Smart Parking System Using Internet of Things: A Step towards Building Smart Cities

Soumyadeep Ghosh[1], Mantsiz Zinath[2], Surajit Basak[3]

***Abstract*--Urbanization is constantly amplifying and traffic in metropolises is getting massive every day. The population growth isn't alone a pressing issue for the administration but a tangible day-to-day fact for uttermost nationals. Road traffic is the biggest difficulty that is being confronted as the number of automobiles in urban metropolises increases. Finding parking space in big metropolises is a constant challenge for motorists. Normally, the customer invests lot of time and effort looking for available vacant space in a designated parking zone. In this paper, we approached a solution to this challenge of finding vacant spaces in parking spaces. We present an automated parking system where the available space in the parking one is to be notified to the user through the mobile application which reduces the searching time. Radio Frequency Identification technologies are being applied to avoid motor vehicle thievery. Accordingly, parking issues and traffic slowdown can be worked out by utilizing smart parking using IoT technology.**

***Index Term*–Automated parking; internet of things; mobile application; radio frequency identification**

I.INTRODUCTION

Humanity has always had a desire of creating "Smart Cities". In recent years, significant work has been made towards implementing Smart cities a reality [2]. Automated parking garages and systems for traffic management have long been critical components of smart city development. [1-2].

The enlargement of web of things. Newer opportunities for Smart Cities have emerged thanks to the Internet of Things and cloud computing.

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The sensors used in IoT-based smart parking systems store and retrieve data from remote places with the help of the cloud, giving rise to the cloud of things (COT) [3].

Thenodes we tend to monitor and control from any location. It is employed to extend the potency of a cloud-based parking system and it is a low-cost parking system than other parking system already available in market. All through this paper, we will handle the parking issue using an IoT-based largely cloud-integrated smart parking system, as depicted in Figure 1. Users in remote locations can book a parking space using our smartphone application. The efforts made throughout this work are designed to fortify a town's parking facilities, consequently improving the quality of service to improve the level of living of its residents. [4-5].

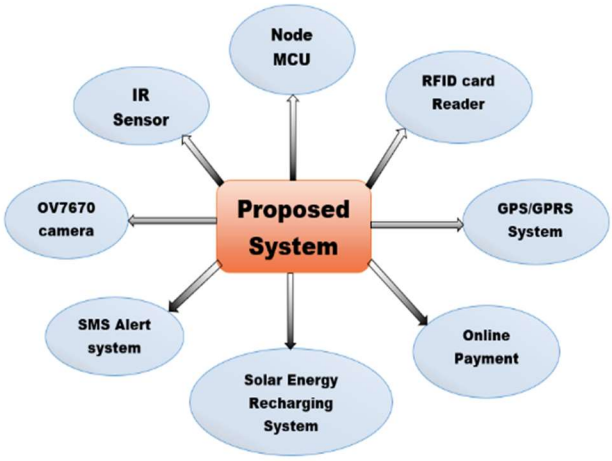

Fig1: Sample diagram of the proposed system

II. WORKING PRINCIPLE

A. Input part

For our parking system, shown in figure 2, we have used sensors like an Infrared ray sensor. The functions of these sensors include monitoring the parking space and identifying whether or not a parking place is available. Here, we are detecting the presence of a car using infra-red (IR) sensors. The IR sensors are connected to the ESP8266 chip. A NodeMCU module comprises of Wi-Fi network and

micro-controller using a battery pack or an external power source, the sensors are connected to a 5V supply, which is connected with a solar panel for a self-recharging system. The external source being more preferable compared to solar panel.

