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Low Cost Smart Parking System with IOT

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Abstract: ***In most of the metropolitan cities traffic congestion is increasing dramatically and thereby searching and finding a parking spot is difficult. Now the cities are changed into smart cities. The smart cities can be easily achievable with the advent of Internet of Things.***
An extensive research is on-going in the field of Internet of Things to increase the quality of services offered in cities and to improve the productivity and reliability of urban infrastructure. The most common problems faced in cities are availability of car parking and traffic jams.
This paper presents an Internet of Things based Parking system for Smart Cities. The proposed parking system contains an IoT module deployed on-site for managing the available parking spaces. A platform is provided in the form of portal for booking the parking spaces.
Keywords: Smart parking, Internet of Things, Raspberry pi 3, Ultra sonic sensor, Cloud Computing, GPS

I. INTRODUCTION

The number of vehicles on the road increasing day by day, in addition mismanagement of available parking slots has created some parking related problems and traffic jams in urban areas. As the rate of people owning their vehicles increases, the need of parking slots to park vehicles also increases.
The scenario is that there are not sufficient parking slots available or there is also possibility that people are not now aware about the legal parking slots available in their locality.
This situation leads to the unnecessary crowding of vehicles on the road and also results in inconvenience of people walking on the road. So it is essential to build a smart parking management system that not only helps to locate a suitable parking space but also reduce the fuel consumption.
Various features of smart parking system are on availability of parking space and reservation of parking lot, real-time parking navigation and route guidance, vehicle occupancy detection and management of parking lots. The proposed smart parking system is an Internet of Things based parking system wherein which drivers can identify vacant parking slots easily with the help of their Smart Phone or a Computer.
It also has the provision for online booking of a parking slot. The main idea behind this concept is minimizing the human intervention by computerized allocation of parking slots. The proposed system helps user to book their parking slots online, by monitoring the parking spaces on a real-time basis for their availability.

II. RELATED WORKS

E-parking helps the patrons to enquire the availability and/or reserve a parking space at their desired parking slot .The system can be accessed through SMS or Internet. Several existing system are available. [1] This paper is implemented using a mobile application that is connected to the cloud. The system helps a user to know the availability of parking spaces on a real time basis. Sensors like Infrared, Passive Infrared (PIR) and Ultrasonic Sensors are used. The ultrasonic sensors are wirelessly connected to raspberry pi using the ESP8266 chip which allows any microcontroller to access a Wi-Fi network. The IBM MQTT server is hosted on cloud and it acts as a database to store all the records related to parking areas and end users that have access to the system. The purpose of this mobile application is to provide information regarding availability of parking spaces and allowing the end user to book a slot accordingly. The problem with this paper is that three sensors are used for the same purpose and that we can reduce to one. [2] This paper contains computer vision and mobile application to provide smart services such as locating available parking slots in real time, detecting car plate number, and recording location of the parked car, calculating parking fee and allowing mobile payment for the fee. Driver use mobile application to find his/her parked location and the current parking fee. Ultrasonic sensor (HC-SR04) is used at each parking slots location to detect the vehicles within the range. The Raspberry Pi will forward detection to cloud, which is updated status available/unavailable. Camera is also used at each parking slots, and aware after occurred detection of sensor. The vehicle is captured by the camera in the parking slot. The disadvantage of the paper is that the prototype is built for single storage parking slot. Model can be extended for multi storage parking space.

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III. PROPOSED SYSTEM

The proposed system needs a camera, ultrasonic sensor, and raspberry pi 3. Ultrasonic sensor is used for detecting the object. The camera opens only when the ultrasonic sensor detects an object. The captured image will sent to the Raspberry pi. The Raspberry pi receives the image from the camera which is placed in the parking space. As per the image extraction process, the Raspberry pi will send it to the Google Cloud vision API. After ensuring the successful operation of extraction, it sends the data to the Parking center Server which is hosted on cloud and hence updates the database. The system supports multi-Edge-Fog which minimizes traffic congestion by displaying free vacant spaces to users as much as possible. The architecture is shown in Figure 1.

