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Smart Parking System using IOT

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***Abstract*— Due to the growing number of automobiles on the road, there is a significant increase in demand for parking spots in metropolitan areas. Therefore, motorists constantly struggle to find good parking spots. Moreover, the existing parking system is ineffective, and also long lines and traffic jams are caused due to manual issuing of parking fees. In order to address these issues and offer a hassle-free parking experience, there is an urgent need of an automated parking system. Therefore we came up with an idea of creating an Internet of Things (IoT)-based smart parking system that makes use of an Arduino, PIR sensors, and stepper motors for the barrier in order to address these issues. This type of parking system would rather enhance a user's parking experience, thus saving them time and effort. The barrier system will be automated through the use of PIR sensors and stepper motors, enabling automation of gate entry and exit, thus minimizing the need for manual intervention. The proposed system intends to offer hassle-free parking for car owners while providing parking lot owners with a dependable and effective parking management system.**

***Index Terms*— Smart parking system, IoT, Automation, Arduino, Vehicles.**

I. INTRODUCTION

Due to an exponential increase in automobiles in the world, parking has become a significant problem. It is tough to find parking places, which causes gridlock and wastes time. Moreover, the current traditional parking systems cannot manage the expanding number of vehicles. An IoT-based parking system can help tackle this problem. Electronic items like Arduino, PIR sensors, and a stepper motor can be used in the system. Both parking lot managers and car owners will benefit from the seamless and effective parking experience offered by the IoT-based parking system

A. Motivation

The current traditional parking system is marked by inefficiency, leading to traffic jams, time and fuel wastage. Consequently, it serves as a primary driver for the development of an Internet of Things (IoT) based parking solution. These concerns can be addressed, and the overall parking experience can be enhanced through the implementation of an automated parking system. Our proposed system aims to give vehicle drivers a piece of real-time information on parking availability, enabling them to rapidly discover an empty parking spot. This will improve the overall parking experience for drivers and enhance the efficiency and cost-effectiveness of parking lot management.

B. Objectives

The following are our project goals:

- To create a system that utilizes PIR motion sensors to reliably and accurately sense the presence of

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automobiles while entering or exiting or while present in a parking lot.

- To use a stepper motor-based barrier system that can be remotely controlled via IoT to regulate entrance to the parking lot.
- To design a user-friendly dashboard for regulating entry and keeping an eye on the parking lot.
- To advise consumers in real-time about parking availability in order to maximize the usage of available parking spaces.
- To make manual parking lot administration and monitoring less time- and labor-intensive.
- To offer a scalable, affordable solution that is simple to use in various parking facilities.
- Increasing the security of the parking lot by spotting and reporting any unauthorized activity.

C. Contribution

Our system proposal makes the following contributions:

- Supplying useful information to municipal planners and decision-makers will help them plan infrastructure and parking rules more effectively.
- Lowering the time spent looking for parking spots which will improve traffic flow, ease congestion, and reduce carbon emissions.
- Establishing a practical and economical parking management system.

II. LITERATURE SURVEY

A smart parking system prototype is developed in the paper with the aim to find empty parking slots without manual efforts which can save time and effort. A wireless sensing network is made that can sense the availability of slots and the collected data can be stored on cloud which can be further analyzed and the information can be accessed from it using the mobile app. Also from the sensory data collected, some informative data is also evaluated. Ref. [1] As population is increasing day by day so to find parking slots is becoming a serious issue in big cities. Ref. [2] With the advancement of IoT, the above addressed issue can be solved. The review on various papers in recent year is presented in order to investigate about different models, sensors and technology which can be integrated and used so as to build a system which can manage the parking slots and can save time, energy, fuel and subsequently carbon footprint.

Ref. [3] With the increase of issues arising like global warming, parking problems, etc. because of growing transportation, the paper presents the system capable of finding the vacant spaces for parking which will in turn reduce the effort of searching the whole area. The prototype is created using IoT which can detect the presence of vehicles and on that basis can update the application for the user to get information for the same. Also some drawbacks are mentioned considering the modern world. Ref. [4] With the challenge of parking of vehicles faced by all smart cities due to which their valuable time, effort and energy is wasted and also fuel consumption increases in order to find the slots for parking, the paper represents a parking system SCPMS that is based on sensors. Basically, the system identifies the available space for parking and updates it at the display counter of main parking. So, this functionality is useful for users to find the slots easily and book the parking. As a conclusion, manual effort gets reduced and in less time the parking slot is identified which in turn helps to save fuel and avoid traffic.

