Smart Valet: Automated Vehicle Parking System

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Abstract: With the exponentially growing population and the lifestyles of people in the country, the number of vehicle count is also increasing at an exponential rate and adding to this, lack of space in urban cities has made innovative and cost-effective solutions to parking one of the most sought-after solutions by the urban dwellers and the governing bodies. When it comes to current scenario of parking facilities in India then it is observed that over 46% of vehicles are parking on Street and about 39% of vehicles use the ground below it to give a ration of 1:1 between the vehicles and parking space which is common in traditional parking solutions. Our project is designed to mitigate these problems and provide a better solution which is fully automatic and in same context required less space and is cost effective with a parking ratio of 1:2 up to 1:4.

Keywords: User Interface; OCR; Number plate recognition; vehicle cradle; real time database.

I.   Introduction

India being the second most populous country and to even be the first in the coming future, there will be an increase in the scarcity of empty spaces in and around the metropolitan cities and to use one to park personal vehicles would be a waste of resources, but we also know that parking space is something that every vehicle in the running requires. Due to this many of the vehicles can be seen parked on public ground such as road bank, on street, in front of enterprises like a hospital or a shop etc. leading to road congestion, accidents and other related problems. So, to overcome this scarcity of places and problems related to unregulated parking, an innovative and effective solution is proposed to mitigate problems related to space by increasing the vehicles per parking space and also provide a regulated parking system that is safe not only for the vehicles but also for the users with ease of operation.

II.   Objective of the proposed system

- To develop a system to mitigate, the issue of finding appropriate parking spaces by creating a system that not only creates a parking lot but is easy to adapt, adopt and deploy model using modern techniques to develop solutions.
- Vehicle parking by vertical stacking of vehicles to ensure better utilization of space and resources.

- Provide reliable, hassle and worry-free legal parking service that ensures vehicles and user safety by serving the purpose.

III. Proposed Methodology

A. Structural Design

The structural design of the system is taken from the existing/proposed system with its moving parts inspired from a Ferris wheel. The dimensions of a miniature model are given in the diagram below.
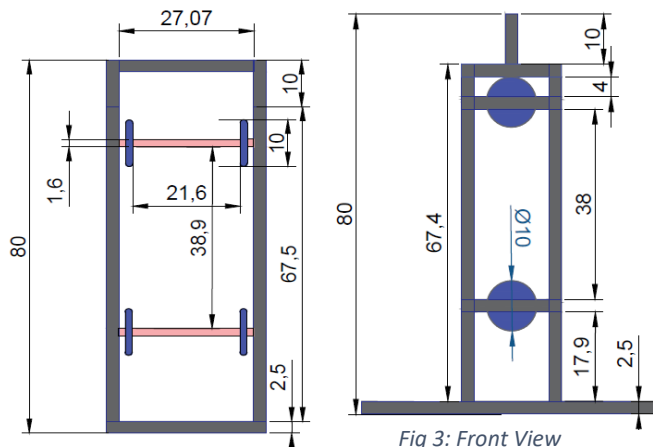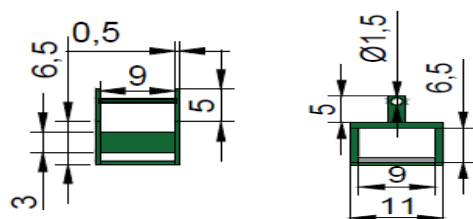

Fig 1: Side View

Fig 3: Front View

Fig 2 Dimensions of the cradle

The miniature structure is made from metal parts with its outer from made from a hollow steel tube of 1in by 1in in dimensions and the cradle for the vehicle is made from pressed light weight steel. The cradle is fixed to the 100mm teethed gear with the help of a chain where the connecting rod (pin) between the chain's Inner plate and the

outer plate is extended to connect to the outer edges of the cradle by making a rotatable connection that is capable to rotate 360 degrees, this ensures that the base of the cradle always faces down and does not cause the vehicle inside the cradle to topple over. This same miniature design concept can be applied to a working size model by change the material based on the strength required and the extent of use of the system.

B. System Design

The system design consists of the entire flowchart of the system, describing the flow of instruction as mentioned below.

1) The user is provided with an application to interact with the Smart Valet system and book their slots or even to bring their slot down.

2) All these interactions are carried out through the internet with database being at the
center to communicate any changes.

3) When user requests log in through the application then it is checked if the user is registered or not, if the user is not registered then the user is registered and the

4) If the User selects to park the vehicle or to retrieve their vehicle then the same is communicated to the database and the microcontroller waits for the command from the user to move the motors.

