# Automatic Car Parking System using Internet of Things and Cloud Technologies

Dr.Rajasekaran T
*Department of Computer Science and Engineering*
*KPR Institute of Engineering and Technology*
Coimbatore, India
rajasekaran30@gmail.com

Suresh Natarajan
*Department of Computer Science and Engineering*
*KPR Institute of Engineering and Technology*
Coimbatore,India
20cs175@kpriet.ac.in

Vasanth Balasubramaniam
*Department of Computer Science and Engineering*
*KPR Institute of Engineering and Technology*
Coimbatore,India
20cs183@kpriet.ac.in

Sowndhar Palanisamy
*Department of Computer Science and Engineering*
*KPR Institute of Engineering and Technology*
Coimbatore,India
20cs163@kpriet.ac.in

**Abstract—The need for effective and sustainable transportation networks grows as the population of cities continues to rise. The management of parking spaces is one of the biggest problems metropolitan areas confront, and it frequently causes traffic jams, pollution in the environment, and annoyance among residents. In this paper, describes an IoT-based cloud-integrated smart parking system in this research. The IoT module for the proposed smart parking system is deployed on-site and is used to track and indicate the availability of each individual parking space. Additionally, a mobile application is offered, enabling users to check for parking availability and reserve a spot in accordance with that availability. The system attempts to solve a number of significant problems with conventional parking management, including the deficiency of real-time data, ineffective spot distribution**

***Keywords— Internet of Things, smart sensors, cloud computing, web application)***

## I. INTRODUCTION

The number of cars on the road worldwide has increased, which is a reflection of the world's rapid industrial growth. It is projected that by 2035, there will be over 1.6 billion cars worldwide, a substantial increase from the 841 million cars that existed in 2008. These days, there aren't enough parking spots in many public sites including stadiums, marketplaces, hospitals, retail centers, and airports; as a result, governments are trying to upgrade their current infrastructure and transportation systems [1]. Paper documentation is used to oversee a manual parking system. where it is quite challenging to filter a big quantity of records. Workers at such parking lots have to spend a lot of time in locating a file containing precise car information and disseminating the income or other document reports. It takes time to enter data in the paper. In an iterative manual labor, needless expenditure of funds on manual parking [2]. To avoid manual parking the smart car parking system is implemented. The Internet of Things (IoT) is a network of physical objects, including gadgets, vehicles, buildings, and other items, that are implanted with electronics, software, ultrasonic sensors, and network connectivity to enable communication and data collection. The Internet of Things expands into a more diverse category of cyber-physical system with the addition of sensors and actuators. This category also covers smart grids, smart homes, intelligent transportation, and smart cities. Through the use of existing network infrastructure, things may now be detected and controlled remotely. This improves efficiency, accuracy, and financial gain while creating prospects for a more direct integration of the physical world into computer-based systems. Every object has an integrated computer system that allows it to be uniquely identified, but it may also work together within the existing internet infrastructure [3].

Vehicle-related traffic congestion is a worrying issue that has been becoming worse on a global basis. Constrained parking places in urban areas and the growing size of luxury vehicles are important contributors to the problem of car parking, which persists to this day. In cities all across the world, finding a parking spot is a common pastime for many people. A smart auto parking system usually gathers data on parking spots that are available in a specific area and uses real-time processing to position cars in those spaces. It entails the use of inexpensive sensors, real-time data gathering, and an automated payment system that accepts reservations via a mobile phone. When used as a system, smart parking lowers automobile emissions in cities.

In this work smart car parking system is proposed which implements the internet of things to facilitate the real time availability of parking spaces. To pre book the parking slot, the ultrasonic sensor is used to detect the availability of the parking space. If the slot is empty, user request & get an otp through the web application and book the parking slot. For that, Node MCU is used to operate the devices of the hardware system.

The outline of this paper is, Section II is based on the related works of the smart car parking system. Section III contains methodology and design of the system. Section IV shows the experimental results of the proposed system. Section V is the conclusion. Section VI is the references for this paper.

