IoT based Smart Parking System: A Literature Review

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Abstract— With number of vehicles increasing day by day and parking places not increasing proportionately, find ing parking areas with free parking slots has become time consuming and cumbersome. There have been many solutions to address this problem with each one adopting a different technology and methodology. This paper presents an overview of such different methodologies using Internet of Things which help people in having a better and smart parking system.

Index Terms—Internet of Things

I. INTRODUCTION

Through several technological advances, the modern society is heading towards an "always connected" paradigm. "If you've watched any live television lately, you've seen commercials for security systems that you can control from your phone, thermostats that learn from your behaviors, and cars that tell you where they are packed. The Internet and mobile devices have made these technologies possible. Most of the devices we use today support communication technology. Such devices include cell phones, sensors, smart grid, and laptops. The devices can interact among themselves through the Internet. Such a paradigm is called the "Internet of Things" (IoT) or "Internet of Object," where the devices are referred to as the things. It is the Internet of relating to things. The term, Internet of things, was first coined by Kevin Ashton, a British entrepreneur in 1999. He meant to represent the concept of computers and machines with sensors, which are connected to the Internet to report status and accept Sarhan M. Musa et al., Internet of things: an introduction 40 http://www.sretechjournal.org control commands. The goal of IoT is to integrate and automate everything from home appliances to plants on factory floors. Experts predict that the IoT will consist of about 50 billion objects by 2020. Analyst IDC reckons that the global IoT market will exceed $7 trillion by 2020 [1].

Traffic congestion caused by vehicle is an alarming problem at a global scale and it has been growing exponentially. Car parking problem is a major contributor and has been, still a major problem with increasing vehicle size in the luxurious segment and confined parking spaces in urban cities. Searching for a parking space is a routine (and often frustrating) activity for many people in cities around the world. This search burns about one million barrels of the world's oil every day. As the global population continues to urbanize, without a well-planned, convenience-driven retreat from the car these problems will worsen. 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 fuels saved by 2050 , if implemented successfully .

Smart Parking systems typically obtains information about available parking spaces in a particular geographic area and process is real-time to place vehicles at available positions .It involves using low-cost sensors, real-time data collection, and mobile-phone-enabled automated payment systems that allow people to reserve parking in advance or very accurately predict where they will likely find a spot. When deployed as a system, smart parking thus reduces car emissions in urban centers by reducing the need for people to needlessly circle city blocks searching for parking. It also permits cities to carefully manage their parking supply Smart parking helps one of the biggest problems on driving in urban areas; finding empty parking spaces and controlling illegal parking. This implies M2M technologies aims rightness/safety as well as convenience [5].

II. RELATED WORK

There have been various methodologies used to come out with a solution for challenging parking problem.

A. GPS based parking system

Finding Parking is a difficult task due to which people spend a certain amount of time in finding the parking space thus causing the traffic to slower down and leads to congestion due to lack of information available about the parking space. Different approaches have been followed to find parking such as wireless sensor and vision sensor. Using coordinates the location of the user could be known and also the parking system. By using the haversine

formula distance between these two can be calculated which will help the user to find the nearest available parking and it will save time and money too as no infrastructure is needed. Using Google API's navigation can also be provided which will lead the way to the parking slot. User can also release parking slot if does not want to access it [2]

B. ParkSense: A Smartphone Based Sensing System For On-Street Parking

Studies of automotive traffic have shown that on average 30% of traffic in congested urban areas is due to cruising drivers looking for parking. While we have witnessed a push towards sensing technologies to monitor real-time parkingavailability, instrumenting on-street parking throughout a city is a considerable investment.

In this paper, we present ParkSense, a smartphone based sensing system that detects if a driver has vacated a parking spot. ParkSense leverages the ubiquitous Wi-Fi beacons in urban areas for sensing un-parking events. It utilizes a robust Wi-Fi signature matching approach to detect driver's return to the parked vehicle. Moreover, it uses a novel approach based on the rate of change of Wi-Fi beacons to sense if the user has started driving. We show that the rate of change of the observed beacons is highly correlated with actual user speed and is a good indicator of whether a user is in a vehicle. Through empirical evaluation, we demonstrate that our approach has a significantly smaller energy footprint than traditional location sensors like GPS and Wi-Fi based positioning while still maintaining sufficient accuracy [18]

C. Automatic Smart Parking System using Internet of Things (IOT)

Internet of Things (IOT) plays a vital role in connecting the surrounding environmental things to the network and made easy to access those un-internet things from any remote location. It's inevitable for the people to update with the growing technology. And generally people are facing problems on parking vehicles in parking slots in a city. In this study we design a Smart Parking System (SPS) which enables the user to find the nearest parking area and gives availability of parking slots in that respective parking area. And it mainly focus on reducing the time in finding the parking lots and also it avoids the unnecessary travelling through filled parking lots in a

parking area. Thus it reduces the fuel consumption which in turn reduces carbon footprints in an atmosphere [8]

