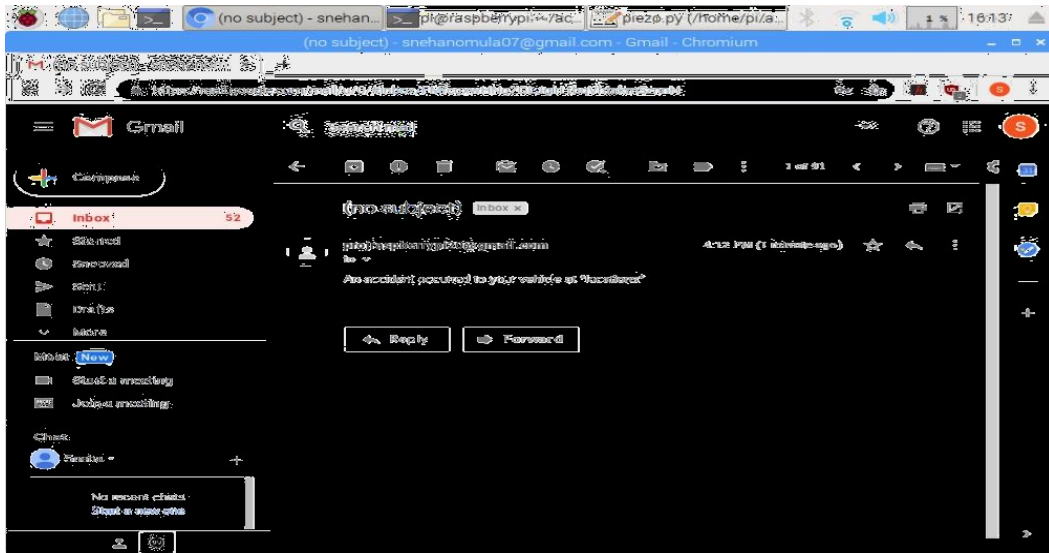
Attachment – The GPS locations

Fig.7: Staus of accident alert in email

The company can have a record of all the mails sent with the time and date with the locations of accident and respective mail ids of the owners of their vehicle.

Parking Slots Booking System

The third application besides authentication, mitigation is the parking slot booking reservation system. The flow of the booking system is shown in the fig.8.The idea is to develop an online car park booking system which allows the user to book parking slots providing the required details and on the other side the administration manages the bookings and the users' details.

So the application can be classified into two:

• User's perspective
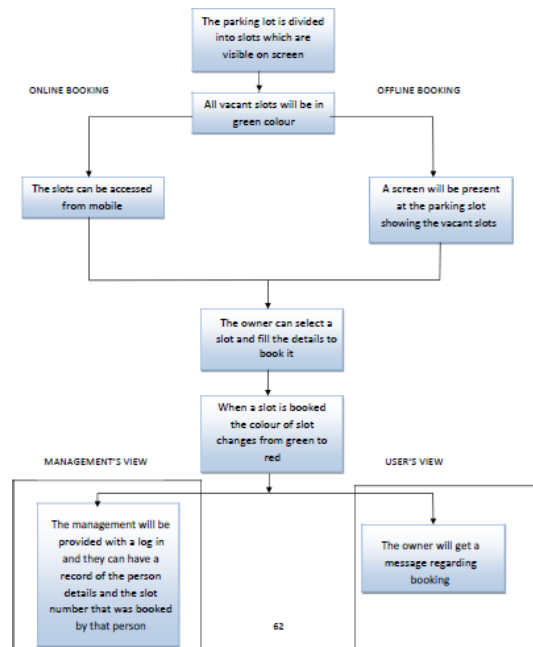
• Management's perspective