## II. RELATED WORKS

Lomat Haider Chowdhury [4] employs each vehicle's radio frequency identification (RFID) card to store the entrance information. The client will see the fare for the parking space he used, as time is automatically calculated from the entering time to the exit time. They have created a system that consists of both software and hardware parts and has an easy-to-use interface for staff members who are responsible for system maintenance. Using the software component, the system also generates other reports, such as revenue and usage reports, straight from the database.
Wael Alsafery [1] suggests a smart vehicle parking system that would help users find parking spaces and give them information on

traffic congestion on the roadways. This system uses data fusion and filtering techniques to decrease the volume of information sent across the network while collecting raw data locally and extracting features. Subsequently, machine learning algorithms are used to process and evaluate the converted data on the cloud. Denis Ashok [2] combines cutting-edge Honeywell sensors and controllers with Internet of Things technology to create a methodical parking system for customers. There is no longer any need for users to look for a parking spot because unoccupied car parking places are marked with lighting and directed there. The central system can virtually store the occupied parking spaces on the cloud, directing approaching cars to available spaces. Because the entire system is automated, less labor is needed, and the parking area's illumination and attractiveness are enhanced. Monika Dixit [5] suggests utilizing parts like an LCD, IR sensors, a servo motor, an Arduino Atmega328p microprocessor, and other parts to create a basic smart car parking system. Parking is given in shopping centers, malls, and other locations with the assistance of a person, which takes a lot of time. The primary purpose of the servomotor is to open and close entrance and exit barriers, allowing or prohibiting cars to enter and exit indoor places based on information gathered from infrared sensors installed on parking spaces, entry gates, and exit gates.

Swatha M, Pooja K [6] creates a smartphone and RTOS (Real Time Operating System) to create a drive-less vehicle. Setting up a flexible AGV's (automated guided vehicle) guidance system is the driving force behind it. With a 100-meter Bluetooth range between the car and the smartphone, GPS is also utilized to determine the location, and it aids in parking the vehicle. "Car Assist" technology uses GPS to track the path taken by the vehicle and displays events around it on a smartphone. Archana S [7] [features the framework to understand the dazzling Light-Emitting Diodes and operating boundaries for a range of applications. The incorporation of Node MCU, an open source IoT platform, in the suggested system offers it a crucial role to play in data transmission. Upon reading a car tag with the RFID scanner, the Node MCU notifies the Arduino controller of the available slots. Yash Agarwal [8] proposes the problem's Internet of Things (IoT) solution that makes use of an Arduino, IR sensors, RFID, and a mobile app as essential components. With the help of the solution, users can easily locate nearby parking lots and verify the current availability of each parking lot. They can also reserve their chosen parking spot via the app. After arriving at parking slot, they can then authenticate with an RFID tag. The linked-in app wallet is used to process the payment. Sara Nayak [9] leverages their smart car parking system's wireless sensor networks. Their method uses inexpensive sensor nodes in each parking lot slot to indicate whether the slot is available. Blink is a mobile application that shows the availability status, allowing users to efficiently park their cars. By not having to look for free parking spaces, the user can save a lot of time and significantly cut down on fuel consumption. makes use of ultrasonic sensors to confirm that the car has been parked correctly in relation to the parking infrastructure.

Praveen M [10] has built infrastructure for NB-IoT. The 3GPP standard helped to design NB-IoT. Parking problems can actually be reduced by utilizing a variety of contemporary approaches, such as GPS-based, wireless sensor-based, artificial intelligence, virtual reality, and vehicle connectivity based on an Arduino or Raspberry Pi board. However, low cost, large area coverage, low power consumption, and strong connectivity are the goals of smart auto parking. And NB-IoT is the source of all these features. Rachapol Lookmuang[11] utilizing computer vision to identify license plate numbers in order to keep an eye on the cars in the parking lot and improve security. It can also assist in designing the mobile payment system to cut down on wait times and eliminate traffic jams at the parking lot's entrance/exit gates.

