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ADVANCED CAR PARKING SYSTEM WITH REAL TIME AVAILABILITY AND BOOKING

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Abstract: This paper delves into the challenges inherent in conventional parking systems, highlighting their inefficiencies and the resulting inconvenience and impact on users. To address these issues, the implementation of Advanced Car Parking System utilizing IoT technology is proposed. This innovative system aims to enable users to locate vacant parking slots within a specified area, thereby minimizing unnecessary travel through congested parking lots. The technology in this system is the integration of IoT, Wi-Fi, and RFID (Radio-Frequency Identification), alongside key components such as a mobile application, IR sensors, RFID tags, and Arduino microcontrollers. Through real-time data provided by the system, users can access information on nearby parking facilities and the availability of parking spaces. Furthermore, the mobile application empowers users to remotely reserve their desired parking spot and authenticate their access using an RFID tag upon arrival. Additionally, if a user enters the parking lot without a booking, they can utilize any available free slots for parking. Importantly, the system implements a restriction ensuring that once a car enters the lot, no other car is allowed to enter until the parked car is settled, contributing further to efficient parking management and traffic flow optimization. By enhancing parking efficiency, reliability, and convenience, this solution not only reduces the time and resources expended in searching for parking spaces but also contributes to pollution reduction efforts

Index terms **- IoT (Internet of Things), Sensors, RFID, Arduino Uno, Advanced Car Parking System, Traffic Congestion, Android Application**

I. INTRODUCTION

The fundamental concept of the Internet of Things (IoT) encompasses the connectivity and remote control or monitoring capabilities of various devices over the internet. IoT comprises a network of sensors, smart devices, and actuators, which streamline day-to-day tasks. This network enables the remote tracking, monitoring, and management of activities and processes via internet connectivity. By extending internet usage, IoT establishes a network of interconnected 'Things' capable of interaction. This vision envisions a scenario where everyday objects, such as home devices, sensors, and wearables, become intelligent. Leveraging cloud computing, IoT achieves scalability and intelligence. The network allows for seamless addition or removal of nodes, while facilitating real-time data analysis and monitoring, thereby reducing manual intervention.

An enduring challenge faced by individuals globally is the difficulty in locating and securing parking spaces, particularly in multi-level parking facilities. This challenge is further compounded in high-traffic areas such as airports and malls. Research conducted by IBM reveals that a significant majority of drivers experience prolonged search times for vacant parking slots, with parking troubles being a primary concern for many. The proposed system aims to alleviate these issues by offering hassle-free, efficient, and convenient parking solutions. In an age where technology is pervasive and smart solutions are increasingly prevalent, public parking infrastructure remains largely untouched by advancements. Establishing an effective, reliable, and real-time parking system remains a substantial challenge. However, this problem can be addressed by integrating parking facilities with the IoT network and deploying sensors, as detailed in this paper.