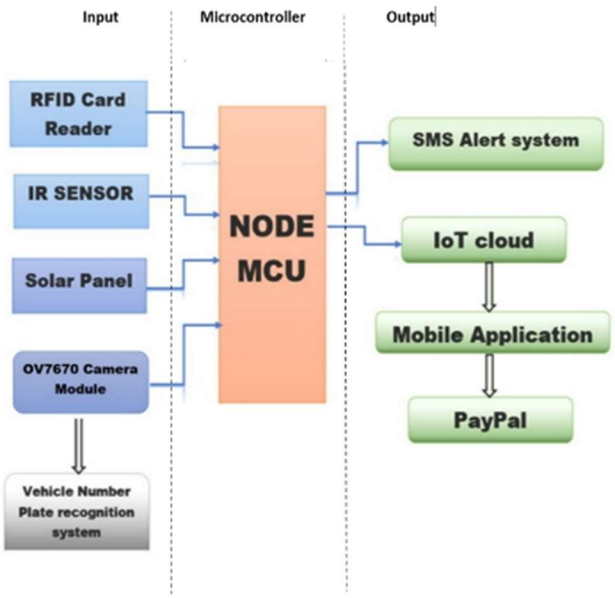

Fig 2: Working Principle of the Smart Parking System

B. *Output part*

1. *Mobile application*

The mobile application acts as a user interface via which users interact with the system. The Angular JS Framework and JavaScript are used to create the application [5]. This framework is used to ensure that the programme runs properly on both the Android and iOS platforms. The application is connected with Amazon SQS. This mobile application's goal is to give users information about parking area availability and to let them reserve that space accordingly.

2. *The cloud*

The Amazon SQS server runs in the cloud. This cloud serves as a repository for all parking-related records, allowing users to use the system. It maintains track of each client who is connected to the system and records details such as the time the vehicle was parked, the time span for parking a car, the compensation given by the customer, the balance on the card, the new registration system, and the mode of payment. Continuous backup is always created of the information in the cloud as no user should face any problem while any failure in the system.

3. *Circuit diagram*

The circuit diagram of this smart parking system is depicted in figure 3 which consists of IR sensor, RFID Module, NODEMCU-ESP8266, GPS Sensor, OV7076 camera, servo motor, solar panel and battery.

4. *Components required*

The proposed system will be designed and implemented based on several new technology modules that are efficient and inexpensive. The modules and sensors used in the implemented system are:

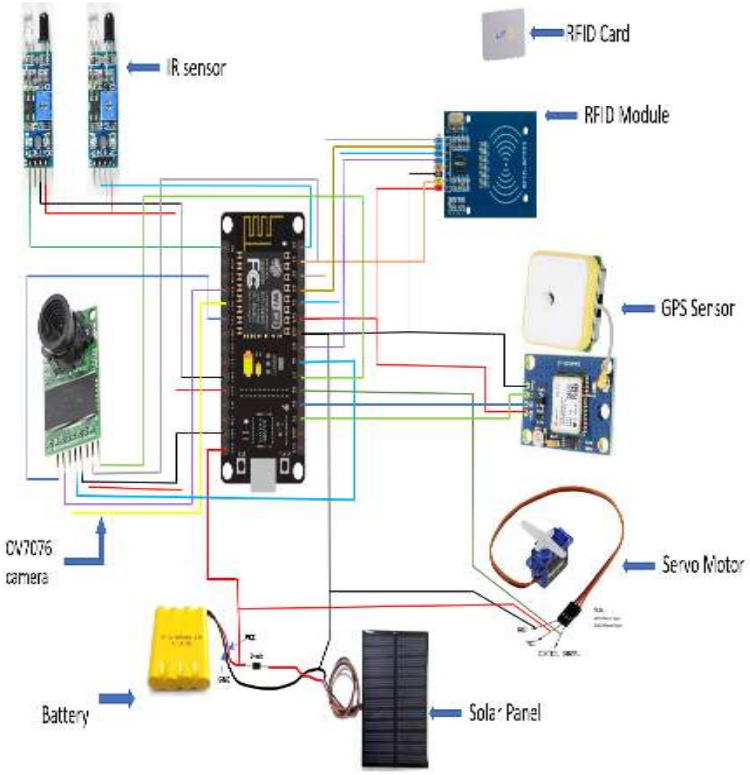

Fig3: Circuit diagram of smart parking system

The modules and sensors used in the implemented system are:

The Hardware components include:

1. QTR sensor, 2. Radio Frequency Identification (RFID), 3. GPRS/GPS, 4. NodeMCU, 5. OV7670 camera module, 6. Solar panel and 7. Servo motor

And the Software parts include:

IoT Cloud severs, Blynk IoT platform and Online payment.

III. FEATURES OF SENSOR USED IN SYSTEM

A. *QTR sensor*

QTR-8RC is a reflectance sensor array however meant as a line sensor, referred to in figure 4. It can be used as a general-cause proximity IR or reflectance sensor. The tool

got here up with 5 or 8 pairs of IR LEDs. This IR array is cost effective and can perform functions of 5-8 different IR sensors alone.

Algorithm:

I. Start operating
II. Checks any car is present in any of the parking slots.
III. If any car detected then availability number decrease and the particular parking slot colour changes from green to red in the mobile application.
IV. If no car is detected then the colour remains green in the mobile application.