Fig.8: The flow diagram of Parking slot reservation system

User's view

The parking area consists of a group of slots which can be accessed by the user and the admin online. There are total 10 slots in this parking lot. Since all the slots are vacant, these are represented in green colour as shown in fig.9.
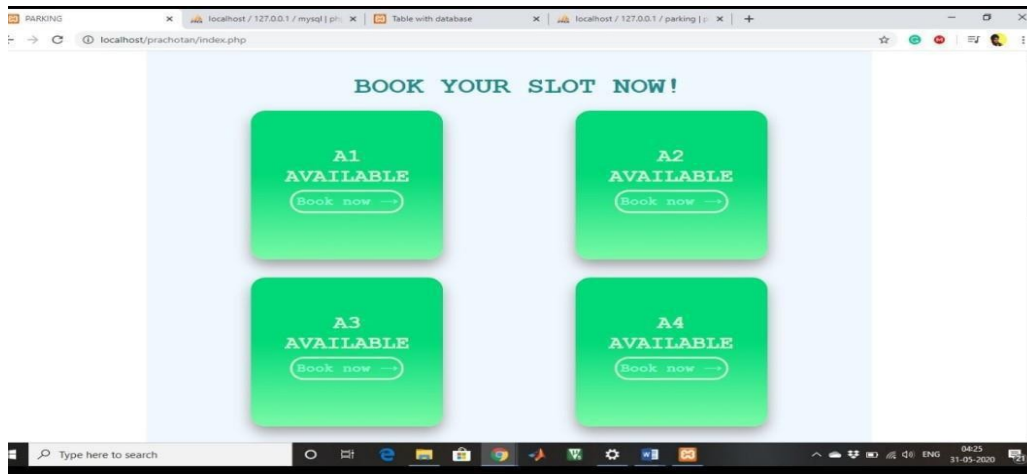

Fig.9: Showing the availability of slots in green colour

There are two modes of booking a slot

• Online booking

• Offline booking

In online booking, the person can access the webpage from mobile from any place and in offline mode, a person can book a slot from the screen present at the parking lot. Here, a vehicle cannot be parked without having a slot booked.

When a person wants to book a slot he has to click on the desired slot and enter his details in the pop up as shown in fig.10. The details include-
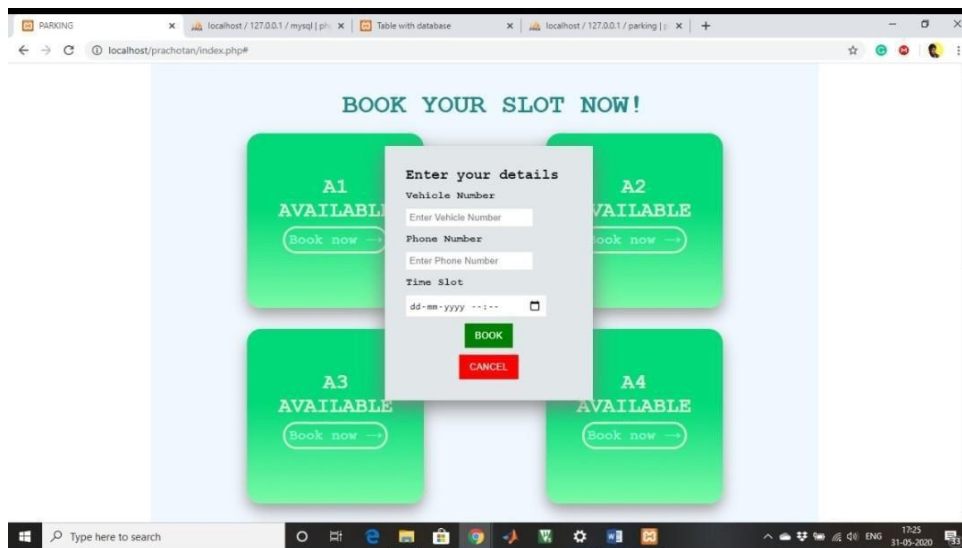
Vehicle number