5) If The User wishes to park the vehicle then the same is selected and the plate is captured and is sent for verification to an onsite running ML program to read and verify the number plate of the vehicle requested for parking facility. Once verified
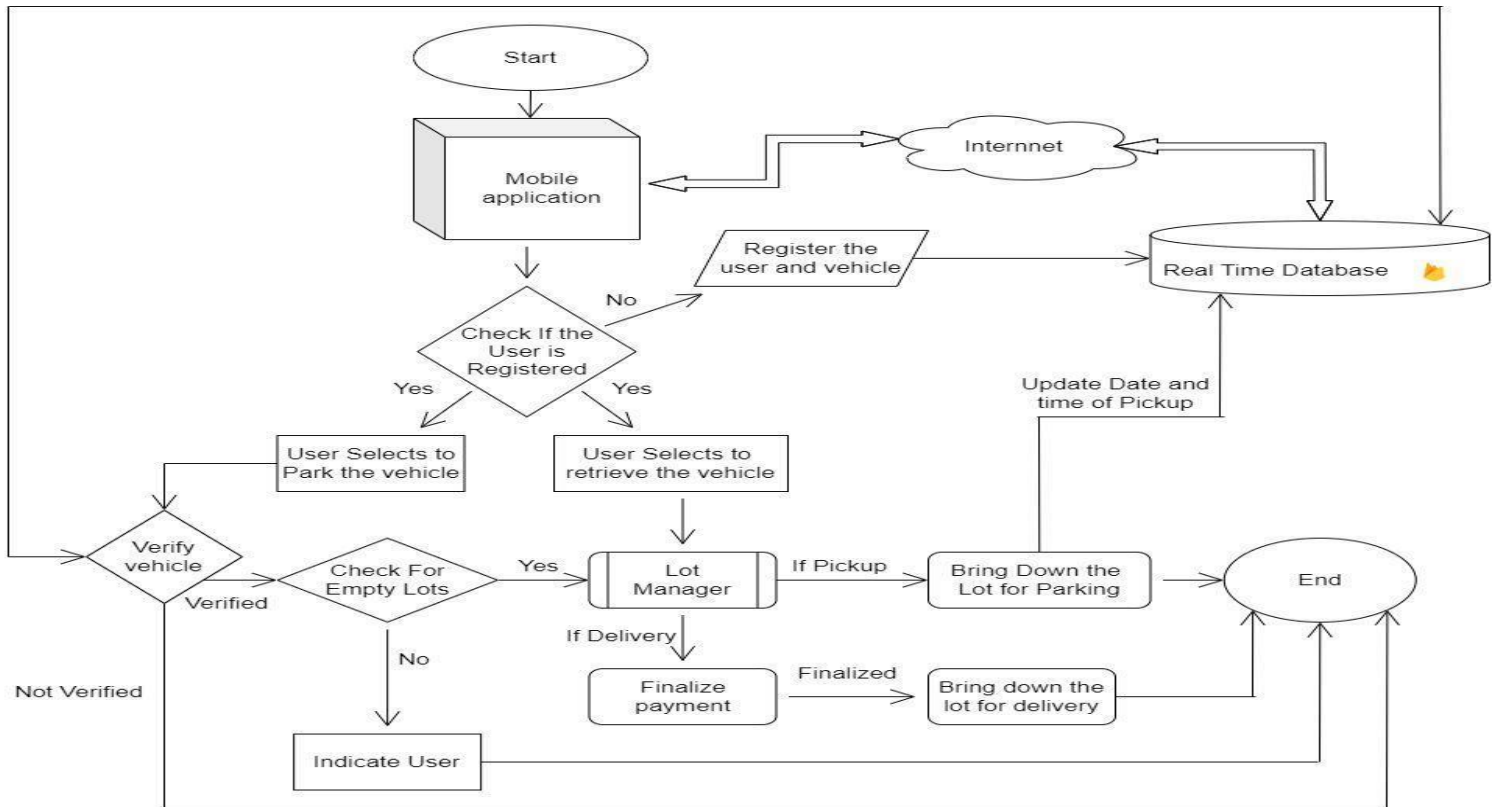
Fig 4 System flowchart

IV. Working

6) The microcontroller employs the shortest path algorithm to find the shortest path for a lot from a given position to the ground level, if selected to retrieve or park, else it assumes the vehicle is parked and moves to serve the next customer.

7) The microcontroller also checks for the empty lots if a present it will proceed further with the booking else it will suggest a nearby tower.