Ref. [5] In order to address issues like traffic congestion, inadequate automobile parking facilities, and road safety, urban towns are continuously seeking solutions that are as dependable and productive as possible. This work thus describes an IoT-based smart parking system which also integrates cloud, which entails the deployment of an IoT eco-system on-site to trace and signalize the vacancy of each parking space. Additionally, an application on the smartphone is made available, which enables the users to reserve a spot by checking the availability of parking spaces. Ref. [6] A system is proposed in the given paper which tells the user about the parking space, verifies them using the mobile technologies and according to the length of the vehicle the slot is given which is then daily analyzed on the basis of the data collected of leaving and coming of vehicle. For the purpose of deciding the slot availability, IR sensor is used. Using Wi-Fi module and microcontroller, data is accessed and send to the server where it is analyzed. RFID label is used to validate an individual and the Mobile App id designed to give a good user experience.

Ref. [7] The process to find the parking slot is very time consumable in big cities. If parking is unavailable, then it may lead to traffic and can create problems. So to have a reliable, secure and accurate solution to this issue, a system is designed which can solve the problem faced in today's time. The proposed system is the combination of IoT and android applications which can help to meet its requirements of finding the parking spaces in short span of time and thus saving the energy, fuel, time and efforts. The system also gives the feature of prebooking the slot

so that the time is saved. From the results it was analyzed that the system is 70% accurate and more efficient than other existing solutions. Ref. [8] Adaption to Internet of Things (IoT) can be helpful in finding the place for parking with ease. In the work, a Smart Car Parking System (SCPS) is designed using IR sensor and a database that also permits the driver for parking and shows the slots available.
Ref. [9] The inconvenience of finding a parking space is becoming a major issue for people in the cities. The traditional method of physically searching for spaces is time and effort consuming which also leads to traffic jam. To overcome this problem, a system is designed using Raspberry Pi 3, an ultrasonic sensor, a Pi Camera, and Python IDE for software. The system detects presence of vehicle and also make the payment method easy through mobile app. Ref. [10] Typically, the Internet of Things is utilized to construct a smart parking system which makes use of web-based technology, a map-view application for parking lot availability, wireless sensor network controllers, and car presence sensors.

III. Methodology

As part of our process, we first determine the requirements for the smart parking management system using an iterative development approach. Following that, the system architecture was developed together with the selection of the hardware and software components. The technique was then tested with a prototype before being put into use. Following system improvements based on test results, the process was repeated until the desired results were attained. Fig. 1-shows a brief idea about our system.

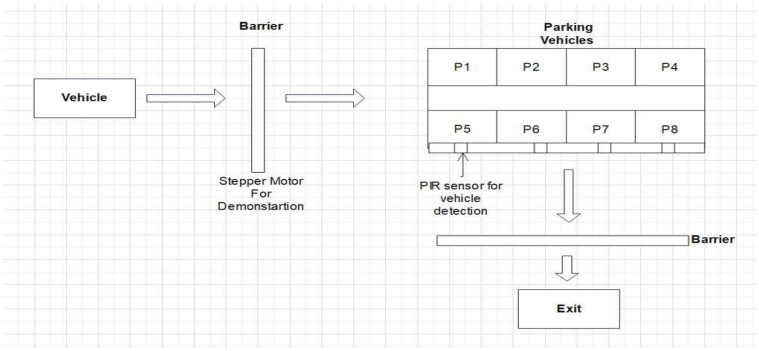

Figure. 1. High level design for the smart parking system

IV. Problem Description

To ensure that parking is managed more efficiently in light of the growing count of vehicles on the road, better parking solutions are required. With the use of IoT, the suggested solution seeks to offer a smarter parking management system. When a vehicle is present in a parking place, the PIR sensors will detect it, and it will then use the internet to send the information to the central server. Drivers can then access the availability of parking space through a mobile app or it can be displayed on a board after the server has processed the data. The barrier will also be powered by a stepper motor that is managed by the central server in the system. Whenever a car wants to enter a parking spot, the barrier will automatically open, and it will close when the car pulls out. This will ensure that only authorized vehicles are using the parking area and stop unauthorized access. In conclusion, the suggested approach intends to address the shortcomings of conventional parking systems by supplying real-time parking availability information, decreasing the time wasted on looking for parking spots, and preventing unauthorized access to parking spaces.

V. Modelling Approach

A. Assumptions

Our system makes the assumption that every part will work together seamlessly. The model also assumes that the component has no internal resistance, which means that its voltage does not decrease with use. Additionally, it is assumed that the system will function flawlessly and that all connected devices will appropriately reflect the slot availability.