Phone number

Time slot

Fig.10: Popup window for online booking

The slot can be booked at any time and on any date if the slot is vacant. If at a particular time the slot is available for booking i.e. it is already booked, then it turns into red colour as shown in fig.11.
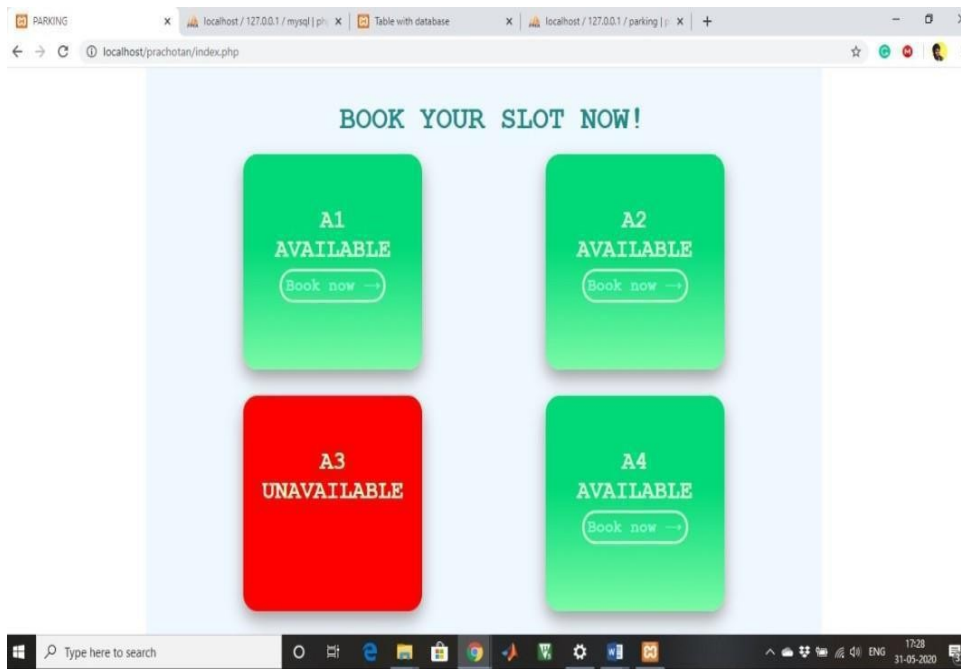

Fig11:After online booking reserved status in red colour

The person booking a slot is notified their date and time and number of slot that has been booked.

Management's view

The management initially has to login with their credentials for the purpose of secure accessing. The management will be able to access a separate website that will be accessing the same database as the user's slot booking website as shown in fig.11.
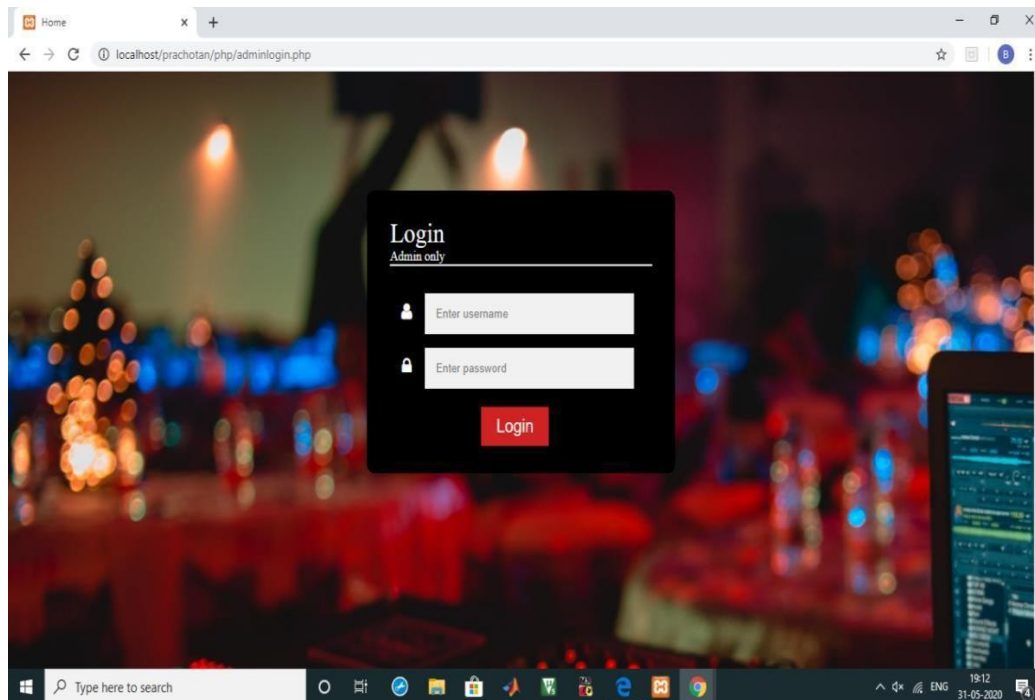