8) The Lot Manager manages the status of the lot along with its position in the frame.

9) When the user has utilized the service and wants to retrieve their vehicle they will be redirected to a payment page, upon the completion of the payment the lot will come down where they can collect their vehicle.

User is provided with a interface to communicate with the database, the database stays always connected to the interface available for data retrieval or updating data now this is an important feature because, when a user tries and books a lot or tries to retrieve a vehicle the database must be connected for data access or updating a data from where the motor gets its command to move the shaft which drives the vehicle cradle.

The user interface will have a login or authentication feature which protects the user vehicle from unauthorized access to the vehicle. When the user logins with the credentials provided then the user is provided with a option to register the vehicle the vehicle which is a compulsory operation to enable the parking facility, when the user vehicle is registered with the database then and upon successful login then the user is

given with options to park their vehicle, on selecting an option to park the vehicle the user needs to bring the vehicle onto the parking driveway, where the user vehicle will be identified and verified with the help of machine learning algorithm which converts the recognized number plate to OCR format from which the number plate characters are recognized and compared with the registered vehicle plate number, upon successful verification the vehicle cradle comes down to facilitate the parking of the vehicle.

Once the user parks the vehicle the user can select on complete parking to raise the cradle above. Selecting this option will update a parameter in the database, this updated parameter will then be read by the microcontroller which will send signals to the motor to make an empty lot come down to the ground position to enable parking of the vehicle. The cradle will be positioned in such a way that no unregistered user will have an empty cradle to park the vehicle for free.

If the user wishes to retrieve the parked vehicle, then, retrieve options can be selected when done this option will update a parameter in the database, this updated parameter will then be read by the microcontroller which will send signals to the motor to make the registered lot of the user to come down to the ground position to enable retrieval of the vehicle.

This Is the overall working of system from user registration to the parking and retrieval of the vehicle. The miniature model will operate on the same working principle trying to keep it as closely possible to the reality.

V. Implementation

The Proposed System was successfully implemented and the outcome of a few test cases are shown below.
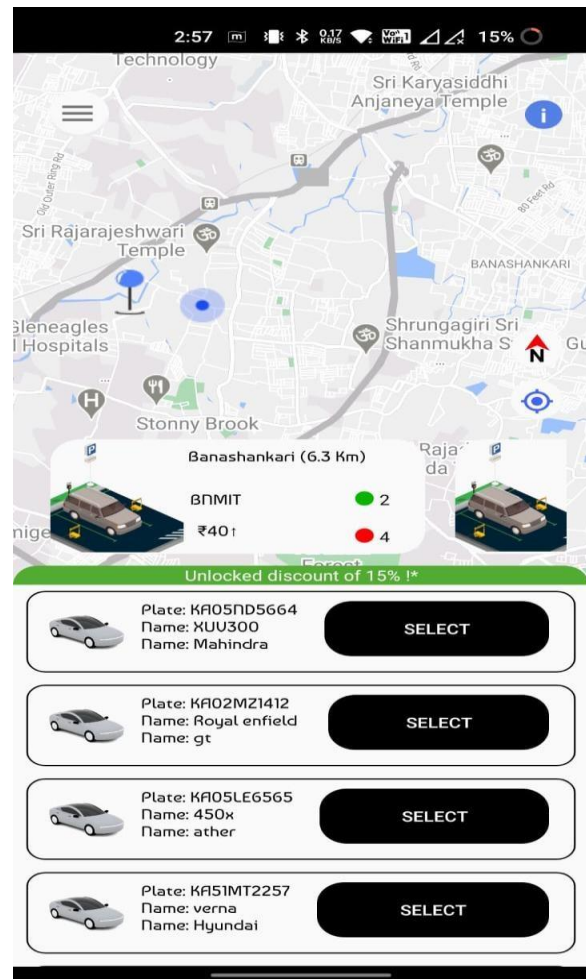

