Smart Park: Innovating the Future of Vehicle Parking

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***Abstract*—** Effective parking solutions become increasingly important as urban areas increase because of wasted space, time-consuming searches, and traffic congestion. By utilizing cutting edge technologies to improve parking management and user experience, the Smart Vehicle Parking System (SVPS) tackles these issues. To deliver dynamic solutions, SVPS combines sophisticated algorithms, sensor networks, and real-time data. Parking space sensors track occupancy and transmit data to a central system, where machine learning maximizes space distribution and directs vehicles to open spaces. This smart parking system is software and hardware based. Different algorithms are used to find vacant slots using machine learning and deep learning. IR sensors, RFID, Servomotors and ESP 32 microcontrollers and Internet of things are useful to find vacant slots in real time signal processing. In traditional method it is difficult to search free space, and this method is time consuming, Smart parking system overcome this problem with new technology and improve parking management system. The SVPS not only improves urban mobility but also contributes to reducing vehicle emissions and enhanced overall efficiency.

Keywords— smart parking, integration, secure payment,advanced technologies, convenient.

INTRODUCTION

With the rapid pace of industrial development, the ramifications of urbanization and infrastructure expansion are evident, notably in the form of heightened traffic congestion. A significant contributor to these traffic challenges is the insufficient provision of parking facilities to accommodate escalating urban traffic demands. The implementation of a smart parking system presents a viable solution, enabling drivers to easily locate and reserve available parking spaces.

Citizens who opt to utilize secure and smart parking facilities stand to benefit from enhanced services offered through computerized systems. Smart parking systems leveraging the Internet of Things (IoT) effectively address urban parking challenges by furnishing real-time information and guiding drivers to unoccupied spots. This methodology not only enhances the efficiency of parking vehicles but also conserves fuel and amplifies the user experience.

Presently, an estimated 4 billion metric tons of CO2 are emitted each day due to traffic congestion. In the fiscal year 2024, India reportedly consumed 233.32 million tons of fuel. In conjunction with the advancement of information technology, the Internet of Things (IoT) has garnered substantial popularity. IoT facilitates the interconnection of various devices, such as smart homes, automobiles, mobile phones, and household appliances, enabling seamless communication among them. Equipped with electronic components, sensors, actuators, and network connectivity, these devices can transmit data or be remotely controlled using internet infrastructure.

The integration of IoT into urban environments introduces the concept of a Smart City. Although a precise definition of a Smart City is elusive, its primary objective is to heighten access to public amenities and enhance their quality. This can be achieved by deploying IoT technology across public infrastructure in urban areas, a concept referred to as Urban IoT. Public parking for four-wheeled vehicles serves as a prominent example of such infrastructure in urban settings.

In Indonesia, a myriad of technologies has been developed for parking systems, some of which are already in use in shopping districts. One example is the implementation of smart parking lots furnished with sensors, actuators, and microcontrollers, allowing users to park their vehicles in designated locations. The microcontroller subsequently directs the actuator to secure the vehicle in an available parking space. Although innovative, this concept necessitates considerable investment and physical renovation to be implemented in existing public parking lots. Another smart parking concept employs sensors, microcontrollers, and Light-Emitting Diode (LED) displays. The sensor detects the number of unoccupied parking spaces and relays the data to the microcontroller, which then displays the information on the LED screen. This IoT-based approach enhances the accessibility of parking facilities, enabling individuals to remotely check for available spaces.

An app connected to the cloud can provide information on available parking spaces, underscoring the necessity of developing a cloud-integrated smart parking system. Such a system can significantly aid vehicle users in locating parking spaces with greater ease. Data from this system can be transmitted to mobile phones or other applications, empowering communities to remotely and continuously monitor unoccupied parking lots in real time.

LITERATURE SURVEY

Amisha Narkhede, Neha Kad, Aniket Nawale, designed a Smart Parking System to resolve the parking issues. It was published by IRJMETS, ISSN;2582-5208,5 May 2022, Volume 4, Issue 5. Findings from this research papers are Today many metropolitan areas have seen explosive growth in the number of visitors and patrons due to urban revitalization, extension of transit services into suburban areas, and the general trend toward increased mobility of our society. As a result, there are too many vehicles on the road and insufficient parking spaces. Internet of Things (IOT) uses sensors to connect physical parking space infrastructures with information and communication technologies, where cloud-based smart management services are provided. Also, it will sense, if a vehicle has arrived at the gate for automated gate opening. This allows users to check for available parking space online from anywhere for hassle free parking. Thus, the system solves the parking issue.

