IoT based smart parking system

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Abstract. Information and communication technologies are the backbone of smart city ecosystem. These technologies are used to improve the operational efficiency of the overall system. People can use and benefit from it, which leads to an improved quality of life for the citizens. To achieve this complex yet comprehensible lifestyle, use of technologies like the Internet of Things, Automation, Artificial Intelligence, Machine Learning, etc. is gaining momentum. They are driving the change and leading towards greater feasibility in the adaption of smart city. Any city can be considered a smart city by providing a system like a smart parking system. Problems such as traffic congestion, road blockage, road safety are major issues faced by the people in metropolitan areas. This has led to the need for an efficient parking system. This paper has proposed the onsite IOT based parking module which is placed in the parking area. It uses a mobile application to help the drivers to locate parking slots in the area where he/she is in. With the help of technique discussed in this paper many densely populated areas get a healthy environment i.e., reducing the overall pollution generated by vehicles during periods of ignition in traffic due to a lack of parking spaces.

Keywords: IoT based Parking, Automated Parking, API, IR sensors.

Introduction

Parking is a major issue in today's world especially when it comes to car parking. There were 'n' numbers of vehicles on roads and have a smaller number of parking space available. Hence the need for an efficient parking system is very important, especially in modern cities. Day by day there is a huge increment in vehicles population, as per the record there were 1.3 billion vehicles around 2035. And the current scenario of oil which is used by vehicles is something around one million barrels [1]. Thus, this parking system minimized the oil consumption which is been wasted in search of the availability of parking space. And a lot of time is saved by using this system.

The actual reason behind the parking system is that there is a huge scarcity of available parking spaces in urban cities. Since the cities started urbanizing ages ago when vehicles especially cars were thought of as a part of luxury. But in the present era, cars are a part of necessity rather than a luxury. As per a survey, 1% of the cars are bought as a luxury whereas

40-60% are owned by the middle class as a basic necessity. So primitive parking solutions would not work now.

This method reveals the use of IoT based parking system that allows the person to utilize the parking area easily by using IoT technology. In remote areas it's hard to manage services for this, IoT is the best solution to this problem of collecting data and making services better. It is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people which are assigned with a unique identity and can send data to a network without any human or computer interaction. In an embedded system, it changes the technology by making every single thing smart for example smartwatch, a clock that also senses temperature, a smart mirror, etc.

This paper first discussed the parking system which deals with the IoT-based automated system. If a slot is available it is shown in LCD according to that barrier opening and closing is done. If no parking space available is shows sorry slot is empty. The hardware kit is made by designing of PCB. Which includes sensors, controllers, servo motor, and Wi-Fi module. After that implementation and discussion, part circuit diagram and flow chart are explained and at last result and discussion section comes which explains exactly about the project. There is also an explanation of each part that is used in designing IoT based parking system.

Literature survey

Abhirup Khanna, Rishi Anand (2016 January) says that the paper is based on an IoT based cloud-integrated smart parking system. It also includes the gateway of booking the parking slots or parking space with the help of cloud computing. It deals with the advancement in low cost and low power embedded systems that are helping a lot of developers to create and work on their new ideas on the Internet of things. All the work which is done in this project is based on cloud computing which is related to cloud storage computation power and cloud integration. The nature of this system is to allow the developer to create and host their application on it. IoT and cloud act as perfect partner because it helps in storing the data of the sensors which can easily be accessed by remote area. In addition to that, it also includes the parking time or the amount of time you want to book that slot. The confirmation of your book is also available to you. It has the feature of adding or removing the number of nodes from the cloud. [2]

Utpala, K. N., Kumar, N. S., Praneetha (2019) says that this project helps the shopping malls and multiplex theatre and multi-specialty hospital to utilize their parking area efficiently. It can be made using a low-cost sensor and some controllers. The main advantage of this project is to find a slot available in the parking area using a mobile application easily. This helps in controlling the number of illegal parking which is increasing day by day. [3]

This system only consists of an IR module that is directly connected with the node MCU Wi-Fi module and give information about the slot availability only. It can be used with ultrasonic sensors instead of IR sensors that help the user to park the vehicle inappropriate direction and in the exact place which he/she want to park. And also give an alert about wall present there.

