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Parking Automation using IoT

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ABSTRACT: Parking systems is a growing concern, particularly in metropolitan areas where the increase in the number of vehicles has led to road congestion. To address this issue, this paper proposes the use of internet of things (IoT) technology to automate the allocation of parking spaces. The system will provide wireless access to users, allowing them to check the availability of parking areas in real-time. To implement this solution, sensors will be installed in each parking space to detect the presence of a vehicle. These sensors will communicate wirelessly with the central server of the system, creating a real-time map of the parking area that shows the availability of parking spots. This will allow users to quickly identify and locate an available parking space, reducing the time and effort required to search for a spot. Overall, this system will be an efficient and smart solution to automate parking management, minimizing waiting times and optimizing the use of parking spaces in metropolitan areas.

KEYWORDS: Arduino UNO, I2C Module, IR Proximity Sensor, 20X4 display, Servo Motor

I. INTRODUCTION

The Internet of Things (IoT) enables the transfer of data between devices without requiring human interaction, providing users with increased transparency. The concept of IoT began with the idea of connecting various devices through the "Identity of Things." These devices can be monitored or controlled via computers over the internet. The term IoT comprises "Internet" and "Things," where the internet is a vast network that connects servers with devices [1]. IoT technology has various applications, including the creation of intelligent parking and traffic management systems. By leveraging data from sensors, cameras, and other connected devices, smart traffic management systems can monitor traffic flow and adjust traffic signals in real-time to enhance safety and decrease congestion. Furthermore, smart lighting systems can be developed using IoT, which can automatically regulate the brightness of lights based on the presence of vehicles or pedestrians, thereby reducing light pollution and conserving energy. The issue of parking creates problems such as air pollution and traffic congestion. Finding parking spaces on a day-to-day basis is a difficult task for people, and the number of vehicles is expected to increase rapidly, with over 1.6 billion predicted by 2035, according to recent surveys. The world burns around one million barrels of oil every day, contributing to fuel wastage. Smart parking systems are a potential solution to reduce fuel wastage by minimizing the time and effort required to find parking spaces. This involves collecting data from sensors and analyzing and processing it to obtain output. This data is then transmitted to the devices that extract relevant information and send it to the Arduino device, which provides command instructions to the devices. Arduino then sends a signal to the servo motor, along with the I2C module, which provides instructions and notifications to the user. When a user enters the parking area, if empty parking slots are available, the gate is opened. The parking area consists of three parts, including Arduino devices and IR sensors, which the user interacts with to access the parking area. The Arduino here plays a very vital role in successfully running the project. Thus, the output the parking jam problem is reduced.

II. RELATED WORK

In [1] authors presented an IoT based cloud integrated smart parking system. The proposed Smart Parking system consists of an on-site deployment of an IoT module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly.

In [2] authors introduced a novel algorithm that increases the efficiency of the current cloud-based smart-parking

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system and develops a network architecture based on the Internet-of-Things technology. They proposed a system that helps users automatically find a free parking space at the least cost based on new performance metrics to calculate the user parking cost by considering the distance and the total number of free places in each car park. This cost will be used to offer a solution of finding an available parking space upon a request by the user and a solution of suggesting a new car park if the current car park is full. The simulation results shown that the algorithm helps improve the probability of successful parking and minimizes the user waiting time. They also successfully implemented the proposed system in the real world. In [3] authors proposed a Smart Parking system which provides an optimal solution for parking problem in metropolitan cities. Due to rapid increase in vehicle density especially during the peak hours of the day, it is a difficult task for the drivers to find a parking space to park their vehicles. The aim of the paper was to resolve the above mentioned issue which provides the Smart Parking system. This system used cloud computing and Internet of Things (IOT) technology. A suitable shortest path algorithm was used to find the minimum distance between the user and each car park in the system. Thus, the waiting time of the user is minimized .The paper also introduced the usage of android application using smart phone for the interaction between the Smart Parking system and the user. RFID technology is used in this system to avoid the human intervention which minimizes the cost. In [4] authors suggested that parking monitoring is an important solution. To avoid these problems, recently many new technologies have been developed that help in solving the parking problems to a great extent. Firstly, this paper given an overview about the concept of smart parking system, their categories and different functionalities. Then we present the latest developments in parking infrastructures. We describe the technologies around parking availability monitoring, parking reservation and dynamic pricing and see how they are utilized in different settings. In addition, a theoretical comparison was presented to show advantages and drawbacks of each different smart parking system to discuss results and open directions for future research.In [5] authors proposed a smart car parking system that assist users to solve the issue of finding a parking space and to minimize the time spent in searching for the nearest available car park. In addition, it provides users with roads traffic congestion status. Moreover, the proposed system collects the raw data locally and extracts features by applying data filtering and fusion techniques to reduce the transmitted data over the network. After that, the transformed data was sent to the cloud for processing and evaluating by using machine learning algorithms.