B. Justification

There are many reasons to use Internet of Things (IoT)-based smart parking systems, including:

Effective utilization of space: By directing cars to available parking spots and saving them the time required and fuel consumed for driving around searching for a parking place, smart parking systems can maximize the utilization of parking space.
Real-time data: Smart parking systems can give drivers real-time information on the vacancy of parking places, easing their stress and aggravation. Real-time parking spot availability can be checked by drivers using a smartphone app or other device, and if a spot is available, it can be reserved.
Reduced traffic: Smart parking systems can aid in reducing traffic congestion in congested regions by directing drivers to available parking spaces. As a result, air quality may be enhanced and greenhouse gas emissions may be decreased.

VI. IMPLEMENTATION

The following components are utilized in the parking slot management system:
Arduino: Arduino is an open-source electronics platform with straightforward hardware and software. Users can build software for the board and upload it to the board using these components, which come with a microcontroller board and a programming environment. The system for detecting spots, transmitting information to the user, and managing the operation of barriers is programmed using an Arduino board (as shown in Figure 2) in our project.

Figure. 2. Arduino UNO

Figure. 3. Passive Infrared Sensor

Passive Infrared Sensor(PIR): PIR sensors (as shown in Figure 3), are machines that continuously scan their range of view for variations in infrared radiation. To detect the infrared radiation emitted by moving objects and living organisms, PIR sensors are often used in motion detection systems. They are utilised in the system because, thanks to the heat produced by the vehicles, which the sensor can detect, they can quickly identify both the presence and absence of automobiles.
Servo Motor(as shown in Figure 4): Automation, robotics, and control applications typically use an electric motor known as a servo motor. Servo motors provide for exact control of the position, speed, and acceleration of a shaft or other mechanical parts. A servo motor consists of a rotor, stator, and feedback control system. It is used in the system to manage the barriers and to verify vehicle entry and exit.
LCD: An LCD (as shown in Figure 5) 16x2 display has two rows of 16 characters each and is a type of alphanumeric display. The Liquid Crystal Display (LCD) technology is used to display characters, which is often used in electrical items like calculators, digital watches, and other consumer gadgets. These displays will be employed in the system to alert users of the presence and absence of vehicles, making it simple for them to identify an empty slot.
Potentiometer: A potentiometer (as shown in Figure 6) is an electrical device that controls the resistance of a circuit. It consists of a moveable contact attached to it and a wiper that moves over the resistive element when it is spun. Potentiometers are widely employed in systems to control a display's brightness or contrast.

Figure. 4. Servo motor

Figure. 5. Liquid Crystal Display

Figure. 6. Potentiometer

Here's how a smart parking system utilizing a PIR sensor and Arduino Uno works:

- PIR sensors are installed in each parking spot. These sensors sense the heat emitted by the car in order to detect the presence of a vehicle.
- Further the data is transmitted to a central server to be processed and analyzed, which is collected by the sensors. The server uses the data to identify which parking spots are vacant and which are not.
- This information is then displayed on a digital sign at the entrance of parking lot, indicating the number of available spots. And then we can choose the parking slot if available.
- When a vehicle enters a parking spot, the PIR sensor detects the change in infrared radiation and updates the server accordingly indicating that the space is now not available. And when the vehicle leaves, PIR sensor detects the absence of heat and updates the server that the space is now available.

VII. Analysis And Discussion

A network of interconnected devices and sensors that collaborate to optimize parking space utilization and make parking for drivers easier is an IoT-based smart parking system. This ecosystem may gather data on parking occupancy, vehicle movement, and other relevant variables, and utilize this data to guide drivers about parking spaces that are available in real-time. The following elements make up the analysis of an IoT-based smart parking system:

Hardware: Sensors, cameras, gateways, and controllers are frequently found in smart parking systems. While the cameras can take pictures of the vehicles and their license plates, the sensors can identify the presence of cars in parking places. Data from the sensors and cameras can be processed by the gateways and controllers before being sent to a centralized server. Additionally, there were certain difficulties with the system's algorithm and sensor integration. But overall, it can be concluded that the system is dependable, effective, and valuable for reducing the amount of traffic in cities.

