Advanced Parking System using IOT

Kiran Kumar A[1, a)] Revanth Derangula, Mahitha Kummeta, Mamatha Chukkaluru, Sai Hemanth Kumar Meda[2, 3, 4, 5b)]

[1]*Assistant Professor, Computer Science and Engineering, Srinivasa Ramanujan Institute of Technology, Anantapur, India.*
[2,3,4,5]*Computer Science and Engineering in AI&ML, Srinivasa Ramanujan Institute of Technology*

[a)]kirankumara.cse@srit.ac.in
[b)]204g1a3336@srit.ac.in
[c)]204g1a3320@srit.ac.in
[d)]204g1a3321@srit.ac.in
[e)]204g1a3339@srit.ac.in

Abstract. In the face of rapid urbanization and the corresponding surge in vehicular density, effective parking management has become an increasingly complex challenge in metropolitan areas. Traditional systems prove inadequate in addressing the dynamic and multifaceted nature of modern urban parking demands.

To meet these challenges head-on, this paper introduces an IoT-based Advanced Parking System that integrates cutting-edge technologies to revolutionize urban parking management. This system employs strategically deployed sensors, such as ultrasonic or infrared, to provide real-time insights into parking slot availability and efficiently identify instances of improper parking. The collected data is transmitted to a central IoTplatform, acting as the intelligence hub for processing and analysis. Through the integration of a Gate System, secure entry and exit are regulated based on dynamic parking conditions. User interaction is facilitated by Blynk applications, offering seamless access to real-time information and advanced reservation capabilities.

This paper highlights the pivotal role of the sensor mechanism in triggering immediate alerts for swift intervention in cases of improper parking, emphasizing a comprehensive and technology-driven approach to address the complexities of contemporary urban parking challenges.

Keywords: IoT (Internet of Things), Microcontroller Sensor Mechanisms, Real-time Parking Slot Availability, Blynk software, Improper Parking Detection.

INTRODUCTION

Amid rapid urbanization and the ensuing surge in vehicular density, the pressing challenge of effective parking management in metropolitan areas has become increasingly intricate. Conventional systems, grappling with the dynamic and multifaceted nature of modern urban parking demands, reveal inherent inadequacies.

To confront these challenges head-on, this paper introduces an innovative solution—the IoT-based Advanced Parking System. This system, utilizing state-of-the-art sensor technologies like ultrasonic or infrared, aims to revolutionize urban parking management by providing real-time insights into parking slot availability and adeptly identifying instances of improper parking. The data collected from these strategically deployed sensors is seamlessly transmitted to a central IoT platform, acting as the intelligence hub for processing and analysis. However, amidst the pursuit of a more efficient parking paradigm, challenges arise in the form of technological integration, data processing complexities, and user acceptance.

This prototype delves into the integration of a Gate System to regulate secure entry and exit based on dynamic parking conditions, all while considering these challenges. User interaction is facilitated through Blynk applications, offering a user-friendly interface for real-time information access and advanced reservation

capabilities. The paper not only emphasizes the pivotal role of the sensor mechanism in triggering immediate alerts for swift intervention in cases of improper parking but also acknowledges the challenges that accompany the adoption of such a comprehensive and technology-driven approach. By addressing these intricacies, this prototype aims to contribute to a transformative solution for the effective and efficient management of contemporary urban parking challenges, ultimately paving the way for a smarter and more sustainable urban mobility landscape. By addressing these intricacies, this research aims to contribute to a transformative solution for the effective and efficient management of contemporary urban parking challenges

LITERATURE SURVEY

A Smart Parking System Using IOT

The paper explores a smart parking system using IoT, Arduino, and 3 IR sensors for user and admin convenience. It employs cloud technology for data storage, utilizes ultrasonic waves for vehicle presence detection, and introduces a two-tier parking concept. Thesystem aims to enhance global connectivity in parking areas, reduce time, and offer a cost-effective solution. [1]

An IoT assisted Intelligent Parking System (IPS) for Smart Cities

This paper discusses Intelligent Parking Systems (IPS) with a focus on an IoT-enabled framework utilizing Raspberry Pi, NodeMCU, RFID, and IR sensors. The system enhances real-time data transmission, parking availability assessment, and efficient space utilization. Through technologies like Firebase and AWS RDS, the study showcases the promise of IoT-empowered IPS and suggests potential avenues for future enhancements in parking management systems. [2]