Proposed System

The smart parking system is a new and innovative solution that utilizes advanced technology to optimize parking management. The main goal of the system is to minimize traffic congestion and assist drivers in finding available parking spaces easily and quickly.

The proposed smart parking system will consist of a network of sensors installed in parking lots and on-street parking spaces. These sensors will employ various technologies such as ultrasonic, magnetic, or infrared to detect parked vehicles. The data collected by the sensors will be transmitted wirelessly to a central server, which will analyze the information and provide real-time updates on parking availability. Drivers will be able to access this information via an electronic display at the entrance of the parking lot.

To ensure the security of the system, it will be equipped with advanced security features such as encryption and authentication protocols. The system will also be scalable, meaning that it can be easily expanded to cover larger parking areas.

The proposed smart parking system aims to offer an efficient and convenient parking solution for both drivers and parking lot operators. By reducing traffic congestion and improving parking management, it will contribute to a more sustainable and livable urban environment.

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III. SYSTEM ARCHITECTURE

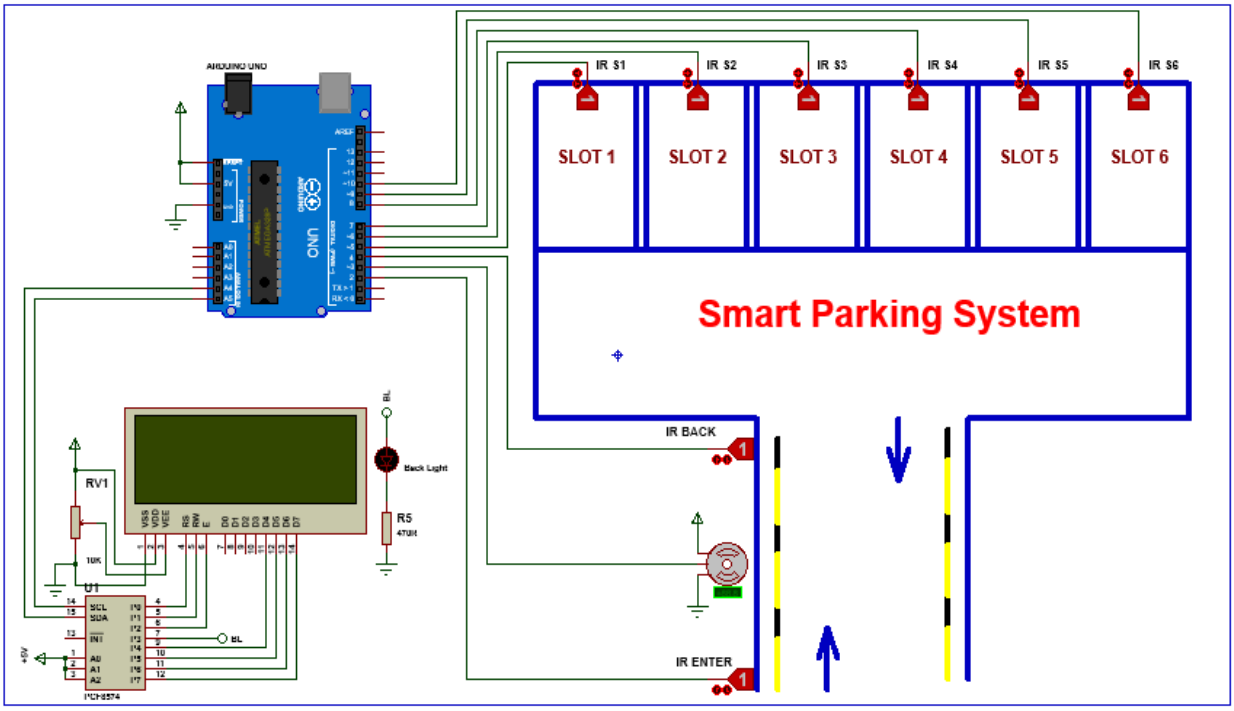

FIG.1. SYSTEM ARCHITECTURE

IV. BREAKDOWN STRUCTURE

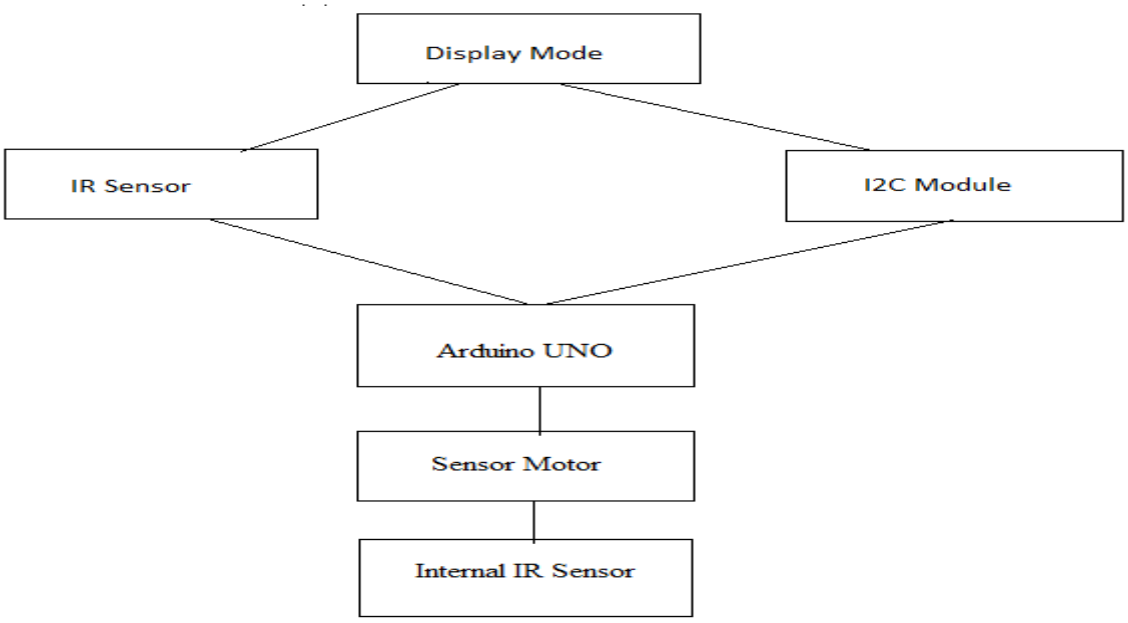

Fig.2. Breakdown Structure

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Module 1: Display Module
Module 2: I2C Module
Module 3: IR Sensor
Module 4: Arduino UNO
Module 5: Servo Motor
Module 6: Internal IR Sensor

Module 1: Display Module
A 20x4 LCD (Liquid Crystal Display) is a type of alphanumeric display that is commonly used in parking systems to provide information to drivers about parking availability, rates, and other relevant information. The 20x4 designation refers to the number of characters and lines on the display - 20 characters wide and 4 lines tall.
An LCD display will show the number of empty slots and the status of the slots.

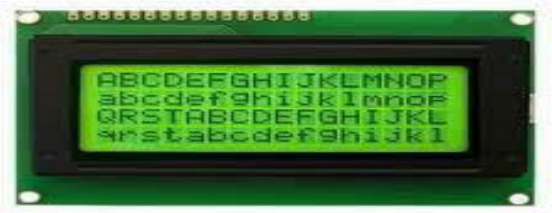

Fig. 3. Display Module

Module 2: I2C Module
An I2C (Inter-Integrated Circuit) module is a type of communication interface that is commonly used in parking systems to allow different electronic components to communicate with each other. The I2C protocol is a two-wire serial communication protocol that allows multiple devices to be connected to the same bus, making it an efficient way to connect sensors, displays, and other components in a parking system.
The I2C Module is connected to LCD Display.