VIII. Simulations And Validations

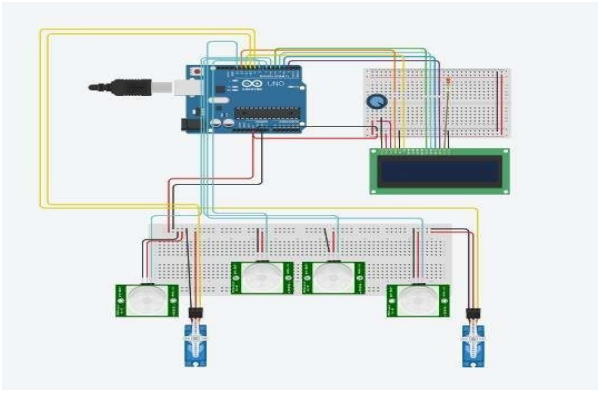

Figure 7. The system design on Tinkercad.

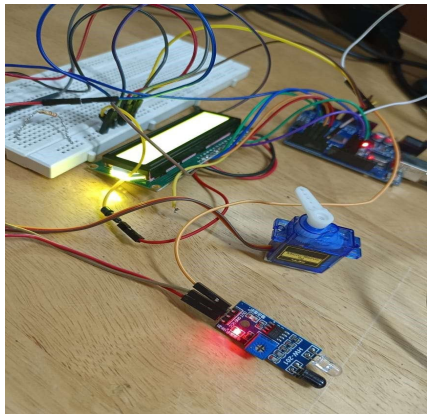

Fig 8. Implementation using all components as mentioned.

IX. Contributions And Implications

The implementation section's smart parking system using IoT project has various important consequences and contributions. First, the initiative advances the development of autonomous parking space identification, making it easier for vehicle drivers to locate parking spots. One can quickly and efficiently identify the free space without losing time or effort by integrating various technologies such verifying algorithms, sensors, and motors. This can

be advantageous at a variety of locations, including campuses, malls, markets, etc., reducing transportation congestion and the rise in global warming in major cities.
Overall, the contributions and implications of the parking system using IoT are significant. The project demonstrates the potential of system to search for free spaces efficiently in dynamic environments, and it highlights the accessibility and affordability of technology. These contributions and implications have the potential to impact various fields and pave the way for the development of new and innovative applications. The results show that the system accurately and efficiently detects the absence and presence of vehicle and displays it on the LCD. Figure 3 – Shows the simulation of the system.

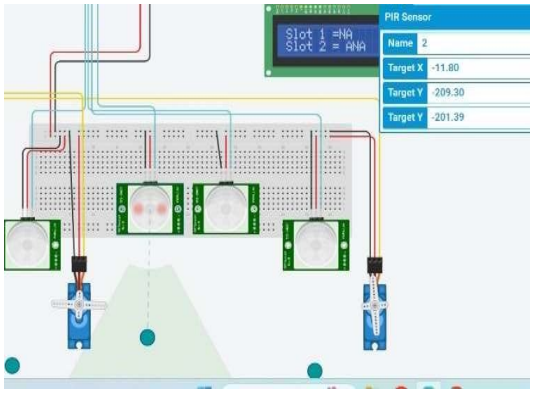

Figure 9. The output for the project on Tinkercad.

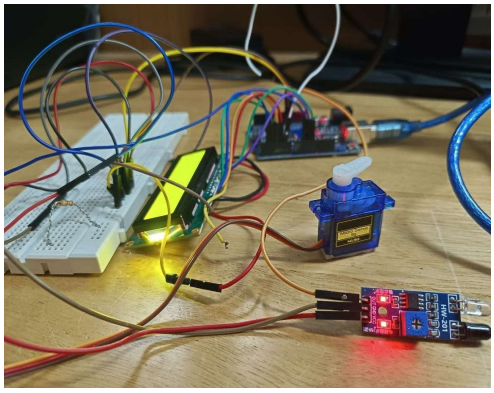

Fig. 10. The output for the project shows the presence of the car.

X. Conclusions

As a result, we have created a parking management system using Arduino and PIR sensors which is a useful and efficient solution for managing parking spaces. The system is capable of detecting the presence of a car or a bike in parking slots and thus provides information regarding the parking spaces in real time. The system is very easy to install and can be adapted to suit the specific requirements of different parking areas. Other technologies such as mobile apps and other cloud-based systems can also be integrated for remote monitoring and management.
Overall, the system is an economical and reliable solution for maximizing parking spaces and improving the parking experience of users.

Limitations And Future Scope

There exist a few issues with our work which can be resolved in later iterations. The work initially focuses only on managing slot availability. The addition of a pre-booking system and mobile application-based payment can further improve it. Moreover, adding a camera that can capture the motion of cars and update the system with AI/ML can also be implemented. Future studies can also examine the security benefits of user and vehicle authentication by QR scanning or number plate detection.

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