An IoT based Smart Parking System using NodeMCU

The paper introduces an IoT-based smart parking system using NodeMCU ESP8266, aiming to alleviate urban parking challenges.It detects vehicle presence, displays available slots, and records data in cloud storage. Future plans include security enhancements, user guidance, pricing integration, and mobile app development for efficient urban parking management. The proposed system promises benefits such as automated payments and contributes to a sustainable and convenient urban environment. [3]

Real Time Car Parking System

This paper explores the progress in Real-Time Parking Systems, presenting a prototype for efficient parking area management withminimal cost and effort. The smart parking system employs infrared sensors and Arduino Uno to automate the examination of available parking spaces, reducing time and enhancing accessibility for common users in the modern world. [4]

OBJECTIVE

To develop an IoT-based system that can accurately and efficiently detect parking slot availability in a defined parking area, providing real-time information to users and developing the Automated Gate System.

Extension to the above setup to develop an effective parking management system using a sensor mechanism to detect and address improper parking instances and to implement a Slot Booking System using a software platform.

EXISTING SYSTEM

The methodology of the existing urban parking system relies predominantly on traditional approaches, characterized by manual monitoring and static signage. In this conventional setup, the assessment of parking availability and the detection of improper parking instances primarily hinge on periodic manual checks conducted by parking attendants or administrators. Real-time information about available parking spaces is often lacking, and users depend on static signs, resulting in delays and increased search times. Entry and exit processes in the existing system are typically

managed through established methods such as ticketing systems. However, these mechanisms may not effectively adapt to the dynamic demands of urban parking, contributing to user dissatisfaction and operational inefficiencies. Users are commonly faced with limited reservation options and lack user-friendly interfaces, affecting the overall convenience and accessibility of the parking experience. The identification of improper parking instances, such as violations related to multiple parking spaces or restricted zones, is largely reactive and relies on manual oversight. This manual approach, coupled with the absence of immediate alerts for violations, poses challenges in maintaining orderand security within parking facilities. Historical data and user feedback highlight these inherent limitations in the methodology of the existing system. Statistical analyses reveal patterns of increased search times, growing dissatisfaction with entry and exit processes, and a rising demand for more user-friendly and efficient parking solutions. Overall, the existing urban parking system, characterized by manual monitoring and traditional methodologies, confronts challenges that impede its effectiveness. Delays in real-time information, reactive responses to improper parking and inefficiencies in the entry and exit operations. To enhance the model's robustness and usability in real-world applications, it is imperative to address these challenges effectively

PROPOSED SYSTEM

The proposed IoT-Based Advanced Parking System represents a paradigm shift in urban parking management by addressing existingchallenges comprehensively. It employs state-of-the-art technologies, including ultrasonic and infrared sensors, strategically deployedto provide real-time insights into parking slot availability and detect improper parking instances. Key to the system's effectiveness isthe integration of a Gate System, ensuring secure entry and exit regulation based on dynamic parking conditions. User interaction is significantly improved through Blynk applications, offering a user-friendly interface for accessing real-time parking information and enabling advanced reservation capabilities. The system goes beyond mere detection, promptly addressing violations such as occupying multiple slots or exceeding parking limits. Continuous monitoring is implemented to ensure optimal performance of both hardware and software components. Evaluation metrics, including traffic congestion reduction, user satisfaction, and parking information accuracy, provide a foundation for ongoing improvements and updates, showcasing the system's adaptability and responsiveness. The proposed concept aims to revolutionize urban parking management through cutting-edge technologies like ultrasonic and infrared sensors, enhancing security, user interaction, and overall efficiency. The system's goal is to optimize space utilization, reduce violations, and provide a seamless and responsive experience for urban mobility.