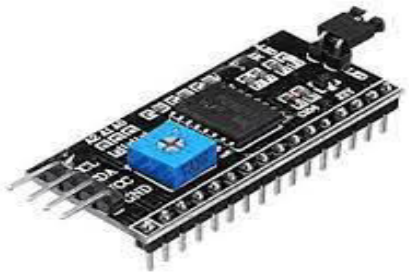

Fig. 4. I2C Module

Module 3: IR Sensor
An IR (Infrared) proximity sensor is a type of sensor that detects the presence of an object or obstacle by emitting and receiving infrared radiation. It is commonly used in parking systems to detect the presence of vehicles and assist drivers in parking.
At the parking area, the IR proximity sensor detects the car.

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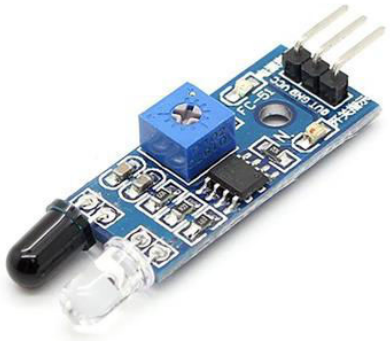

Fig 5. IR Sensor

Module 4: Arduino UNO

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet) It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, sim- ply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++ An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller (although since 2015 other makers microcontrollers have been used) with complementary components that facilitate programming and incorporation into other circuits.

Each component connected to the system will be controlled by Arduino board.

Fig 6. Arduino UNO

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Module 5: Servo Motor

In a parking system, a servo motor may be used to control the movement of a gate or barrier, allowing vehicles to enter or exit the parking area. The servo motor is typically connected to a controller, such as a microcontroller or PLC, which sends signals to the motor to control its movement.
Program code specifies the degree for the servo motor to be used as a gate.

Fig 7. Servo Motor

Module 6: Internal IR Sensor
IR proximity sensors are commonly used in parking systems because they are reliable, low-cost, and easy to install. They can detect objects at distances of up to several meters, depending on the sensor's specifications. They are also able to work in a variety of lighting conditions, including low light and complete darkness, making them ideal for outdoor parking lots and garages.

V. RESULT AND DISCUSSION

The results and discussion of a smart parking system can provide insights into the effectiveness and efficiency of the system. The following points can be considered in the results and discussion section of a smart parking system project:
1. Accuracy of the IR sensor: The accuracy of the IR sensor in detecting the presence of vehicles in the parking space can be evaluated. This can be done by comparing the sensor readings with the actual presence of vehicles in the parking space.
2. Efficiency of the gate mechanism: The efficiency of the gate mechanism controlled by the servo motor can be evaluated. This can be done by measuring the time it takes for the gate to open and close.
3. Reliability of the system: The reliability of the smart parking system can be evaluated by testing the system under different conditions such as heavy rain, strong winds, and extreme temperatures.
4. User interface: The usability and user-friendliness of the LCD display and the overall user interface can be evaluated. This can be done by conducting user testing and getting feedback from users.
5. Overall performance: The overall performance of the smart parking system can be evaluated by testing the system in a real-world environment and comparing the results with the initial objectives of the project.

VI. CONCLUSION AND FUTURE WORK

Smart cities have long been a vision for urban planners, and recent advancements in technology, such as the internet of things and cloud computing, are making this vision a reality. One key component of smart cities is smart parking systems, which provide real-time information on available parking spaces, helping to reduce traffic congestion and save users time. In the future, these systems could be enhanced further by incorporating GPS, reservation facilities, and license plate scanners. By automating the management of parking systems, users can easily find available spots, and the waiting time can be minimized. This can be achieved by using sensors to detect vehicle presence and providing a real-time map of available parking spots. The ability to reserve parking spots in advance and pay through mobile apps or web-based interfaces offers further convenience to users. In addition to user benefits, smart parking systems can also

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help parking lot operators maximize usage and reduce the need for manual management. Ultimately, smart parking systems offer an effective and efficient solution to the challenges of urban mobility.

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