## III. METHODOLOGY

### System Design

SMPS

The transformation of one type of electrical energy into another is the main purpose of a power supply.

MICROCONTROLLER

Using one of the four ports, the microcontroller is utilized to control the serial operation based on the program that is present in the output.

SERVO

An electrical device that can precisely push or spin an item is called a servo motor. The object is rotated at a precise angle using servo motors. It consists only of a basic motor driven by a servo mechanism.

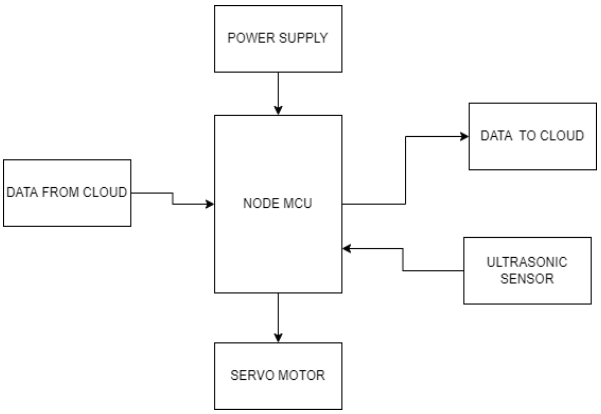


Figure .1 Operations of Node MCU

Hardware Used

NODE

One of the development boards designed by Node MCU to assess the ESP-WROOM-32 module is the ESP-32S. Its foundation is the ESP32 microprocessor, which combines low power consumption, Bluetooth, Wi-Fi, and Ethernet functionality into a single chip.

Figure .2 Node MCU ESP -32

FLASH LAYOUT

The ESP32 module's internal flash is arranged into a single flash region with 4096-byte pages. Several sections are set aside for Esp32, however the flash begins at address 0x00000.

PERIPHERALS AND I/O

There are 17 GPIO pins in total on the ESP8266 Node MCU, which are separated out to pin headers on either side of the development board. A 10-bit ADC channel is one of the many peripheral functions that may be assigned to these ports. Serial code loading is done using the UART interface.

PWM outputs: PWM pins used to operate motors or dim LEDs.

SPI, I2C, and I2S interface: You can connect a variety of sensors and peripherals using the SPI and I2C interface. Interface I2S - Interface I2S

ULTRA SONIC SENSOR
Sound waves move through many media, which can be solid, liquid, or gaseous. Depending on the propagation medium, sound waves have varying velocities across it. High-frequency sound waves bounce off of objects and create characteristic echoes in patterns.

PHYSICS LAWS FOR SOUND WAVES
Certain frequencies or numbers of oscillations per second are present in sound waves. The frequency range that humans can hear sounds in is roughly 20 Hz to 20 KHz. However, 100 KHz to 50 MHz is the typical frequency range used in ultrasonic detection. In a medium, ultrasonic velocity is constant at a given temperature and time.

OPERATION OF ULTRASONIC SENSORS
The ultrasonic transducer vibrates throughout a certain frequency spectrum and produces a burst of sound waves when a high voltage electrical pulse is delivered to it. The waves of sound return in the form of an electric pulse and cause an echo if an obstruction gets in the way of the ultrasonic sensor. It computes the amount of time that passes between generating sound waves and getting an echo. To ascertain the status of the detected signal, we'll compare the sound wave patterns with the echo.

APPLICATIONS INVOLVING ULTRASONIC DETECTION:
The time it takes to receive an echo and the sound waves' velocities in a medium are related to distance of obstacles or discontinuities in metals. Therefore, the liquid level can be shown, discontinuities in metals can be found, and particle lengths can be found using ultrasonic detection.

