Smart Parking System for Smart Cities

Supreeth Y S
Student, Dept.of ISE
R V college of Engineering
Bangalore,India

S G Raghavendra Prasad
Asst. Professor, Dept.of ISE
R V college of Engineering
Bangalore,India

Dr. Jitendranath Mungara
HOD, Dept of ISE
New Horizon College of Engineering,
Bangalore, India

Abstract— **In recent days, searching for a parking space especially in densely populated cities has become a daily concern for people since it consumes a lot of their precious time. In order to overcome difficulties such as waiting in long queue and circling around the blocks to find a vacant parking space, in this paper we are proposing a unique system wherein people living in the vicinity of crowded streets can rent their unused parking space. Using this approach, especially malls can productively manage the parking problem effectively during rush hours. This system also provides convenience to customers by reducing the amount of time spent to find a vacant parking slot by allowing them to reserve a vacant slot through pre-booking.**

Keywords— Automated Parking, NodeMCU, IR sensors, Proximity sensors, Internet of Things (IOT).

I. INTRODUCTION

Heavy traffic caused by vehicles is becoming a major problem and it is growing exponentially. Around 1400 new cars enter the roads of Delhi in India every day. Looking out for a vacant parking space in peak hours is often frustrating for people. This in turn has made it more difficult for people to park their vehicles in crowded public places like restaurants and malls during peak hours. We burn around one million barrels of oil every day. In a recent survey, it was found that a driver takes nearly 8 minutes to park his vehicle because he spends more time in searching for a parking lot. This searching leads to 30 to 40% of traffic congestion [1].

According to a report, Smart Parking could result in 2,20,000 gallons of fuels saving till 2030 and approx. 3,00,000 gallons of fuel saved by 2050, if implemented successfully. Finding spaces during weekends or public holidays can take more than 10 minutes for about 66% of visitors [2]. Our primary objective remains reducing the two of man's most important factors, cost and time. It also helps malls regulate traffic efficiently in the parking lots. Manpower is reduced considerably by directing the vehicles through our independent system.

II. LITERATURE REVIEW

The existing parking systems simply gather the available information of vacant parking lots using various sensor networks, and update the data to direct drivers. But the problem lies here, this system will not be able to direct the drivers to their respective parking slots. Blind searching is a common way by which drivers look out for vacant spaces when there is no availability of parking information. The drivers keep searching for empty parking spaces within a close distance to their end location. The drivers will not stop looking around until they find an empty space and keep extending the searching area. To tackle the problem of "many-vehicles-chase-single-slot", the way of sharing the information about the parking slots is modified. The designers intentionally decrease the number of available slots while publishing the information, they act as buffer slots. When there are many vehicles wanting to park in a limited amount of available space, this system will have some extra spaces reserved in order to avoid a conflict. But it is a difficult task to estimate the number of the buffer spaces required. If the reserved space is too small, then we cannot overcome the problem of "many-vehicles-chase-single-slot". If the buffer is too large, then parking space cannot be utilized effectively. Walking distance and Traffic volume are two performance metrics that address these issues. In order to address these challenges few systems have been already proposed such as Reservation Performance where the system continuously retrieves and stores data about the performance metrics, it also includes the status of parking slot(occupied or vacant), reservation time, exact parking location and also about driver's identity. As soon as the reserved space is occupied by a vehicle, the system should automatically verify the driver's identity in order to block that slot. Iris-net has proposed a system which uses cameras, microphones and motion detectors. These sensors are used to detect the availability of vacant parking spaces. It also acquires real time information about vacant parking slots through their web applications. But the problem is that it generates huge amount of data. One of the main limitations of this system is high energy consumption and it also suffers from technical aspects [3]. E-parking system makes use of latest technologies to merge reservation of parking slots and the payment systems. A driver can utilize this system to get information about the availability of vacant parking spaces, to reserve a parking space at his desired location and also to make the payment when leaving [4].The above system can be accessed through a smartphone, or through web. But still there is a requirement of conventional detectors to detect the status of the parking slot. Automated parking system makes a way for an efficient use of limited number of parking spaces.