Fig 5 Screen Shot of the Android Application

The Pictures include the User Interface of the Application developed during the course of the project and the output of the ML program showing a Plate verification status of the requested vehicle, A test case showing vehicle slots full status, Circuit of IOT devices and the Prototype model itself.
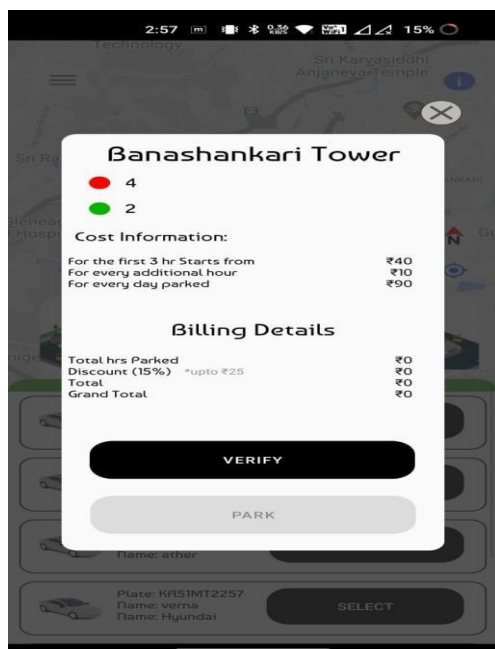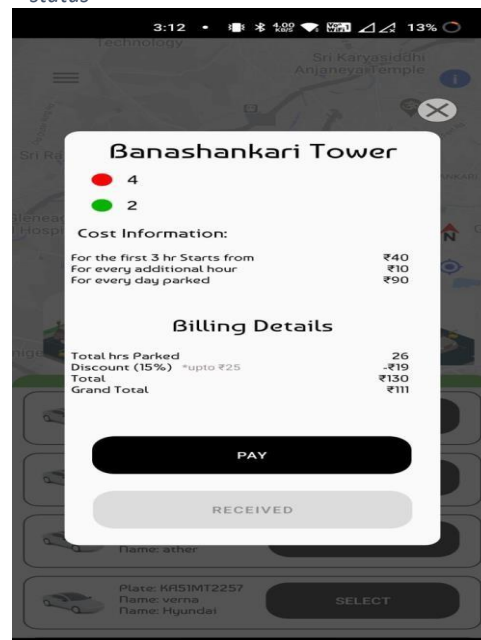
Fig 6 Screen Shot showing the UI after selecting the vehicle to park

Fig 8 Screen Shot of the ML program showing Plate Verification status

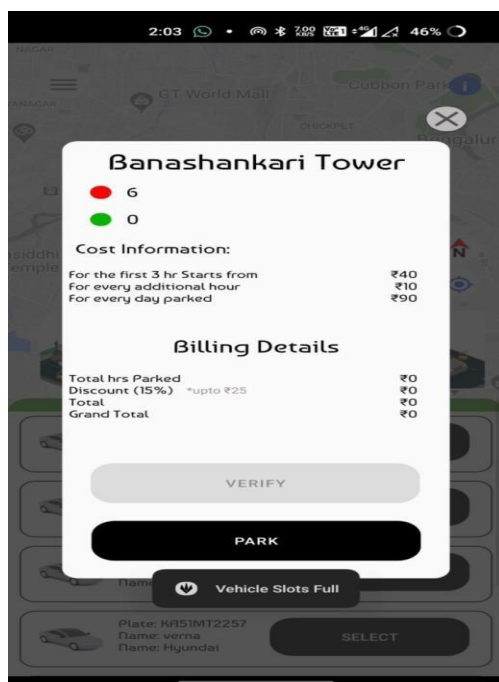*Fig 9 Screen Shot showing retrieval UI for the selected vehicle*

Fig 7 Screen Shot showing slots full status
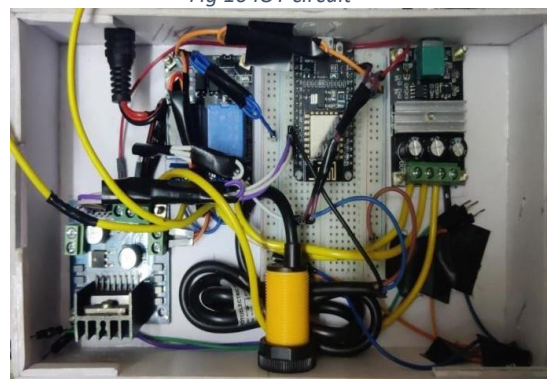
Fig 10 IOT circuit

Fig 11 Picture of the Prototype

VI.   Conclusion

As this system is developed, the system offers a simple, straightforward and cost-effective solution for one of the major growing problems in today's world i.e., vehicle parking. This system is designed in such a way that more 4 cars can be parked in the space of 3. It is stacked vertically and a motor is used to move the platforms where the cars are parked. This is implemented using a microcontroller to which input is fed from the database to operate the motors. An interface is also available through which any user can book an available parking spot. This enables a user to plan their journey without any hassle. This system can undoubtedly be seen as the starting point for the more recent development in problems related to parking of vehicles and can act as a benchmark for future improvements in the same field if required.

VII.   References

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