ASPECTS
20mA of power usage
Communication pulse in/out Narrow acceptance angle
gives precise, non-contact separation estimates between 2 and 3 meters.
The explosion point LED displays predictions ahead of time.
It is easy to connect using a servo development connection thanks to the 3-pin header.
Details:
Energy source: DC 5 volts
Current at idle: less than 15mA
Angle of effect: <15°
Distance range: 2 cm to 350 cm
Focus: 0.3 centimeters
Cycle of output: 50 ms

MECHANISM OF SERVO MOTOR
A servo motor is a type of rotary actuator that enables exact control over acceleration, velocity, and angular position. In essence, it is capable of certain things that a standard motor is not. As a result, it uses a standard motor and connects it to a position feedback sensor. A servo motor's angle of rotation is determined by the length of the pulse that is applied to its control pin. This is known as the PWM (Pulse Width Modulation) principle. rotational angle. The principle of pulse width modulation, or PWM, is this. A servo motor is essentially a DC motor with gearing and a variable resistor, or potentiometer, for control. A servo motor is essentially a closed-loop servomechanism that controls its motion and end position by position feedback

Flow Chart

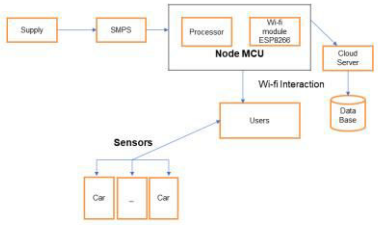


Figure .3 Workflow of the system.

## IV.EXPERIMENTAL RESULTS

The user of our proposed system can examine the availability of parking spaces and choose the appropriate vehicle type. if the user needs to visit a large mall. The user must first log in to the website, search for a specific mall, and then see the parking lot's status. Users can happily reserve a parking spot if one is available. If not, the user can see the parking space for two-wheelers. If the space designated for parking two-wheelers is also occupied, the user may choose to take public transportation. After checking the parking situation, the user can make an informed decision about the kind of car that will work best for him.

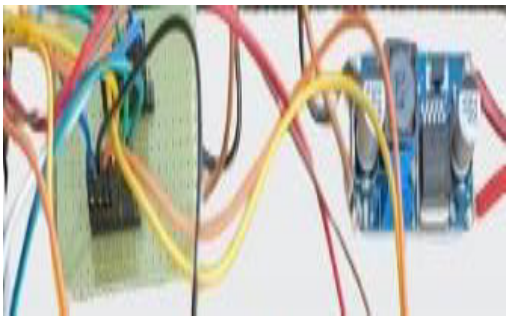

Figure. 4 Buck converter connected to the Dot board

In order to connect all of the devices together, buck converters used to convert 12 volts to 5 volts. The voltage is sent to the Dot board. The 5 volt supply is distributed among the board's different devices using a dot board. Following that, the Node MCU receives a 5 volt supply from the dot board. The ESP32s are one of the development boards that Node MCU created to evaluate the ESP-WROOM-32 module. It is built around the ESP32 microcontroller, which combines low power consumption, Bluetooth, Ethernet, and Wi-Fi capabilities into one chip. The LED display is connected to the Node MCU. When a user is utilizing a mobile application, the LED display displays the application's remarks.

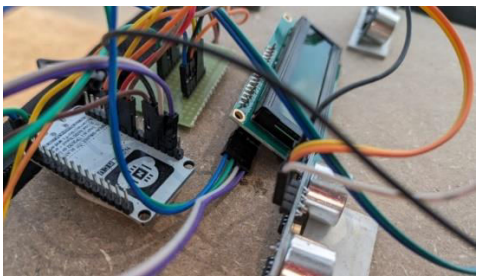

Figure .5 Node MCU connected with LED display.

ULTRASONIC SENSOR

Ultrasonic sensors are utilized for target detection and distance measurement. For object detection, sensors with digital outputs that may be turned on and off are available, as are commercially available sensors with an analog output that varies in relation to find how far away the sensor is from the target. It determines the vehicle is in the slot or not. This sensor is made up of a pair of ultrasonic transmitters and receivers that share a common frequency. The alarm is sent off when an object moves within the secured zone, aggravating the circuit's fine offset.