Sadhukhan, P. (2017, September) says that the main objective is to save time in searching for parking space and also utilization of parking area efficiently. Nowadays a lot of people is using smartphone and doing a lot of work on figure tip. Many public places especially in metro cities have a smaller number of parking spaces available in shopping malls, multiplex theatres, market areas, offices etc. some areas where there is such a facility, they need a guard to maintain the parking area from entry to exit. [4]

The user gets the information about the availability/unavailability of parking space before they entered the parking area. Its implementation involves a smaller number of human interactions and provides an effective parking experience thereby it minimizes the time that is been wasted in vehicle parking. This paper doesn't give the option of prior booking of the slot.

Parking System

In this paper, the IoT-based parking system is made which helps many people in finding parking spaces more easily without wasting a lot of time. This technology helps people in saving their time and utilize the parking area efficiently. A hardware kit is used in making this project or in other words, a separate PCB is designed which consists of one microcontroller, node MCU, and an IR sensor which is made using an LM358 comparator, LCD using I2C module, and a servo motor. The PCB used in this also includes a power supply section in it. And four IR sensors for different parking slots. The node MCU which is mentioned above is generally a Wi-Fi module that helps the circuit for internet connectivity. It's forming a bridge between the hardware part and the software part there. The two IR sensors with the PCB helps in the automated opening and closing of a barrier this happens with the help of a servo motor which is present there. The reading of barrier opening and closing is connected with the controller and that with LCD for showing the number of slot availability. In the user end section, the Blynk application is available on smartphones for seeing the slots and user interface.
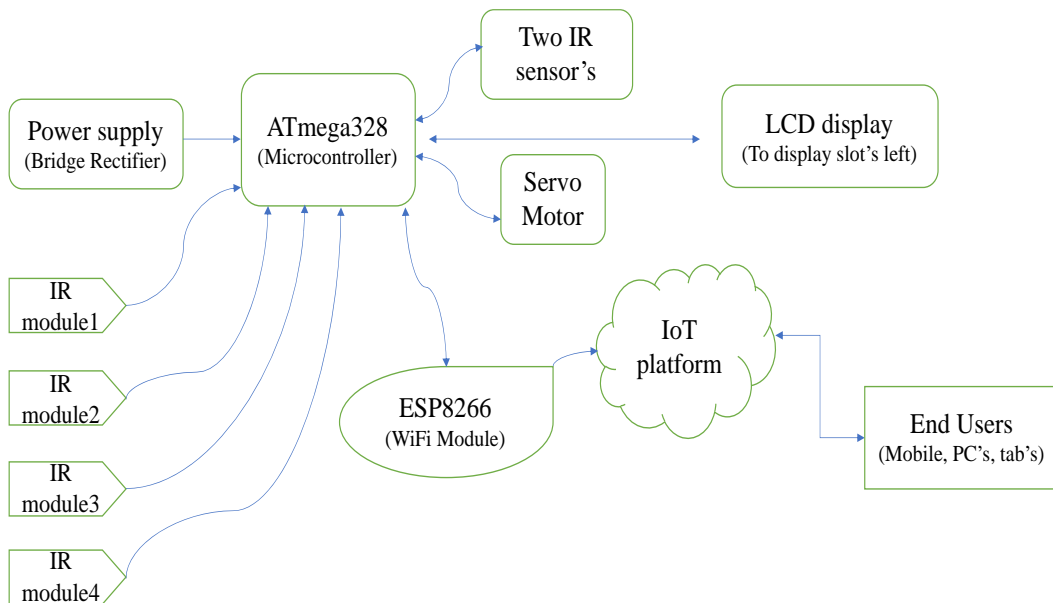
Fig. 1. System Architecture.