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III.   PROBLEM DESCRIPTION

Finding a vacant parking space especially in crowded public places can be made easy using smart parking system. In this system people can rent their unused parking space. Malls especially by adopting the smart parking system, can reduce the inconvenience faced by users. This system gives users the convenience of booking parking slots online. The user can book a slot through the app/website a few minutes prior to his arrival or when they are within a certain distance from the parking space. It provides the user with a unique id and once the driver reaches the parking lot, the unique id is read and the app guides the drivers to their respective slots. The driver's stress is also reduced since he knows where to park beforehand. It provides accurate and real-time data of vehicle occupancy in each slot.

IV.   METHODOLOGY

Every parking slot in the given mall is identified with a unique id(Parking id).The User registers using either the app/website which prompts him to enter the Username and Password. Once he is registered he is given a unique Customer id. This id is used every time he wants to book a parking slot. To book a parking slot he initially needs to select a destination of his choice. The available number of parking slots in that place will be displayed. One constraint we consider is that the user is allowed to book only when he is within 30 minutes from his arrival time.

Case 1: For parking in public areas

Parking spaces in public areas are considered registered to this system. Even people who are having unused parking space/garage can register to this system. This will be beneficial during peak hours. If the parking slots are available at the specified time at the desired location, the user is allocated a slot. This slot has a unique id (Parking id) associated with it which notifies the user where he has to exactly park his vehicle. He would receive a confirmation receipt regarding his parking status.

Case 2: For parking inside malls:

If the parking slots are available at the specified time in that mall, the user is allocated a particular slot. This slot has a unique id (Parking id) associated with it which notifies the user the slot where he has to park. He would receive a confirmation receipt regarding his parking status.

a) User didn't arrive at the specified time
If the time slot is opened and if the user hasn't cancelled, whether he arrives at the specified time or at a later time, he will be charged the same amount. The amount deducted is based upon the duration of the slot booked by him.

b) Cancelled before the time slot opens
The slot is released into the pool of available slots and the amount will not get deducted from the user's account.

c) Cancelled after the time slot opens.
The slot gets released into the available pool but a small amount (cancellation charges) gets deducted from the user's account.

V. PROPOSED SOLUTION

The proposed system is very much similar to many online reservation systems where you are allowed to book prior to your arrival at the destination.

1. The user first opens his app/website and enters the destination of his choice.

2. Then he proceeds to pick the tentative arrival time and also the amount of time for which he wants to book the slot.

3. Once he reaches the destination and checks in at the chosen time, the slot and amount gets reduced from his account (online wallet) accordingly.

4. When he exits, the sensor notices that there is a state change from blocked to vacant and sends a notification to the server, which updates the database.

5. If the user wants to spend more time than the specified booking time, he has the option to extend his time slot through the app by a certain amount of time.

VI. WORKING

I.HARDWARE REQUIRED:

1. IR sensors namely IR Proximity sensors or IR Obstacle sensors are used to detect a car's motion and also identify the status of the parking slots.
2. A NodeMCU to integrate the sensors so as to collect the required data from them and send the data to a server. This is based on the concept of "Internet of Things". Things (sensors and the board) communicate with each other via internet.

II.APP DEVELOPMENT

An app is developed which is supported on android, windows and IOS. This app enables the users to register and book slots in advance. Another advantage is that the users can pay through their linked wallets in the app.

III.WEBSITE

Similar to the app , the users are authenticated and allowed to book through the website also. The programming languages that are used to build the website are PHP, JS, Bootstrap, Jquery and HTML.

VII. DISCUSSIONS

The user has an option to extend his time slot if he wants to. One constraint is that he has to extend the

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time slot only when he is within his specified departure time. He is allowed to extend his time slot by a certain amount of time and this happens to be his final end time.

Each user is allowed to book only once with his customer ID and he will be enabled to book again only when his current booking expires, that is, when he leaves the mall

The database periodically checks the status of the slots and updates accordingly.

VIII. LIMITATIONS

Every user has to be registered in order to use the system.

The user needs to park his vehicle in the slot that is allocated to him.
The user should be sensible enough to know that he should vacate the parking space at his specified departure time.
This system fails if the sensors stop working.

IX. BENEFITS OF THIS SYSTEM

Manages traffic well inside the malls without any havoc.

Limited parking spaces can be utilized efficiently.

Guides the drivers to the available vacant parking slots.

It helps in managing parking space effectively which results in significant revenue generation.

It plays an important role in making our environment pollution free by reducing the emission of CO, NO_2 and CO_2 . [5]

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