D. A Cloud-Based Car Parking Middleware for IoT-Based Smart Cities: Design and Implementation

This paper presents the generic concept of using cloud-based intelligent car parking services in smart cities as an important application of the Internet of Things (IoT) paradigm. This type of services will become an integral part of a generic IoT operational platform for smart cities due to its pure business-oriented features. A high-level view of the proposed middleware is outlined and the corresponding operational platform is illustrated. To demonstrate the provision of car parking services, based on the proposed middleware, a cloud-based intelligent car parking system for use within a university campus is described along with details of its design, implementation, and operation. A number of software solutions, including Kafka/Storm/Hbase clusters, OSGi web applications with distributed NoSQL, a rule engine, and mobile applications, are proposed to provide 'best' car parking service experience to mobile users, following the Always Best Connected and best Served (ABC&S) paradigm [10]

E. Design and Development of RFID Based Automated Car Parking System

In the light of the number of vehicles rising consistently and parking space is fast becoming a major issue in urban and semi urban cities so there is a need to design parallel parking.. It is essentially a stacked car park. Instead of car's parking on streets, a more modern and a fast operating parking-lot system have been developed. In this paper, a solution has been provided for the problems encountered in parking-lot management systems via RFID technology. The application of RFID technology in parking lots makes parking effective, convenient and safe. The RFID system is used to park the cars automatically in the multilevel parking area. The use of RFID tags, readers and antennas makes it easier to automate the 'in and out' privileges of parking subscribers. Personnel costs will be reduced considerably using this technology. It will be possible in the future to make unmanned, secure and atomized parking-lots functioning with RFID technology. Check-ins and checkouts will be handled in a faster manner without stopping the cars. By this the traffic jam problem will be avoided during parking. Drivers will not have to stop at the circulation points. The ticket jamming

problems for the ticket processing machines will be avoided as well [11]

F. Reservation Based Vehicle Parking System Using GSM and RFID Technology

This paper is to develop a Reservation based vehicle parking reservation system to overcome the problem of unnecessary time consumption in finding parking spot in commercial parking areas. In this proposed system, we reserve the parking slot in shopping malls, theatres and offices by using short message service (SMS). User reserves the slot by sending a message to GSM modem placed at the parking end. GSM modem gives slot number and a password if the slots are available which is used to allow or deny access to the parking area at the entrance and exit. IR sensor is used for the indication of empty slot with a green LED. User can park the vehicle at the given zone, and this is valid up to a certain grace period only after that the priority will be given to next user. RFID technology is used for entering and exiting parking area and also used to debit the amount for parking charges through RFID tag. The main contribution is the system has more security .Thus users can just reserve the parking slots using the SMS [12]

G. A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies

This paper introduces a novel algorithm that increases the efficiency of the current cloud-based smart-parking system and develops a network architecture based on the Internet-of-Things technology. This paper proposed a system that helps users automatically find a free parking space at the least cost based on new performance metrics to calculate the user parking cost by considering the distance and the 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 a request by the user and a solution of suggesting a new car park if the current car park is full. The simulation results show that the algorithm helps improve the probability of successful parking and minimizes the user waiting time. We also successfully implemented the proposed system in the real world [6]

H. IoT based smart parking system

In recent times the concept of smart cities have gained grate popularity. Thanks to the evolution of Internet of things the idea of smart city now seems to be

achievable. Consistent efforts are being made in the field of IoT in order to maximize the productivity and reliability of urban infrastructure. Problems such as, traffic congestion, limited car parking facilities and road safety are being addressed by IoT. In this paper, we present an IoT based cloud integrated smart parking system. The proposed Smart Parking system consists of an on-site deployment of an IoT module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly. The paper also describes a high-level view of the system architecture. Towards the end, the paper discusses the working of the system in form of a use case that proves the correctness of the proposed model [3]

III. CONCLUSION

Looking at the various methodologies implemented, every methodology has its own advantage over the other. Though lot of advancement has happened at the conceptual level, there is a requirement to bring this to the user level. Based on the literature review, we would like to take this to next step by integrating few of the technologies to provide an end to end solution to the customers. This end to end solution would involve parking availability information and navigation enablement from an android app to the users with QR based login and RFID recognition at parking units. This RFID reader is in turn connected with the server which maintains the database of vehicle coming in and coming out of the parking unit. Also with the in-time and out-time being recorded in the database, it could further be used to deduct parking fee from the e-wallet associated with the user. Thus, it would provide an automated end to end solution for the customers

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