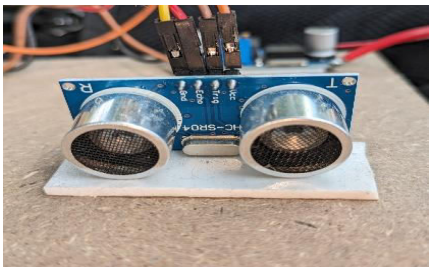

Figure .6 Ultrasonic sensor detection

SERVO MOTOR

A servo motor is a type of rotary actuator or motor that enables exact control over acceleration, velocity, and angular position. In essence, it is capable of certain things that a standard motor is not. As a result, it uses a standard motor and connects it to a position-feedback sensor. To turn on every device, the web application was linked to the node mcu. The sensor and the motors will operate in accordance with the user commands displayed on the application's LED display. The device creates the OTP and sends it through the application if the user requests it. Next, reserve a time slot for parking. By pressing the door open button, the user can depart through the opened door. The sum will be computed for the whole time the vehicle is parked in that time slot. After that, make the appropriate payment.

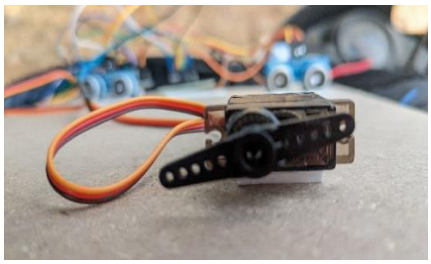

Figure .7 Servo motor connected with ultrasonic sensor

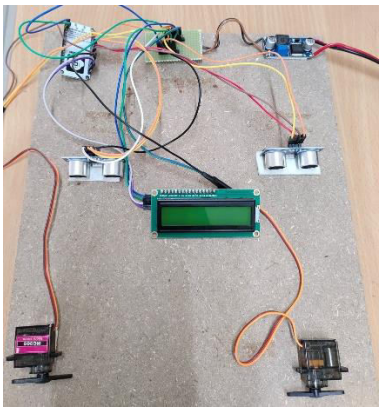

Figure .8 Overall setup

The web application of the system is used to book the parking slot, in this the request otp is used to get the otp for the user to book slot. After otp matches, book now option gets enabled. By using door open button the door gets opened to park the car. While left the parking slot the amount of the duration is calculated and it displays in the amount box and the pay now button is used to pay the amount of the car parking. The user can examine the availability of parking spaces and choose the appropriate vehicle type based on our result. if the user needs to visit a large mall. The user must first log in to the website, search for a specific mall, and then see the parking lot's status. Users can happily reserve a parking spot if one is available. Devices for identifying and connecting items were the foundation of the Internet of items. Remote PCs connected to the internet could be used to track, manage, or observe the devices. Smart city parking systems have shown promising results in optimizing urban parking management. Utilizing real-time data and IoT technology, these systems offer drivers details regarding parking spots that are available, cutting down on the amount of time spent looking for spots and easing traffic congestion. Mobile applications facilitate seamless interactions, allowing users to locate, pay for, and manage parking sessions effortlessly. Sensors embedded in road surfaces or integrated into parking meters detect vehicle presence, providing accurate occupancy information. The integration of smart parking with public transportation enhances overall mobility solutions. Data analytics derived from these systems offer valuable insights into parking patterns, aiding cities in making informed decisions for urban planning and traffic optimization.


Figure 9. Web Application

## CONCLUSION

The development of the Internet of Things has opened up new opportunities for smart city development. The foundation of building smart cities has always been sophisticated traffic management and parking infrastructure. In this study, we tackle the issue of parking and develop an Internet of Things-based smart parking system web application. Information about available parking spaces in real time in a parking area is provided by the proposed system. Using our web application, anybody from anywhere can seize a spot in the parking lot for themselves. The goal of this article is to improve a city's parking infrastructure, which will in turn improve the lives of its citizens. Users of our system can see the actual view.