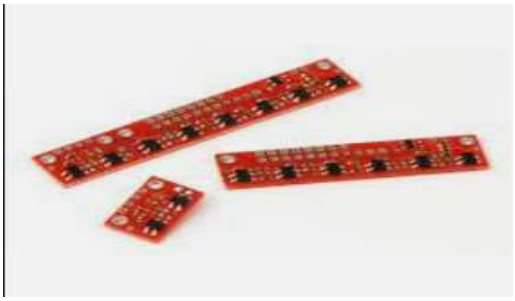

Fig 4: QTR Sensor

B. RFID

Figure 5 shows a module that detects and collects data from an RFID card. This mapping can be utilized to keep track of items. When a car enters the parking lot, the driver scans the RFID card, and the entire information on the card is transferred to administration via this module.

Fig 5:RFID card and RFID Module

Algorithm:

I. Starts operating
II. Permits the driver after showing the RFID card to RFID card reader module
III. If it detects that the driver is already a user, then it cut the parking charge and give permission to enter the parking area
IV. If it detects that the driver is a new user, then it first needs to register them and then gives them to enter the parking area.

C. GPS

It is used to establish communication between a mobile device and computing machine and a GSM or GPRS system, given in figure 6. As like cell phones, a SIM (Subscriber Identity Module) card is required to enable communication with the network.

Algorithm:

I. Start operating
II. Search nearby parking area around the user
III. Book nearby parking area slot

Fig 6: GPS module

D. NodeMCU

NodeMCU offers a variety of development environments including support for the Arduino IDE. It includes firmware running on Express if Systems' ESP8266 Wi-Fi SoC and hardware based on ESP-12 module, so the Arduino IDE can also be used to programme it. and act as a Wi-Fi access point or a can connect to one in figure 7.

Fig 7: NodeMCU

E. OV7670 camera module

This is a camera module shown in figure 8,which allows you to get the vehicles registration number plate to maintain a record of the vehicles parked at the parking slots.

Algorithm:

I. Start operating
II. Capture images of the vehicle number plate
III. Detects vehicle number plate using OCR algorithm

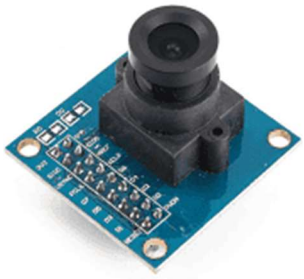

Fig8:OV7670 camera module

F. Solar Panel

Figure 9 depicts a solar panel, which is a collection of solar (or photovoltaic) cells that may be used to generate power via the photovoltaic effect. These cells are organised in a grid-like arrangement on the surface of solar panels.

Algorithm:

I. Start operating

II. Recharge the system when needed

Fig9: solar panel

G. Servo Motor

It is a revolving device that allows for the control of both angular and linear motion given in figure 10. A servo motor is being employed in this project as a gate operator to open and close the gate.

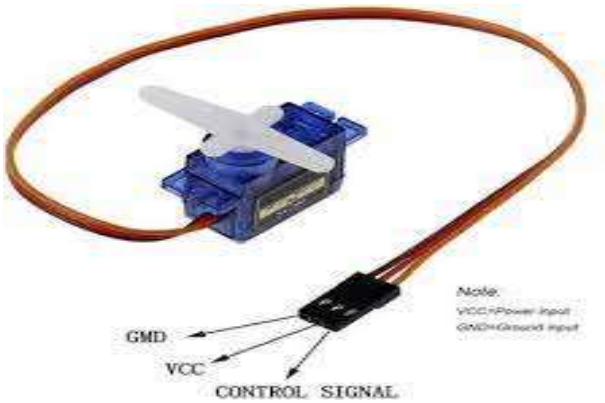

Fig 10: SERVO motor

IV. METHODOLOGY

A. Vehicle number plate recognition

A detailed diagrammatic view is given in figure 11 where we have implemented the vehicle number recognition using Optical Character Recognition (OCR) also called Text-recognition is a program which extracts and identify data from images. Videos, and scanned documents. The basic of OCR contains identification of the text in any type of scanned documents or digital images and video and translate of those characters into code. OCR system have the parts of both hardware components like OVC7670 for scanning vehicle number plate and software which is used to convert the physical documents into machine readable documents.