II. PROPOSED SYSTEM

The proposed system is the Integration of the below mentioned components

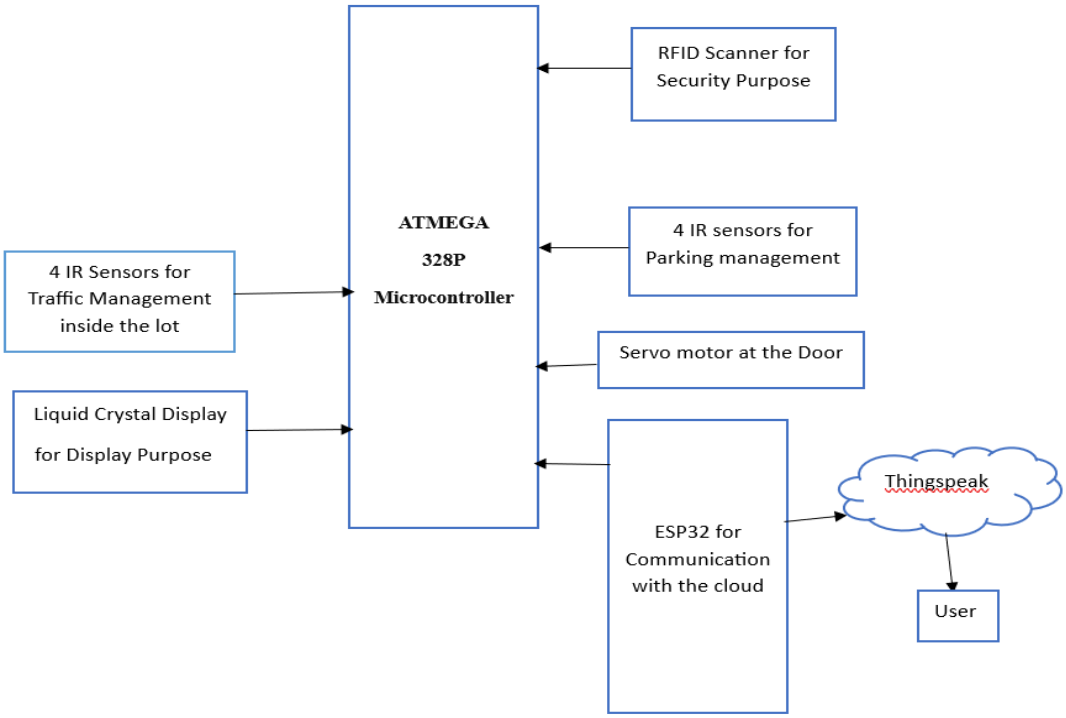

Fig 1: Block diagram

2.1.1 Arduino Uno

Arduino Uno plays a pivotal role as the core component within the proposed system. It serves as the central processing unit, orchestrating the interactions among various elements. The versatility and programmability of Arduino Uno make it an ideal choice for integrating different systems and managing data flow effectively

2.1.2 Security system

In this project, the RFID scanner serves as the security system. When a user enters the parking lot, they are required to scan their RFID tag. If the RFID tag is authorized, the door opens, granting access. This system ensures that only authorized drivers can enter the parking lot, enhancing security and control over access to the premises.

2.1.3 Integrating IOT system with the Cloud

In this setup, the Arduino Uno communicates seamlessly with an ESP32 module, enabling the transfer of information to the ThingSpeak cloud. ThingSpeak provides a platform for effortless collection, processing, and visualization of data from IoT devices. Leveraging the features of Arduino Uno, the ESP32 efficiently gathers data from connected sensors or peripherals and transmits it to the cloud.Once uploaded to the ThingSpeak cloud, the data becomes accessible through a mobile app. This integration enhances the system's usability, allowing users to remotely monitor and analyze information in real-time

2.2 Implementation

The project's execution consists of two components: creating a software environment with MIT App Inventor and building an IoT hardware system that interacts with the developed app via ESP32 and the cloud.

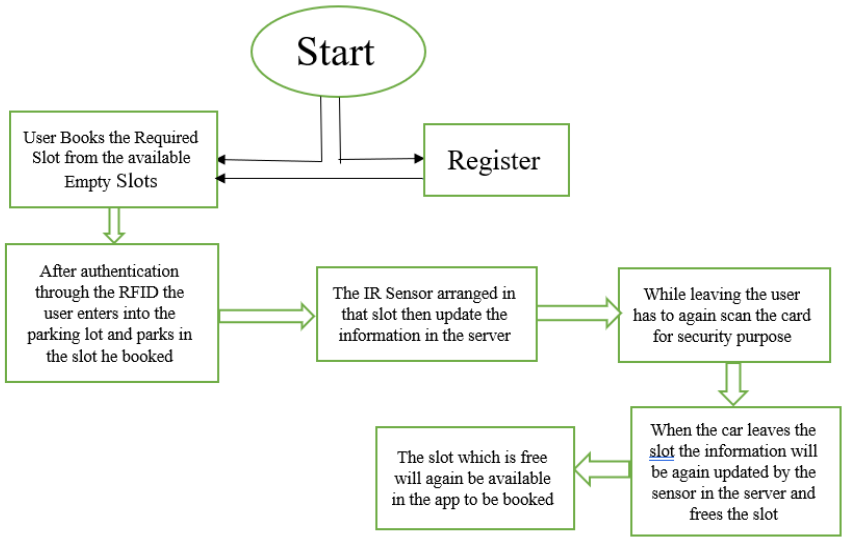

Fig 2: Implementation diagram

2.2.1 Hardware setup

The hardware setup in this project contains the Arduino board connected to the power source and the security system that comprises of RFID scanner and RFID tags, a LCD module is used to showcase the status of the IR sensors. To enable IoT functionality, the project utilizes the ESP8266 WiFi module. With its built-in WiFi capability, this module allows seamless connection to local networks, facilitating communication between devices and access to the internet. By integrating the ESP8266 module, the project gains the ability to communicate with remote servers and other IoT devices, enhancing its connectivity and enabling various IoT applications.

