A SURVEY ON CLOUD BASED SMART PARKING SYSTEM BASED ON INTERNET OF THINGS TECHNOLOGIES

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Abstract –

This study introduces a new algorithm that increases the efficiency of the current Cloud-based smart-parking system and develops network architecture based on the Internet-of-Things technology. This study proposed a system that helps users automatically find a free parking space at the least cost and without any human interaction. The cost is based on new performance metrics. This system calculate the user parking cost by taking into account the distance and total number of free places in each car park. This cost will be used to offer a solution of finding an available parking space upon request by the user. This system also provides a solution of suggesting a new car park if the current car park is full. The studied system minimizes the user waiting time.

Key Words: IoT, Smart Parking, Cloud Computing, WSN, RFID

1. INTRODUCTION

1.1 Smart Parking systems based on cloud computing:

As the numbers of vehicles on the road are increasing tremendously from thousands to lacs, the traffic problems are bound to exist. In the year 1951 the number of the registered vehicles was 35000 while the figure increased to 15.03 lacs in 2007 and still increasing tremendously. Almost all major cities are facing the parking problems, insufficient parking space cause traffic jams, air pollution, health hazards etc., The price for parking expansion is extremely high. Smart parking is a parking garage/system that utilizes various technologies to efficiently manage the garage. In the near future the demand for the intelligent parking service will increase because the rapid growth in the automotive industries. The automatic management of parking lots by accurate monitoring and providing service to the customers and administrators is provided by such emerging services. A cost effective solution to this service can be provided by Wireless sensor networks which consists of large number of sensor placed in area of interest or in existing parking lots without installing new, expensive cabling and are capable of adjusting with the cheap and easily available sensors. In the development of traffic management systems, an intelligent parking system was created to reduce the cost of hiring people and for optimal use of resources for car-park owners. Currently, the common method of finding a parking space is manual where the driver usually finds a space in the street through luck and experience. This process takes time and effort and may lead to the worst case of failing to find any park space if the driver is driving in a city with high vehicle density. The alternative is to find a predefined car park with high capacity. However, this is not an optimal solution because the car park could usually be far away from the user destination.

This study aimed to provide information about nearby parking spaces for the driver and to make a reservation minutes earlier using supported devices such as smart phones or tablet PCs. Furthermore, the services use the ID of each vehicle in booking a parking space. However, the current intelligent parking system does not provide an overall optimal solution in finding an available parking space, does not solve the problem of load balancing, does not provide economic benefit, and does not plan for vehicle-refusal service.

1.2 The Internet-of-Things technology

To resolve the aforementioned problems and take advantage of the significant development in technology, the Internet-of- Things technology (IoT) has created a revolution in many fields in life as well as in smart-parking system (SPS) technology. The present study proposes and develops an effective cloud-based mart parking system solution based on the Internet of Things. The proposed system constructs each car ark as an IoT network, and the data that include the vehicle GPS location, distance between car parking areas and number of free slots in car park areas will be transferred to the data centre.

1.3 Cloud Server

The data centre serves as a cloud server to calculate the costs of a parking request, and these costs are frequently updated and are accessible any time by the vehicles in the network. The Smart parking system is based on several innovative technologies and can automatically monitor and manage car parks.

1.4 RFID Technology

In the proposed system each car park can function independently as a traditional car park. This research also implements a system prototype with wireless access in an open-source physical computing platform based on Arduino with RFID technology using a smartphone that provides the communication and user interface for both the control system and the vehicles to verify the feasibility of the proposed system. Radio frequency Identification (RFID) and wireless Sensor net- work (WSN) are two important wireless technologies that have wide variety of applications. RFID is means of storing and retrieving data through electromagnetic transmission to an RF compatible integrated circuit.

RFID mainly consist of two components: Tags and Readers. A Tag has an identification (ID) number and memory that stores some additional Reader is able to read and/or write data to tags via wireless transmission

2. Literature Survey

2.1 "ZigBee and GSM based secure vehicle parking Management and reservation system "[1]:

ZigBee is a wireless networking standard that is aimed at remote control and sensor applications. GSM which is the Global System for Mobile communication is a wireless communication device used to receive the users request for reserving the parking lot and also for sending the entry and exit password to the user for accessing the parking lot. In this method Parking lot vacancy module uses ZigBee along with PIC. PIC Microcontroller also called as Peripheral Interface Controller is an 8 bit Microcontroller used in this system. PIC16F877A, series controller used here seems to be efficient and cost effective for this parking management system.