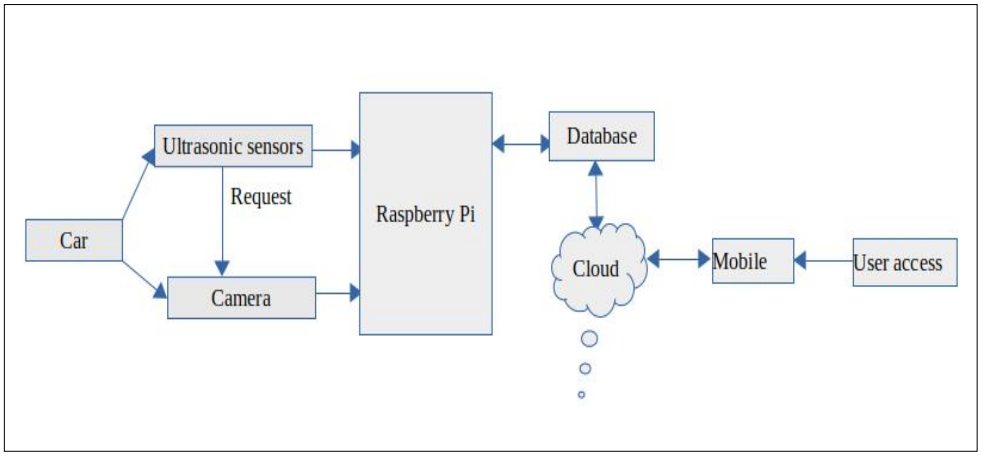

Figure 1: The architecture of the proposed system

In most of the cities, it is difficult to get a parking slot. People took 10 to 15 minutes for finding a vacant slot. A proper mechanism to identify parking slot can save a lot of useful time. This problem can be solved if the drivers could find the availability of parking spaces in and around their intended destination in advance. Therefore the proposed system provides an interface for the user to book a slot online. In the proposed system, the website displays the number of free slots and the user is prompted to select a slot. If the slots are free then it appears in green colour else in red colour. The user can book the available slots using graphical interface. User has to give some personnel details and the time that he/she wants to book the slot. The information are then stored in database. No-one allowed booking a particular slot for the time that is already booked. If the person has not arrived on booked time, then after one hour from booked time the reservation get automatically cancelled. After successful booking an id is generated and sends to the mobile. Figure 2 shows the data flow diagram of online booking.

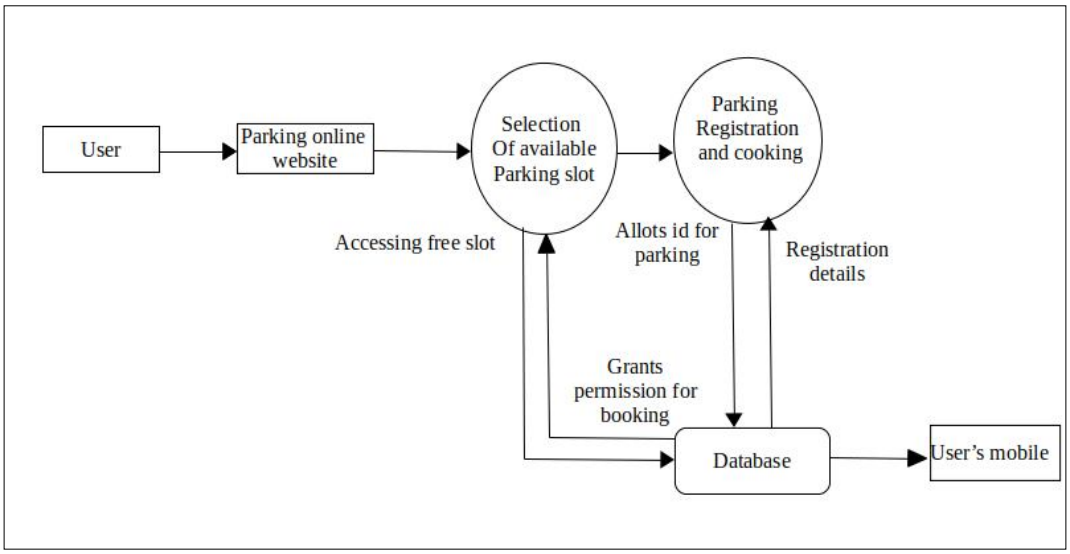

Figure 2: The Data Flow Diagram of Online booking

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IV. HARDWARE REQUIREMENTS

1) *Ultrasonic sensor HC-SR04:* HC-SR04 is most popular and low cost sensor. It has four pins- Trigger, Echo, VCC and GND. The TRIG pin of HC-SR04, which sends eight 40 kHz ultrasonic waves and starts listening for echo. Once the echo received the distance based on the time spent waiting for the wave to come back calculated. The specifications of Ultrasonic Sensor (HC-SR04) are shown in Table 1. Thus, it shows HC-SR04 sensor is accurate and profitable for implementing smart parking system. The sensor works with the simple formula that Distance = Speed * Time.