System Architecture

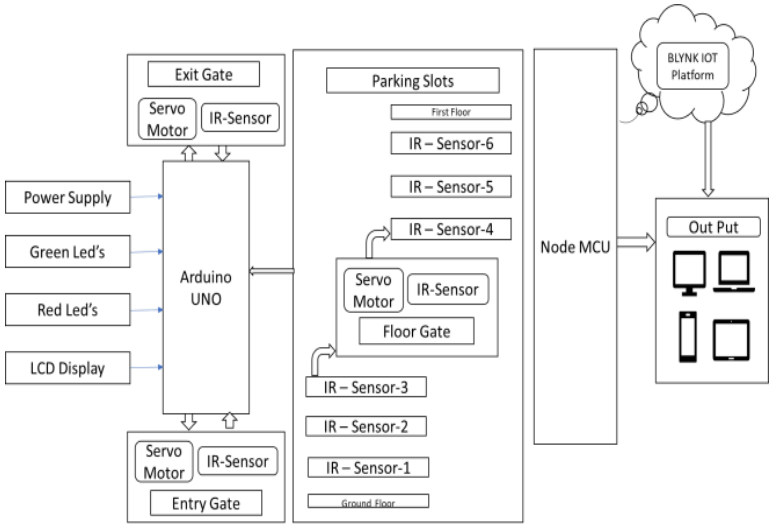

FIGURE 1: Block Diagram of System Architecture.

Circuit Architecture

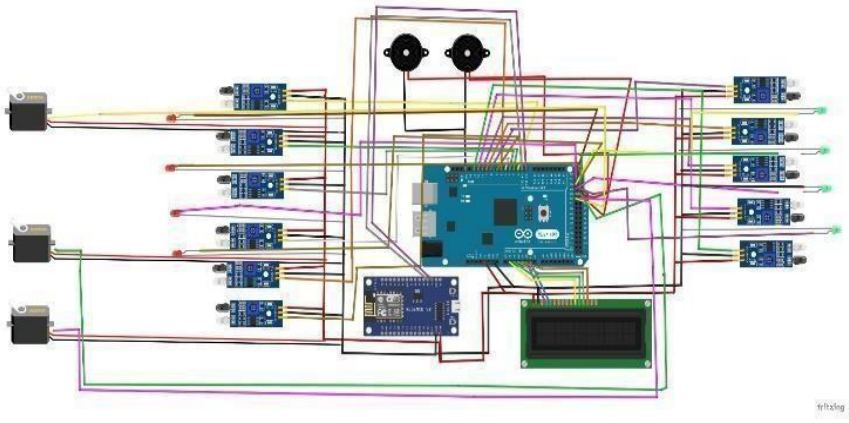

FIGURE 2: Block Diagram of Circuit Architecture

Details Of Components

Arduino Mega 2560

The Arduino Mega 2560 R3 One well-known microcontroller board that Arduino has created is the Mega 2560 R3. The revised version provides an ample number of 16 analog inputs and 54 digital input/output pins. With the 256KB of flash memory and 8KB of SRAM, the Mega 2560 offers significantly more storage space than the standard Arduino Uno. The majority of Arduino Uno shields are compatible with the Mega 2560 and other boards, making it easy to expand its capabilities with additional modules and sensors. It can read input such as light sensors, sense motion, and output the proper data on it.

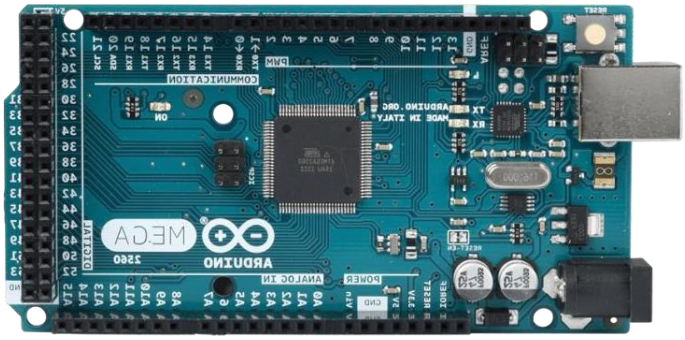

FIGURE 3: Arduino Mega 2560

Node MCU

Node MCU can transmit data wirelessly to a central server or cloud platform, allowing parking operators or users to access parking space availability information via a smartphone app or a website. The Node MCU development board typically features several GPIO (General Purpose Input/Output) pins, which may include GPIO0, GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO9, GPIO10, and others, depending onthe specific Node MCU board version.