Hardik Tanti, Shikha Patel, Pratik Kasodariya designed a Smart Parking System based on IOT. It was published by IJERT, ISSN:2278-0181, Volume 9, Issue 5, May 2020.Findings from this research are Internet-of-things-based technologies have advanced so much and helped public necessities. The use of IoT at a parking slot will help vehicle users to know the availability of a parking location through smartphones. This IoT-based parking system is created by using controllers, sensors, servers and clouds. Controllers and sensors will be placed on the ceiling of each parking slots to detect the presence of a car. Server collects the results of the sensors and stores them in Cloud.

AlbertusEgaDwiputra,HandryKhoswanto,RaymondSutjiadi, Resmana Lim designed an IoT-Based Car's Parking Monitoring System. It was published by MATEC Web of Conferences 164 in 2018.Findings from this research are IoT or Internet of Things plays an important role in our day-to-day life. It is used to interconnect one device too. Another through the internet. In the proposed system, we develop a user-friendly application for IoT based Smart. Parking assistance is provided to find the user's parked vehicle from the parking lot through the. Application. At each parking slot, LED indications are used to identify the occupied and unoccupied spaces. IR Proximity sensor is

used to detect whether parking slot is occupied or not. Firstly, this paper gives 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 is presented to show advantages and drawbacks of each different smart parking system to discuss results and open directions for future research.

P. Kanakaraja, L.S.P. Sairam Nadipalli, S.V. Aswin Kumar, K. Sarat Kumar, K. Ch. Sri Kavya designed implementation of advanced IoT in the car parking system the findings are Administrations are entrusted with holding a parking space, verifying a saved client, recognizing the nearby free space determined by the length of the vehicle, and exploring the leaving opening and figure day by day, week by week and month to month accounts data. IR sensors are utilized to decide if there is a free parking spot. Utilizing Wi-Fi module innovation, microcontroller, and remote correspondence innovation, the accessibility of a free opening with its area data is transmitted to the server and recovered by means of versatile application.

Sunil Chouhan, Sandhya P designed Internet of things based car parking system the findings from this are in the current era, we are facing a new problem of parking of vehicles. It is a major problem in urban cities. The problem is tougher because of the continuously growing number of vehicles and size of vehicles. Car parking is not just a major problem in India but also in all over the world. We know that one million vehicles burn oil every day. In this paper, we propose an automatic and real-time system for automated car parking. This system would be implemented using internet of things (IOTs). IOT refers to any physical thing that is connected to the internet or exchanging information or data between internet and physical device. IOT automation by supplying parking slot free information. The user can book in advance the parking slot and update the information to the server. Every user has a unique id and password. In case a car is stolen and enter the parking IOT the server checks the database and informs the police.

PROPOSED SYSTEM

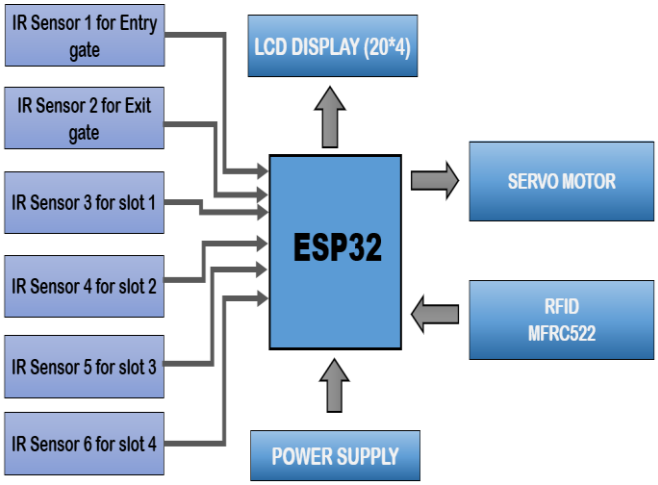

Figure 1: Basic Module

1. IR Sensors:
- IR Sensor 1 for Entry Gate: Detects the presence of a vehicle at the entry gate. When a vehicle arrives, this sensor signals the system to open the gate or update the parking slot status.

- IR Sensor 2 for Exit Gate: Monitors the vehicle's exit from the parking area. It signals the system to open the exit gate or update the parking slot status upon vehicle departure.

- IR Sensors 3, 4, 5, and 6 for Slots 1, 2, 3, and 4: These sensors are placed at individual parking slots. They detect whether a slot is occupied or vacant. The information from these sensors is crucial for updating the parking availability status in real time.

2. ESP32:
- The ESP32 is a microcontroller that acts as the central processing unit for this smart parking system. It receives signals from the IR sensors and processes the data to manage the parking slots. It also controls other components like the LCD and servo motor.

3. LCD Display:
- The LCD is used to show real-time information about the parking slots. It could display messages such as the number of available slots or direct vehicles to vacant spots. The information on the display is updated based on the data received from the ESP32.