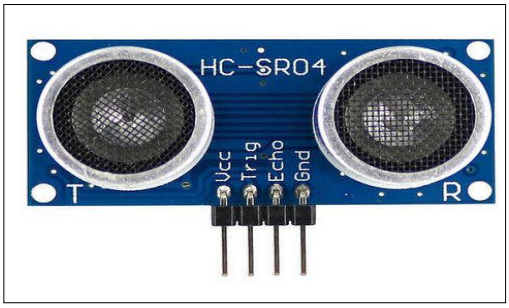

Figure 3: Ultrasonic Sensor

TABLE I
Specifications of ultrasonic sensor

Parameter	Ultrasonic Sensor
Range	2cm -10m
Beam-width	30 deg
Beam Pattern	Conical
Frequency	40 KHz
Unit Cost	135 R

2) *Raspberry Pi 3*: Raspberry Pi3 is a Debit card sized single-board computer with an operating system Raspbian installed. The specifications of Raspberry Pi3 are given in Table 2. The Raspberry collects the number of parking slots from sensors and processes the data and updates the database with a total number of vacant slots. The Raspberry Pi with a quad-core ARM Cortex-A53 processor is described as having ten times the performance of a Raspberry Pi 1. This was suggested to be highly dependent upon task threading and instruction set use. Most Raspberry Pi systems-on-chip could be overclocked to 800 MHz, and some to 1000 MHz .There are reports the Raspberry Pi 2 can be similarly overclocked, in extreme cases, even to 1500 MHz (discarding all safety features and over-voltage limitations). In the Raspbian Linux distro the overclocking options on boot can be done by a software command running “sudo raspi-config” without voiding the warranty. In those cases the Pi automatically shuts the overclocking down if the chip temperature reaches 85 C (185 F), but is possible to override automatic over-voltage and overclocking settings (voiding the warranty); an appropriately sized heat sink is needed to protect the chip from serious overheating.

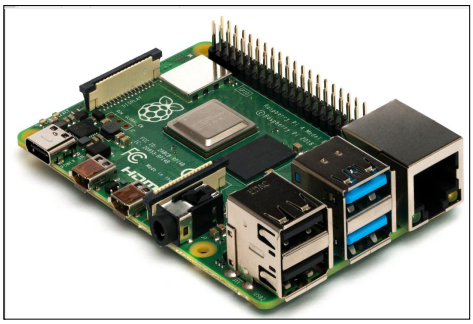

Figure 4: Raspberry Pi 3

TABLE II
Specifications of raspberry pi 3

Features	Raspberry Pi 3
CPU	1.2GHz 64-bit quad-core ARMv86
RAM	1 GB
USB Ports	4
GPIO Pins	40
Other features	Bluetooth 4.1, Bluetooth Low Energy (BLE), 802.11n WirelessLAN, Full HDMI port, Ethernet port, Combined 3.5mm audio jack and composite video, Camera interface (CSI), Display interface (DSI), Micro SD card slot, Video Core IV 3D graphics core

3) *GPS Module:* The shortest distance from the current location can be determined by GPS. Availability of parking spaces can be estimated using previous occupancy information that once searched in and navigational directions to the parking slot are given based on that information. If the signal is blocked due to tall towers or walls within a building or under the ground, a GPS may give wrong results and may leads to wrong directions. Therefore, in closed indoor parking lot, the chances of errors occurring are more in navigational directions using GPS. But there is less chance for signal blocking in outdoor parking slots. So the usage of GPS is more suited for outdoor open parking lots. In addition, availability of satellite has to be considering for the accuracy of the GPS signal.

4) *Camera Module:* Is used to capture images of vehicles entering the parking lane.