Implementation and discussion.

Every parking place has to install an IoT hardware kit. So that the IoT device updates the status of that particular slot that is vacant to parked any car.

The controller collects the sensor data and uploads it to the server using API (application programming interface). The API is created on mobile using the Blynk app. The server receives the data using API and stores it in the database. Whenever any user search for the parking places the Blynk application used that data to display the real result of the parking place.
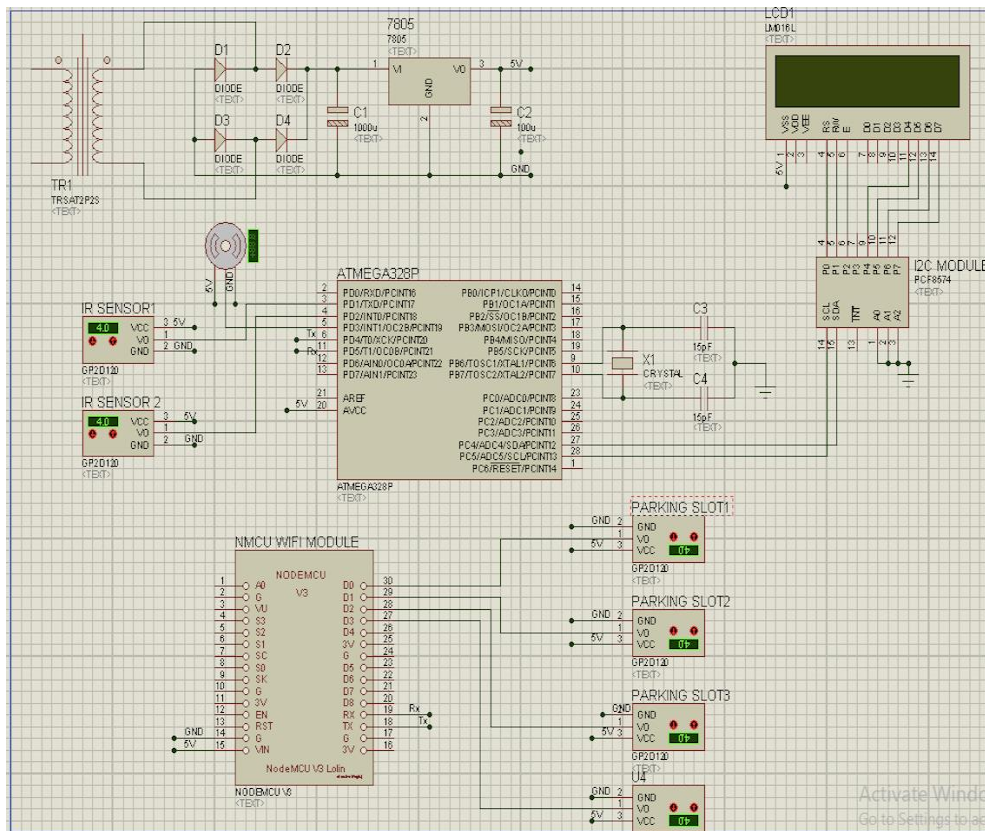
Fig. 2. Circuit diagram of parking system.

The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. This block uses two major applications one is a bridge rectifier and 7805 voltage regulators to take a DC output. Two capacitors are used for eliminating the pulsating dc to pure dc supply.

ATmega328 is an 8-bit, 28-Pin AVR Microcontroller, manufactured by Microchip, follows RISC Architecture, and has a flash-type program memory of 32KB. It is like the main processor of the system. All the components are attached to this microcontroller and it gives commands to all components for operation.

In this design six IR sensor is used which two is used for opening and closing of parking barrier. And the other four for slot availability. Two IR LED is also used one for transmitter and one for receiver and one (LM358) comparator to compare the voltage and according to that, it gives an output. Which is received by the microcontroller.

The basic function of a servo motor is rotation from 0 to 180 degrees. This servo motor is used for the normal opening and closing of barriers by receiving the commands from the microcontroller.