4. Servo Motor:
- The servo motor is likely used to control the movement of the entry and exit gates. When the ESP32 receives a signal from the IR sensors at motor to open or close the gate accordingly.

5. Power Supply
- The power supply component provides the necessary electrical power to all the components in the system, ensuring that the sensors, ESP32, LCD, and servo motor operate correctly.

6. RFID MFRC522
- The MFRC522 is a highly integrated RFID (Radio-Frequency Identification) reader/writer chip developed by NXP Semiconductors. It operates at a frequency of 13.56 MHz and is designed for contactless communication with RFID tags and cards. The RC522 is a popular module based on this chip that provides an easy-to-use interface for interfacing with microcontrollers like Arduino.

CIRCUIT DIAGRAM

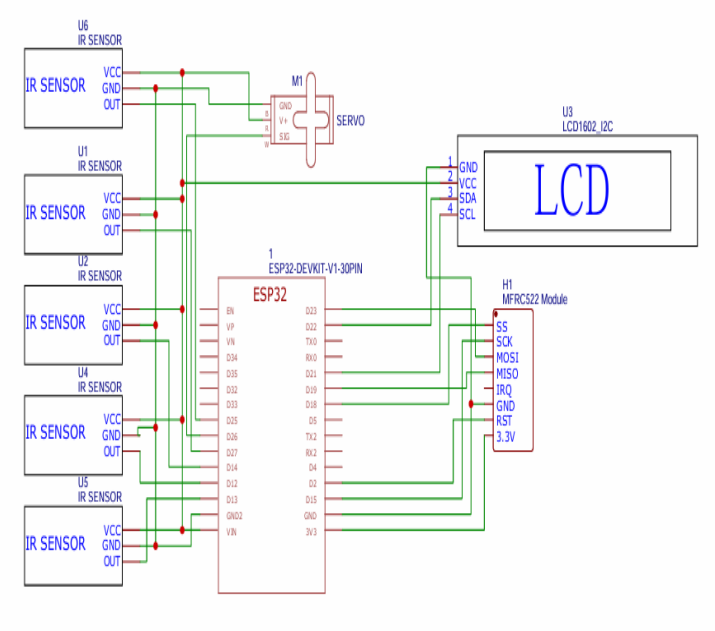

Figure 2: Schematic car parking

METHOLODGY

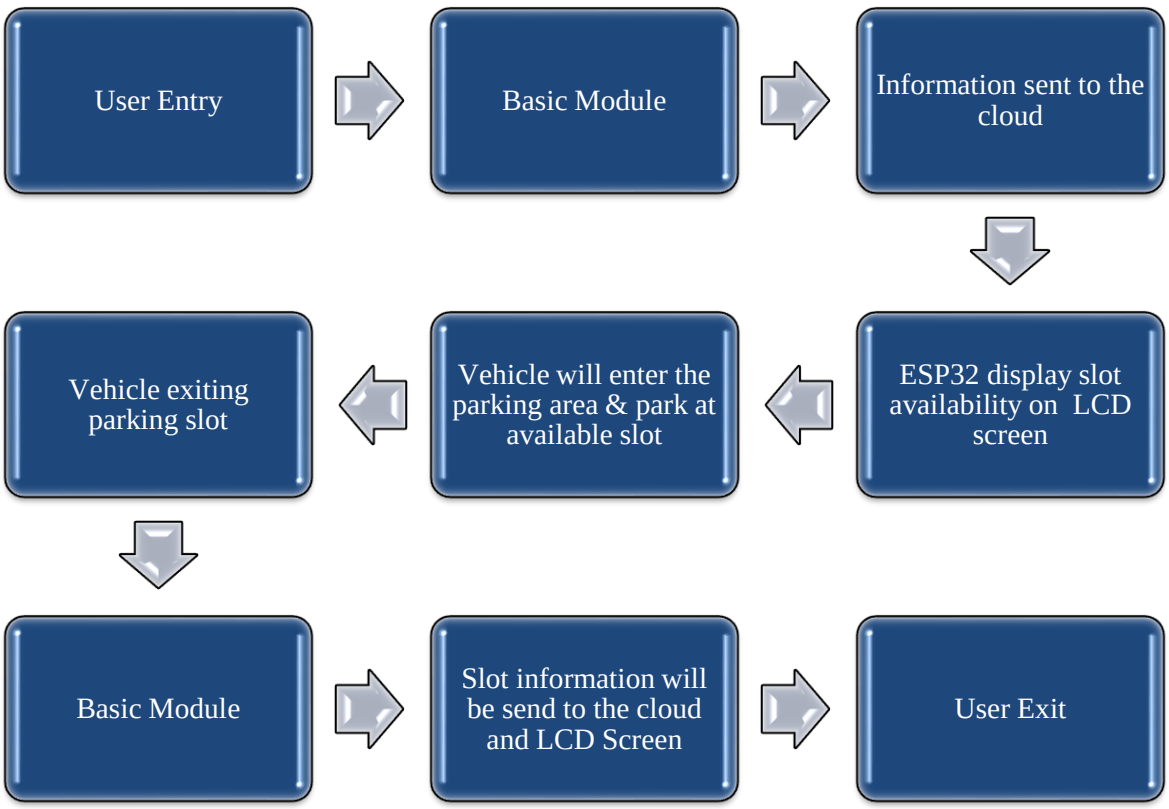

Figure 3: Working of system

1. User Entry: A vehicle arrives at the parking facility.

2. Basic Module Activation: The system activates the basic module, which includes the detection of the vehicle's presence.

3. Information Sent to Cloud: The system sends data about the vehicle's entry to the cloud for processing and storage.

4. Vehicle Parking: The vehicle is directed to an available parking slot based on real-time data.

5. Slot Availability Display: The ESP32 microcontroller updates the LCD screen with the availability status of parking slots.