Advantage:

This system supports Security Feature. The exit password must be entered else the user is not allowed to get out of the parking bay as the barrier gate will not get open until correct exit password is entered.

Disadvantages:

The GSM and SMS module makes the system expensive. The SMS contains entry/exit password to the parking lot may not be received due to network congestion.

2.2 "Wireless Sensor Network and RFID for Smart Parking System" [2]:

RFID is Radio Frequency Identification that helps to identify parking slots through radio waves. It enables wireless data transmission with the help of WSN. RFID technology increases efficiency and provides many advantages. RFID technology is much more secure compared to other networks. RFID technology is used for vehicle identification system and no personnel is required in this process. Automatically vehicles are identified and parking-lot fees are collected via this system. RFID system helps the vehicles to check-in and check-out within less time in secure and convenient conditions. Most of

the system in parking area has barriers at the gate. These system allows one by one parking, is time consuming and thus preventing multiple check-ins or check outs at a time.

Advantages:

It provides information of the slot available as well as guides the driver to the particular spot. There is no need to change the existing parking system and it is compatible with the existing wired networks.

Disadvantages:

Reservation of available slot is not provided. Node-to-node implementation of the system requires more time

2.3 New "Smart Parking" System Based on Resource Allocation and Reservations." [3]:

This smart parking system adopts the basic structure of PGI systems which is also called as Parking Guidance and Information. Such a system includes a Driver Request Processing Centre (DRPC) and a Smart Parking Allocation Centre (SPAC). The Parking Resource Management Centre (PRMC) collects and updates all real-time parking information, and disseminates it via VMS or Internet. The DRPC gathers driver parking requests and real-time information (i.e., car location), keeps track of driver allocation status, and sends back the assignment results to drivers. Based on the driver requests and parking resource states, the Smart Parking Allocation Centre makes assignment decisions and allocates and reserves parking spots for drivers.

Advantages:

Reservation of the desired parking slot is available. Efficient resource allocation and management using MILP.

Disadvantages:

A parking spot is reserved by a driver. The driver parks his vehicle but forgets to confirm. The system requests confirmation and until the driver says YES.

2.4 Cloud based smart parking system using Internet of things [4]:

This system constructs each car park as an IoT network, and the data that include the vehicle GPS location, distance between car parking areas and number of free slots in car park areas will be transferred to the data centre. The data centre serves as a cloud server to calculate the costs of a parking request and these costs are frequently updated and are accessible any time by the vehicles in the network. This system uses the WSN consisting of RFID technology to monitor car parks. An RFID reader counts the percentage of free parking spaces in each car park. The use of RFID facilitates implementation of a large-scale system at low cost.

Advantages:

This system Search car park at least cost. Support Forwarding vehicles to another car park if the current park is full. This system reduces the number of vehicles failing to find a parking space and minimize the cost of moving to the car park.

2.5 "Automated Car Parking System Commanded by Android Application".[5]

System presents an Autonomous car parking that regulates the number of cars that can be parked in a given space at any given time based on the parking space availability. When a car arrives at the entrance, it will be stopped at the main gate and the driver de-boards the car. Using the Android application on his Android device, the user commands the Parking Control Unit to check the Status of available Parking slots, through an SMS. On receiving this command, a search for free slot is carried out and corresponding information is provided to the user, by means of SMS.

If the availability of Parking space is confirmed, the user commands the car to get parked to the designated slot. The car traces its path to the entrance of the parking area. Here, it waits and the details required for parking of car at the proper slot are communicated to the Car Control Unit. On receiving the information, the car will further trace its path to free parking spot. On successful parking, the data on the LCD will be updated automatically. For retrieval purpose, the user commands Unpark, through the

Android Application. On reception of this SMS, the car begins to trace back the path to the entrance, where the car driver is waiting.

Advantage:

This system is useful for the purpose of the car parking automation and helps reduce the car driver's time, as the searching of the free parking space is handled by the Parking Control Unit

Disadvantage:

SMS sent through Android Application is not secure.