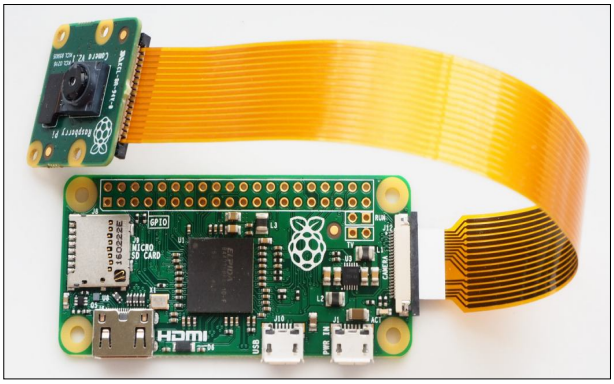

Figure 5: Raspberry Pi camera

V. SOFTWARE REQUIREMENTS

A. *Raspbian OS*

Raspbian is the recommended operating system for normal use on a Raspberry Pi. Raspbian is a free operating system based on Debian, optimized for the Raspberry Pi hardware. Raspbian comes with over 35,000 packages: precompiled software bundled in a nice format for easy installation on your Raspberry Pi. Raspbian is a community project under active development, with an emphasis on improving the stability and performance of as many Debian packages as possible.

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VI. SYSTEM IMPLEMENTATION

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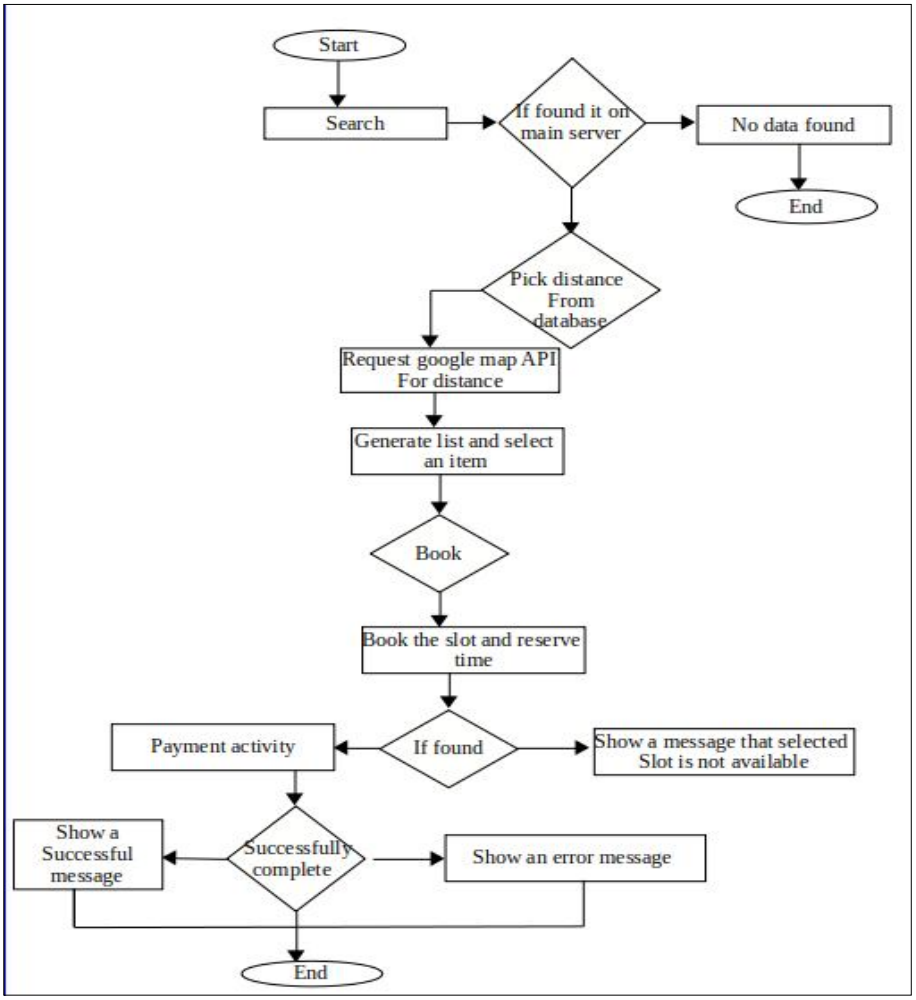

Figure 6: Flowchart of the proposed system

VII. CONCLUSION

The system uses the ultrasonic sensors and cameras that help to recognize the parking spaces and improper parking. The proposed architecture for a parking detection system would decrease the searching time for empty spaces as all the data of the parking center going to be stored in the main server. The system helps the user to find out the parking slots, giving the priority to chase user desired parking location. The proposed system considered as full automation, high energy efficiency, and cost-effectiveness. The system can decrease traffic jam as well as human effort. Furthermore, it will reduce the unnecessary traveling as the status of the parking slots will be kept by the system.