6. Slot Information Update: The system sends updated slot availability information to both the cloud and the LCD screen.

7. Vehicle Exit: When the vehicle leaves the parking slot, it is detected by the system.

8. Basic Module Activation (Exit): The system reactivates the basic module to update the exit status.

9. User Exit: The vehicle exits the parking facility, and the process is complete.

CONCLUSION AND FUTURE SCOPE

Enhanced Urban Mobility: The implementation of Smart Vehicle Parking Systems (SVPS) can significantly improve urban mobility by efficiently managing parking resources. By reducing time spent searching for parking, these systems contribute to decreased traffic congestion and lower emissions. Technological Integration: Future advancements in IoT technology will further enhance smart parking systems. Integrating artificial intelligence and machine learning can optimize space allocation even more effectively, offering predictive analytics to anticipate parking demand based on real-time data. Sustainable Urban Development: As urban areas continue to growth adoption of smart parking solutions will play a critical role in sustainable urban development. Future projects could focus on expanding these systems to encompass other public facilities, creating a cohesive urban.

FINAL SYSTEM

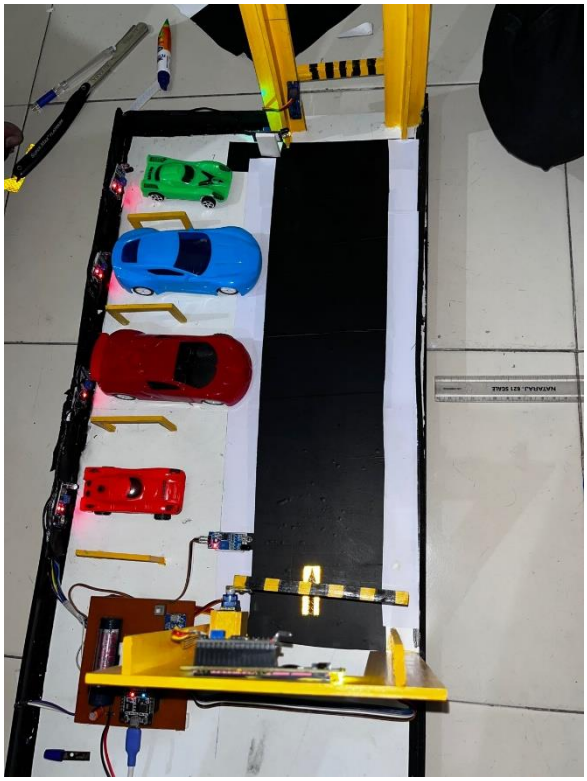

Figure 4: Final module

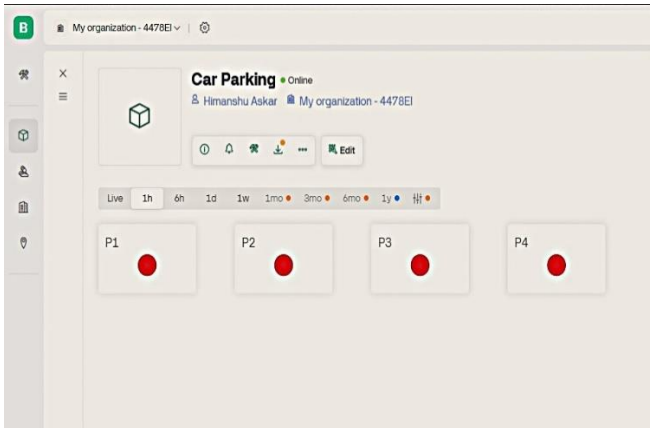

Figure 5: Web Server

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