16*2 LCD is used to display the total number of parking slots available or left. It receives the command from the microcontroller and accordingly displays the outputs.

A Wi-Fi module ESP8266 is used. It is connected to the controller via serial communication and takes information about the slots and gives it to the cloud for users who are connected to the application.

The software to implement is the BLYNK app and Node MCU. For the connection with the internet. This two software make the system an IoT-based system. Arduino programming is also required in the microcontroller (ATmega328) as well as for node MCU. All the function of the circuit is based on the program compiled to the microcontroller.

Working

It is an IoT-based system that sends information about free parking spaces and occupied spaces to a mobile app; the hardware includes sensors, microcontroller, and a Wi-Fi module placed at the parking area's gate. Users can locate the exact slot available and park easier and in a shorter amount of time. This uses an IC instead of the Arduino, so a crystal oscillator and (22pf) capacitors are used. This hardware is installed in the parking area, which includes a controller, Wi-Fi module, and an infrared sensor for opening and closing the barrier, as well as for sensing when a car is parked or a slot is empty in order to allow other people to get that. The number of availabilities is shown in the LCD. If a slot is available there then as soon as the car arrived their barrier automatically opens. At the same time, a person can see the available slot while using the mobile application which is the Blynk application in this paper. The information of the slot is sent through the Wi-Fi module which is present in the hardware kit.
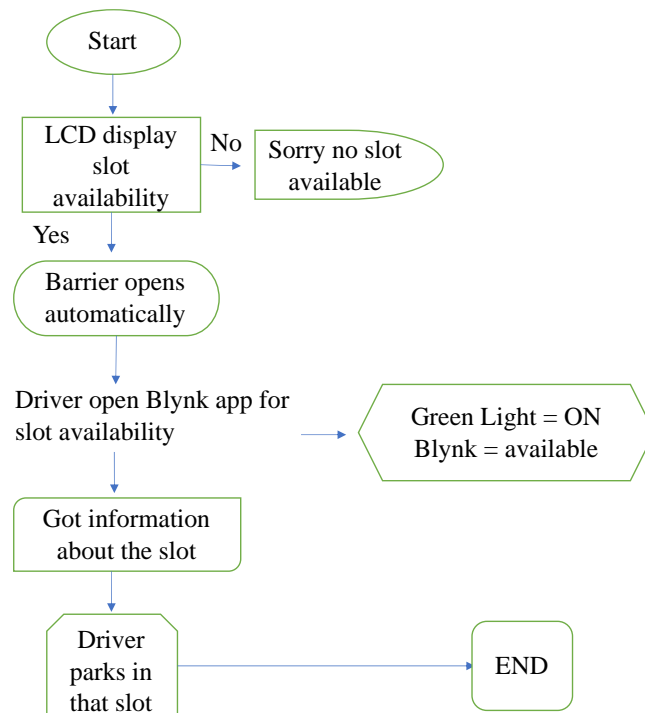
Fig. 3. Flow chart.

Result and Discussion

In this model, there are four parking slots that are connected with infrared sensors, and the sensor readings are directly linked to the LCD display, which provides information about the available space, as well as the opening and closing of the barrier. All these systems are controlled by the microcontroller and Node MCU Esp8266.