VIII. ACKNOWLEDGMENT

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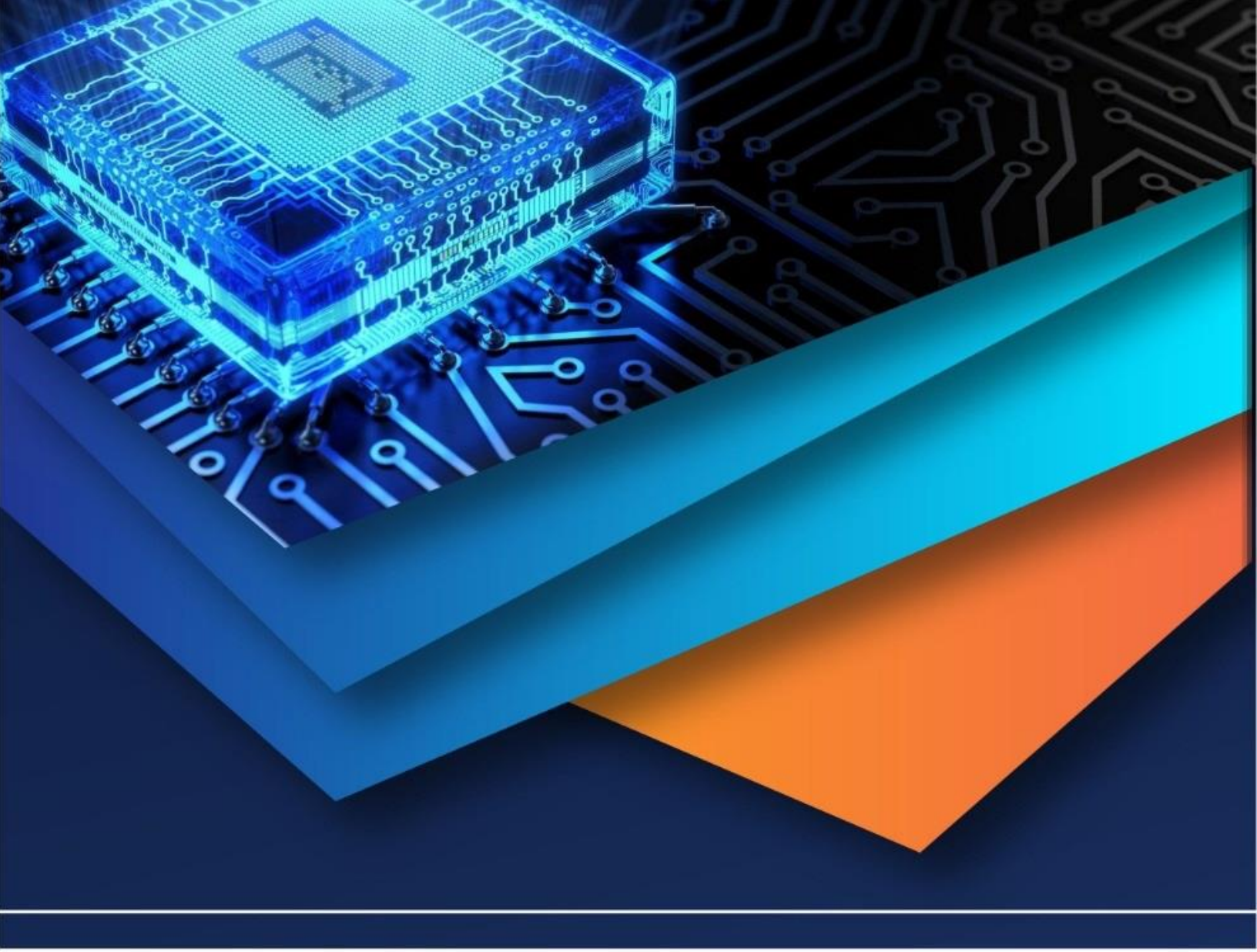

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