B. Online Booking System

Our proposed system provides an interface for the user to book a slot online is fully diagrammatic in figure 12. The system displays how many free slots are available, and the user can choose any of them. The user can book the available slots using the graphical interface. User can also book the parking slots from anywhere and for anytime. The user has to give some personnel details and the time that he/she wants to book the slot. The information is then stored in the database. If the individual does not come at the scheduled time, the reservation is automatically cancelled after one hour from the scheduled time. After successful booking, an id is generated and sent to the mobile.

Additionally, it will alert the user if the balance decreases. Any new users who arrived to use the parking space must first register before they are allowed to access the parking area. If any registered user came then they need to show their RFID card then it automatically cut the parking charge and allows the user to enter the parking area.

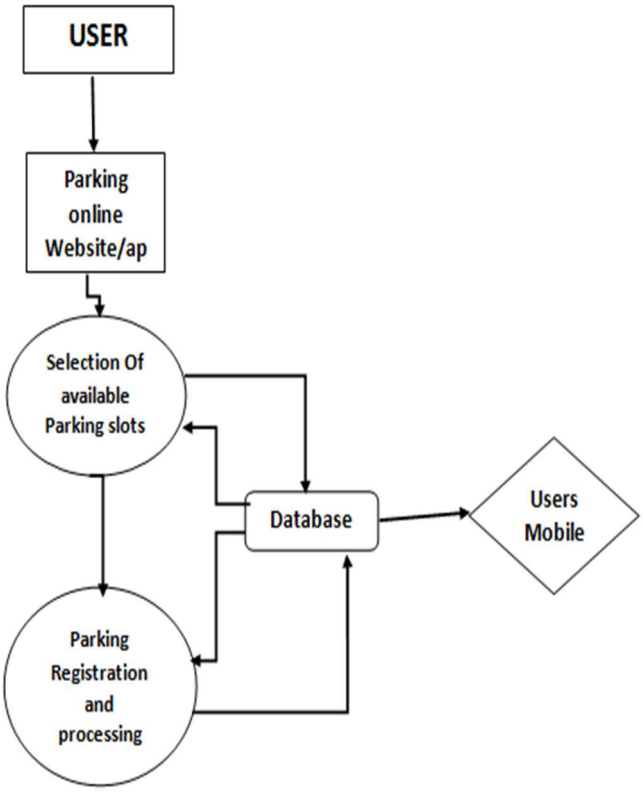

Fig 12: Work-flow of online booking system

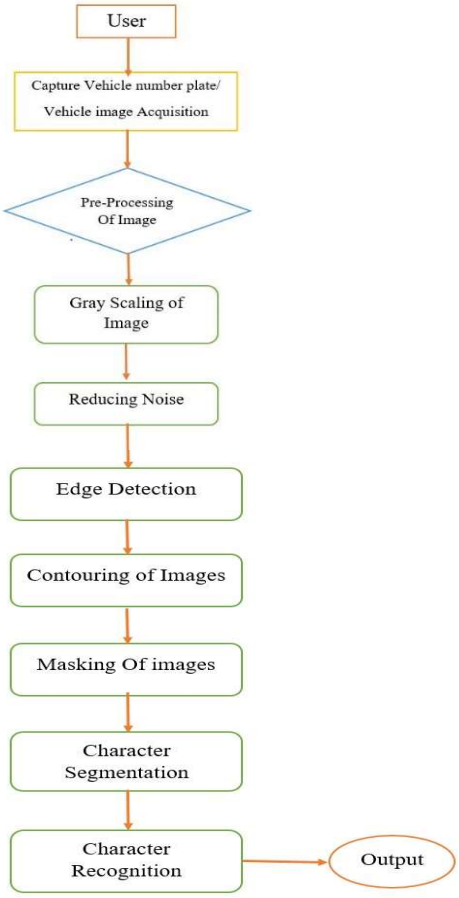

Fig 11: Work-flow of vehicle number plate recognition

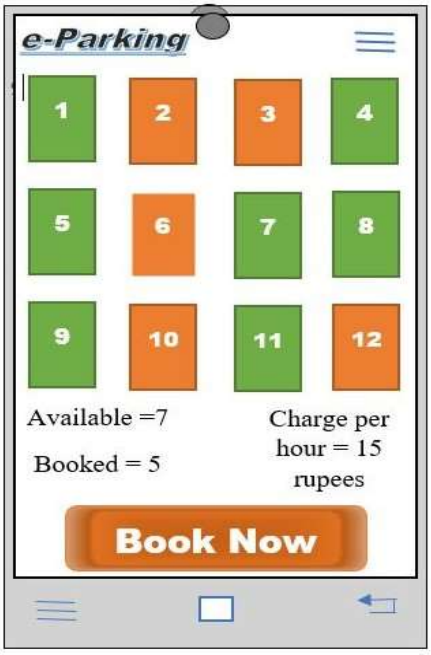

Fig 13: Schematic diagram of parking system and online booking system

C. Parking availability

When the IR-sensors detects no vehicle is present in that particular parking slot then it makes the green in the mobile application which means that the parking slots is available to park the vehicle. If the mobile application is red, it means that particular parking slot is already booked. It also shows the number of available parking slot available in that parking area. A preview of the proposed system is represented in figure 13.