## REFERENCES


[1] Wael Alsafery, Badraddin Alturki, Stephan Reiff-Marganiec, Kamal Jambi, "Smart Car Parking System Solution for the IoTin smart cities", 2018 1st International Conference on Computer Apllications & Information Security (ICCAIS)

[2] Denis Ashok, Akshat Tiwari, Vipul Jirge, "Smart Parking System using IoT Technology", 2020 International Conference on Emerging Trends in Information Technology and Engineering (ETITE)

[3] Megha D hedge, "smart parking system", 2019(RTESIT).

[4] Lomat Haider Chowdary, Z N.M Zarif Mahmud, Intishar-Ul Islam, Ishrat Jahan, Salekul Islam, "Smart Car Parking Management System", 2019 IEEE on Robotics Automation Artificial-intelligence and Internet-of-Things (RAAICON)

[5] Monika Dixit, Anjali Priya, Gaurav Haldiya, Anu Priya, Bhavesh Kumar, "Smart Car Parking System using Arduino", 2023 IEEE International Cinference on Electrical Electronics and Computer Science (SCEECS)

[6] Swatha M, Pooja K, "Smart Car Parking with Monitoring System", 2018 IEEE International Conference on System Computation Automation and Networking (ICSCA)

[7] Archana M, Shanmuga Raju, Preethi D, Mydhili S.K, Vinothkumar U, "Smart Automated Parking System using IoT", 2023International Conference on Sustainable Computing and Data Communication Systems (ICSCDS)

[8] Yash Agarwal, Punit Ratnani, Umang shah, puru Jain, "IoT based Smart Parking System", 2021 5th International Conference on Intelligant Computing and Control Systems (ICICCS)

[9] Sara Nayak, Reethika Renganathan, Ashwin Nair, L R Saritha, Leena Ladge, "Smart Car Parking System using Wireless Sensor Networks", 2020 Fourth International Conference on Inventive Systems and Control (ICISC)

[10] Praveen K, Harini V, "NB-IoT based smart car parking system", 2019 International Conference on a Smart Strucutres and Systems (ICSSS)

[11] Rachapol Lookmuang, Krit Nambut, Sasiporn Usanavasin, "Smart Parking using IoT technology", 2018 5th International Conference on Business and Industrial Research.

[12] Chi-Hung Chuang, Luo-Wei Tsai, "Vehicle License plate recognition using super resolution technique", 2014 11th IEEE InternationalConference on Advanced Video and Signal Based Surveillance (AVSS).

[13] Mingkai Chen, "A Parking Guidance and Information System based on Wireless Sensor Network", IEEE International Conference on Information and Automation Shenzhen,china 2011.

[14] Mingkai Chen, "A Parking Guidance and Information System based on Wireless Sensor Network", IEEE International Conference on Information and Automation Shenzhen,china 2011Huang Cai-mei, He Zhi-kun, "Design of Reverse Search Car System for Large Parking Lot Based on NFC Technology", 2014 IEEE

[15] Huang Cai-mei, He Zhi-kun, "Design of Reverse Search Car System for Large Parking Lot Based on NFC Technology", 2014 IEEE.

[16] BhosaleSwapnali B, Kayastha Vijay S, "Feature extraction using surf algorithm for objectrecognition", International Journal of Technical Research and Applications.

[17] Face recognition using principal component analysis and neural networks, at:http://www.researchgate.net /publication/23595016.

[18] W.S. Tang, Yuan Zheng, "An Intelligent Car Park Management System based on Wireless SensorNetworks", 2009 IEEE.

[19] Giuliano Benelli, Alessandro Pozzebon, "An Automated Payment System for Car Parks Based on Near Field Communication Technology", University of Siena, Italy be nelli, alessandro.pozzebon

{@unisi.it}.

[20] Abhirup Khanna "IoT based Smart Parking System" University of Petroleum and Energy Studies(UPES) Dehradun, Uttarakhand, 2016