3. SYSTEM ARCHITECTURE

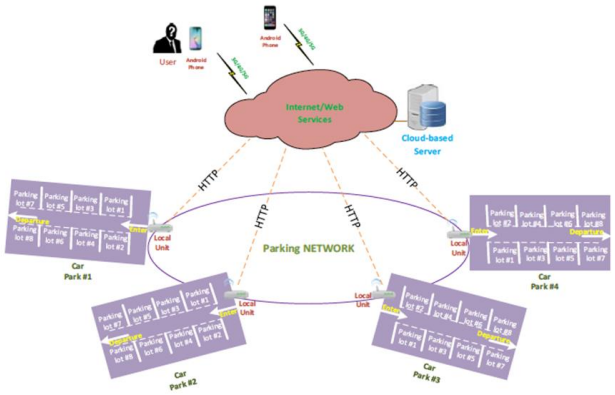

Fig. 1. Architecture of the proposed system

The system is derived from the idea of Internet of things technology. The system uses the WSN consisting of RFID technology to monitor car parks. An RFID reader counts the percentage of free parking spaces in each car park. The use of RFID facilitates implementation of a large-scale system at low cost. The system provides a mechanism to prevent disputes in the car park and helps minimize wasted time in looking for a parking space. After logging into the system, the user can choose a suitable parking space. Information on the selected parking location will be confirmed to the user via notification. Then, the system updates the status of the parking space to "pending" during which time the system will not allow other users to reserve it. If after a certain period of pending time the system determines that no car is parked in that space, then it changes the status to "available." The system will update the status from the WSN node (the status of car park spaces) when a new car joins in the system. Therefore, the status of the overall parking system is always updated in real time. The system will help plot the parking time for each parking space in real time and can support the business with hourly parking charges.

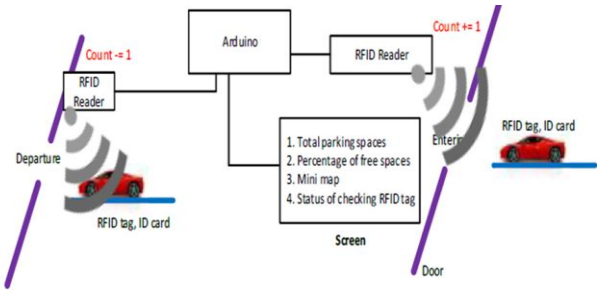

Fig. 2. Local unit

3.1 Use of RFID Reader:

Here RFID technology is used to calculate the percentage of total free parking spaces in each car park. In each car park, an RFID reader is installed at the entrance. We use available named "Count" to calculate the total number of vehicles in the car park. Count = Count +1 when a vehicle enters, and Count = Count-1 when a vehicle leaves.

3.2 Elements in the system:

3.2.1 Cloud-based server:

This is a Web entity that stores the resource information provided by local units located at each car park. The system allows a driver to search and find information on parking spaces from each car park without the need to directly access the local server node by directly accessing the cloud-based server.

3.2.2 Local Unit

This unit is located in each car park and stores the information of each parking space, as shown in Fig.2. The local unit includes the following:

a) Control Unit:

This is an Arduino module, which is connected using an RFID reader. The card reader authenticates the user information and then displays this information on the screen. If the information of the RFID tag or card is correct, the Arduino module will control the opening of the door for the vehicle to enter. The Arduino module connects with the cloud server through an Internet connection to transfer data from the local car park to the cloud server database.

b) Screen:

This displays information on the capacity of the local car park, the total current percentage of free spaces, the status of the RFID tag check, the user card when entering, and a mini map of the local car park.

c) RFID tag or ID Card:

This is used to check and authenticate user information and calculate the percentage of total free spaces in each car park.

d) Software Client:

This is an application software system. Running on Android operating system, the users will install it on their smartphones and use it to reserve parking spaces. The users access the system via 3G/4G mobile connections.

e) Algorithm:

i. When a user wants to find a parking slot, he must login to our system.
ii. After successful login, a request message is sent to search for a free parking slot.
iii. Then, the system will send back a response message containing the information, including the car park address and the directions to reach it.
iv. The choice of the car park is based on the cost which is calculated based on the current location of the vehicle and the location of the car park
v. The system will forward the vehicle to a car park with a minimum cost if the current car park is full. When the user arrives at the car park, he must be authorized to enter.
vi. This authorization is achieved via the RFID technology or by scanning the user card. This mechanism is simple but economical. If the information is correct, the user is allowed to park.
vii. If the current car park is full, the system will send a suggestion message that includes information on a new car park, including the address and new directions, with a minimum cost.
viii. The new car park will be selected based on the neighbour table of the current car park which is maintained at every car park node.

4. CONCLUSION

This study has proposed a parking system that improves performance by reducing the number of users that fail to find a parking space and minimizes the costs of moving to the parking space. Save time and money and reducing environmental pollution In the future study the security aspects of system will consider. As well as implement this proposed system in large scales in the real world.

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