V. COMPARISION WORK

Already many smart parking systems are available in markets which are giving few features at high price. Our proposed system offers some additional features with affordable price so that in every parking area can use this system.

Table 1: Comparison of [6] with proposed system

Features	Our proposed system	IoT based smart parking system [6]
Auto-Rechargeable system	✓	×
Online Booking	✓	✓
Cloud usage	✓	✓
Mobile app	✓	✓
Vehicle number plate recognition system	✓	×
Map assistant	✓	×
Cheaper system	✓	×

VI. CONCLUSION AND FUTURE SCOPE

The development of cloud and Internet of Things technology has opened up new possibilities for smart cities. Building smart cities has traditionally been centred on having smart parking facilities. By reducing user time spent looking for a suitable parking space, this study enhances performance. Contribute to addressing the growing issue of traffic congestion. This system is implemented using a low-cost infrared sensor, an OV7670 camera, a NodeMCU microcontroller, an “eParking” mobile app, and a IoT cloud server. Through a smart phone application, users can reserve a parking place using the system's real-time information about space availability.Users can also pay for their parking online via PayPal without having to queue at a counter or ticket machine. In addition to reducing traffic congestion, the planned work offers quick payment, intelligent user management, and no additional equipment. In thefuture, users can use the other popular options to make payments instead of PayPal.

iv. REFERENCE

1. Abhirup Khanna, R. A. (2016). “IoT based Smart Parking System. International Conference on Internet of Things and Applications”(IOTA) (p. 5). Pune: IEEE.
2. ElakyaR, Juhi Seth, Pola Ashritha, R Namith, “Smart Parking System using IoT” (IJEAT) ISSN: 2249-8958 (Online), Volume-9 Issue-1, October, 2019
3. Serge Koba, IoT Based Smart Parking System Development,2019
4. Mohd Mustari Syafiq Ismail,“IoT Based Smart Parking System” et al 2019 J. Phys.: Conf. Ser. 1424 012021
5. Sahil Rupani, Nishant Doshi,“A Review of Smart Parking Using Internet of Things (IoT)”https://doi.org/10.1016/j.procs.2019.11.023, Procedia Computer Science, volume 160,2019, page 706-711
6. https://www.projectsof8051.com/iot-based-car-parking-system/amp

V. BIOGRAPHIES

Soumyadeep Ghosh born in Janai, West Bengal, India on April 02, 2002. Pursuing Bachelor of Technology degree on Electronics and Communication engineering from Guru Nanak Institute of Technology, West Bengal, India.

He recently a student of 3rd year, previously he published his paper in Prepare@4u, CCMNT-2022, and ICESD-2021 conference. He worked on nanotechnology, VLSI, robotics and artificial intelligence.

Mr. Ghosh received best paper presentation and best paper award in AICTE sponsored CCNMT-2022 conference. He also received a special award for being the department topper in college.

Mantsiz Zinath born in Canin, West Bengal, India on April 15, 2003. Pursuing Bachelor of Technology degree on Electronics and Communication engineering from Guru Nanak Institute of Technology, West Bengal, India. He recently a student of 3rd year, previously he published his paper in Prepare@4u and CCMNT-2022conference. Mr. Zinath received best paper award in AICTE sponsored CCNMT-2022 conference.

Surajit Basak completed his B. Tech degree in Electronics & Communication Engineering from West Bengal University of Technology, West Bengal, India in 2005. He received his M. Tech. degree from Applied Physics department of Calcutta University, India in 2009 and obtained the Ph.D. degree in engineering (Electronics & Tele. Comm.) from Indian Institute of Engineering Science and Technology (IIEST), Shibpur, Howrah, India in 2019.

Mr. Basak is an Associate Professor in the department of Electronics and Communication Engineering, Guru Nanak Institute of Technology, Kolkata, India. His current research interest is in joint routing and spectrum sharing techniques in multihop wireless networks, physical layer security and IoT in smart cities.