Fig11: Login page for Management

The management after getting logged in to the account can access the user's slot booking information. Only the management will have the access of the user's information.

After logging in, they will be taken to a page where they can see a table showing the details filled by the user at the time of slot booking is shown in fig12..
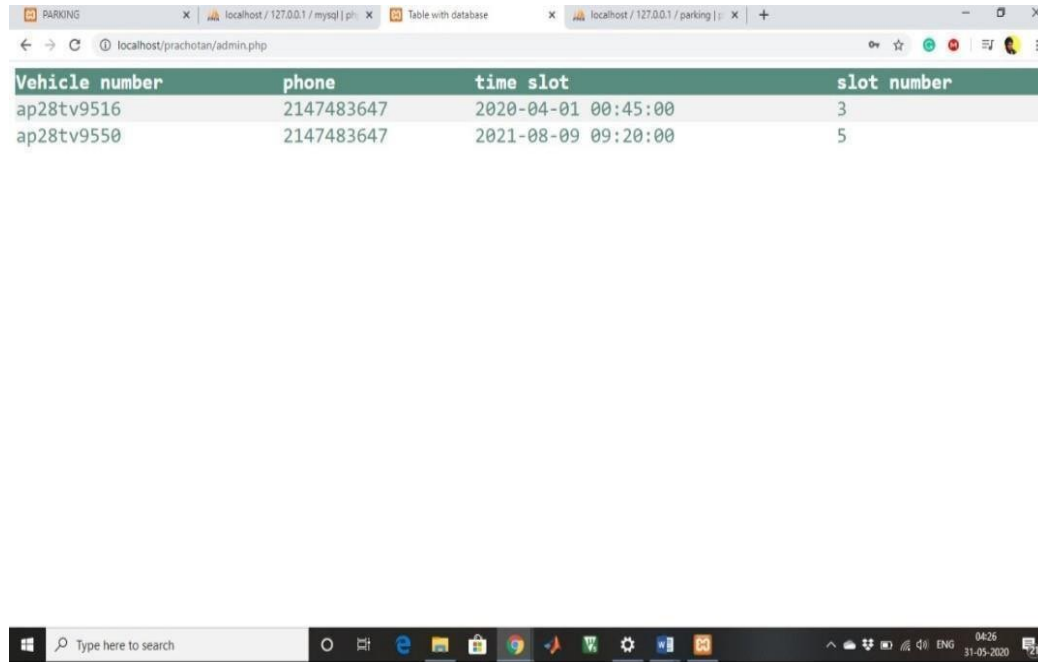
This page shows

Vehicle number

Phone number

Time for which the slot has been booked

The slot number

Fig: 12: **Details** of users who have booked the parking slots

4. Conclusion

The work is focused on dealing with three major aspects of a vehicle, a systematic approach to vehicle parking in parking lots, effective post-accident communication and mitigation and prevention of vehicle theft. The system is developed with design of website through which a user can book a slot at a parking lot both offline and online that will reduce the chaos at the time of parking. It also integrates an application using Raspberry pi where Driver is authorized every time the vehicle is keyed to start and the locations of the vehicle will be sent to the registered mail whenever an accident occurs. In the future where the possibility of driver-less vehicles is increasingly grooming, an amalgamation of automated systems comes into picture such as the aforementioned ones. The mere extensions of these automated components can serve the purpose of a complete vehicular automation which ultimately reduces immense human effort.

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