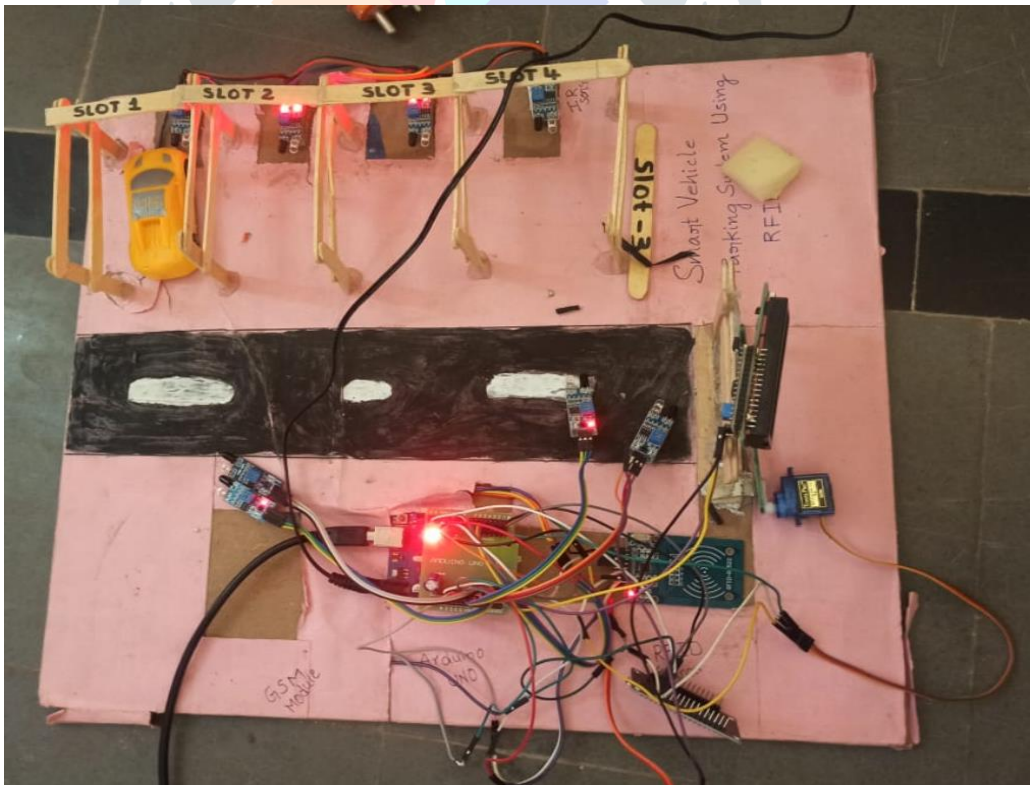

Fig 3: Hardware setup

2.2.2 Software development

In the software development phase, there are two key elements: the backend system responsible for data analysis and acquisition, and the frontend mobile application for user interaction. Arduino IDE plays a pivotal role in transmitting data from hardware to WiFi. It

is employed to customize the programming of the WiFi module based on user-defined requirements. The backend system establishes communication with the IoT platform, facilitating seamless integration across all components. The mobile application used in this project is developed using MIT App Inventor. In this App we Access the information about the Sensors through the cloud enabling the user to get updated with the information about the available free slots in the parking lot system are implemented in this paper.

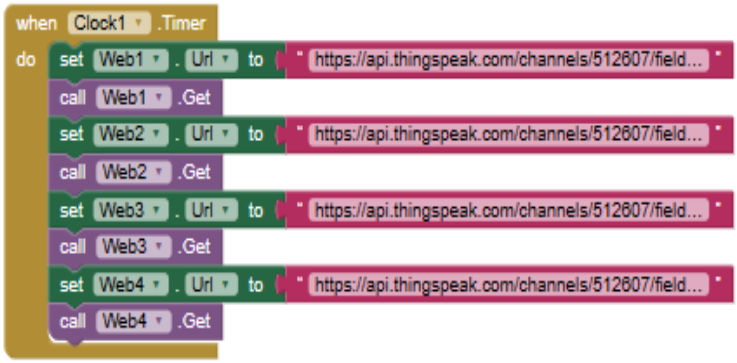

Fig 4: Mobile APP Development in MIT APP Inventer

III. RESULTS AND DISCUSSION

The results of this Project showcases the system's efficiency in overcoming the problems with conventional parking system underscores its viability as a reliable solution which meets present age requirements. Also, the Rfid system provides Real time security more than the other Image Processing and other security systems.

The below figure shows the parking allotment for the user in LCD in the project when theuser enters the parking lot by checking the status of the IR sensors the system automatically allots the free space available. The A,B,C and D are the available slots in the parking lot. If slot shows '0' it means it is free,if it is '1' it means it is filled and when it is '2' it means the slot is booked.