The demand for smart parking systems is enhancing day by day. The implemented model helps the user to access the available parking area in real-time. A current parking system doesn't provide any information about available spaces, and a large number of people are working in these areas from the entry to the exit of the parking areas. And it's also a very tedious task to maintain that thing by human beings. The overall result of the paper is to make parking areas faster to access by humans and to save time which is being used in searching for parking space. All these things can bring sweeping changes to our society and with this fuel consumption, traffic and car theft can also be reduced.
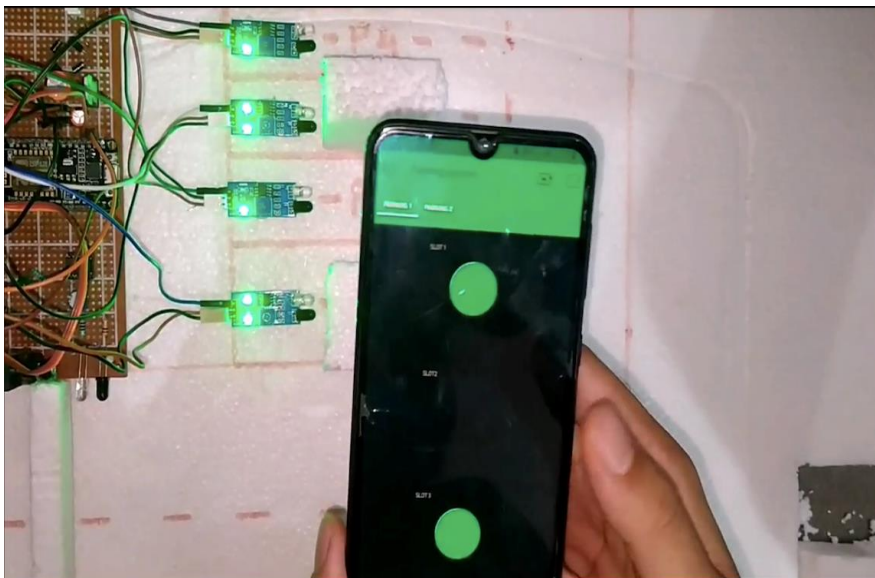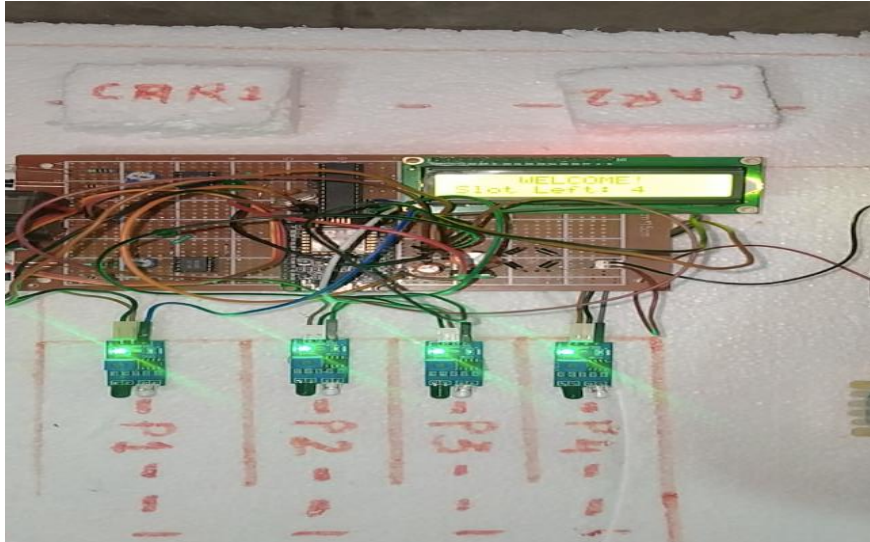
Fig. 4. Implemented IOT based parking system.

Conclusion and Future work

In this paper, various conditions of parking systems are discussed which provides the information of available parking spaces in a real-time process. The advantages and limitations of different types of parking systems are also discussed. The parking system is selected based on the cost of the system, maintenance cost, and the area available for the implementation of

the system. The concept of smart parking is based on the use of sensors and IoT to detect the availability of parking space is also discussed in this paper.

For future work, online booking or prior booking of parking system can be implemented through the website or mobile application from distant places or other cities or states using the vehicle's registration number. Integration with a secure payment gateway could be done through online mode. The vehicle's registration number is been scanned at the time of entrance. In the densely populated area where there is a very smaller number of parking spaces, this project can be implemented there as a pilot project. Adding other ultrasonic sensors would make the developed model more adaptable and scalable.

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