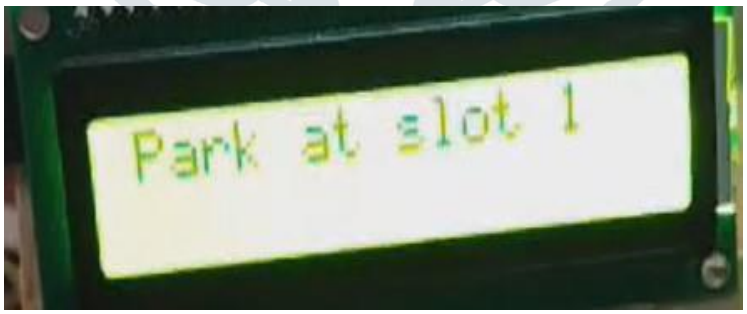

Fig 5: Lcd Showing parking Allotment

Fig 6: LCD showing Slots Status

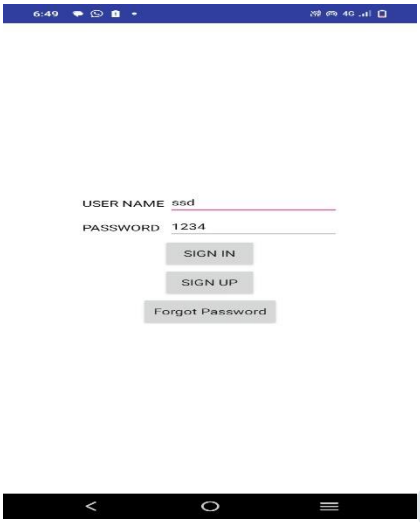

Fig 7: App Registration Page

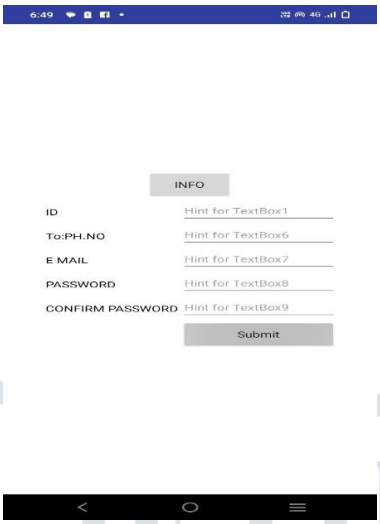

Fig 8: Sign Up Page

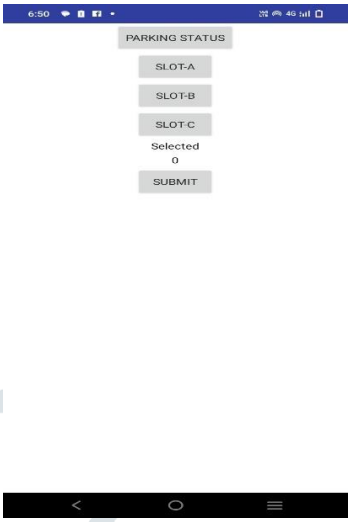

Fig 9: Slot Booking Page

IV. CONCLUSION

In conclusion, the proposed Advanced Car Parking System utilizing IoT technology presents a promising solution to address the challenges faced by conventional parking systems. By leveraging IoT, Wi-Fi, and RFID technologies, alongside key components such as mobile applications, IR sensors, RFID tags, and Arduino microcontrollers, the system aims to enhance parking efficiency and user convenience. Through real-time data dissemination, users can locate vacant parking slots, reserve spots remotely, and authenticate access upon arrival, thereby minimizing unnecessary travel and optimizing parking management.

This innovative solution offers several merits. Firstly, it improves efficiency by reducing time and resources expended in searching for parking spaces, leading to improved overall satisfaction for users. Secondly, the system enhances the user experience with features such as real-time data access and remote reservation capabilities through the mobile application, offering a seamless and convenient parking experience. Additionally, by minimizing unnecessary travel through congested parking lots, the system contributes to traffic flow optimization and supports pollution reduction efforts.

However, certain demerits must be acknowledged. The initial implementation cost of deploying IoT infrastructure and hardware components may pose a financial challenge. Technical hurdles such as integration and maintenance of various technologies, including IoT, Wi-Fi, and RFID, could also arise during system operation. Moreover, the system's dependence on technology for parking management may introduce vulnerabilities such as system downtime or technical glitches.

Looking ahead, there is significant scope for future development and refinement of the Advanced Car Parking System. Potential areas for improvement include enhanced data analytics for optimized parking allocation, integration with broader smart city infrastructure, further incorporation of sustainable practices, and implementation of autonomous parking technology. Despite the challenges, the Advanced Car Parking System holds promise for revolutionizing parking management and urban mobility, with opportunities for ongoing innovation to meet evolving user needs and urban challenges.

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