Node MCU's Wi-Fi capabilities and compatibility with various sensors and actuators make it a versatile choice for enhancing the functionalityof a smart car parking system.

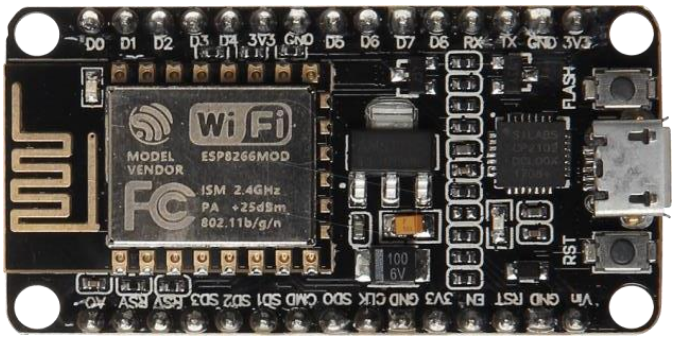

FIGURE 4: Node MCU

IR Sensor

An electrical gadget called an infrared sensor emits light to detect certain elements of its environment. Along with detecting motion, an infrared sensor may measure an object's heat. A passive infrared sensor is one of these kinds of sensors, it does not emit any IR radiation and measures it.

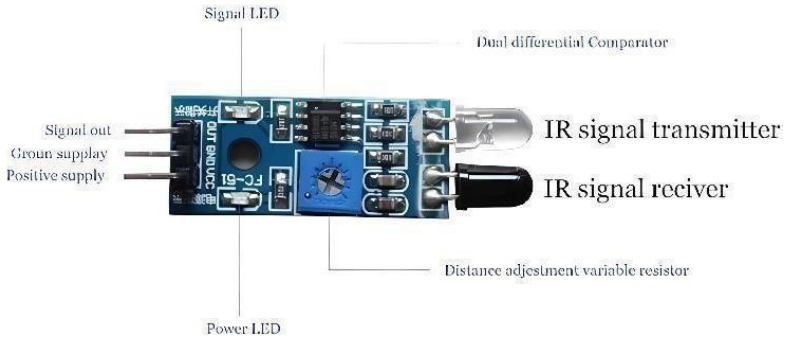

FIGURE 5: Infrared Sensor

Servo Motor

Servo motors are a type of rotary actuator that provides precise control of angular or rotational position, velocity, and acceleration. The motor receives control signals that dictate the desired position, and the sensor provides feedback to ensure the motor reaches and maintains the correctposition. They are widely used in various applications that require controlled and automated movement.

FIGURE 6: Servo Motor

*LCD's (Liquid Crystal Display) 16*2*

The term "LCD 16 * 2" typically refers to a specific type of a liquid crystal display (LCD) module within a 16x2 character configuration. This means the module can display 16 characters per line and has 2 lines of display. These LCD modules are commonly used in various electronic devices and DIY projects for displaying textual information such as sensor readings, messages, and menus.

FIGURE 7: LCD's (Liquid Crystal Display) 16*2

METHODOLOGY

The methodology of the Proposed IoT-Based Advanced Parking System is designed to address urban parking management challengesthrough a multifaceted approach.

The first part of the Objective 1, involves strategically deploying cutting-edge sensors, such as ultrasonic or infrared, in the defined parking area. These sensors are crucial for accurately detecting real-time parking slot availability. The collected data from the sensorsis then transmitted wirelessly to a central IoT platform, which serves as the intelligence hub for processing and analysis. This integratedapproach ensures that users have access to up-

to-date information about parking availability. Additionally, the deployment includes the integration of an Automated Gate System to regulate secure entry and exit based on real-time parking conditions.

In the second part of Objective 1, user interaction is facilitated through Blynk applications. This allows users to seamlessly access real-time parking information and conveniently reserve parking slots in advance. The Blynk applications enhance the user experienceand contribute to the overall efficiency of the IoT-based parking system. This part of the objective emphasizes the user-centric designaspect of the system, ensuring that the technology not only accurately detects parking availability but also provides a user-friendly interface for interaction and convenience.

Module 1

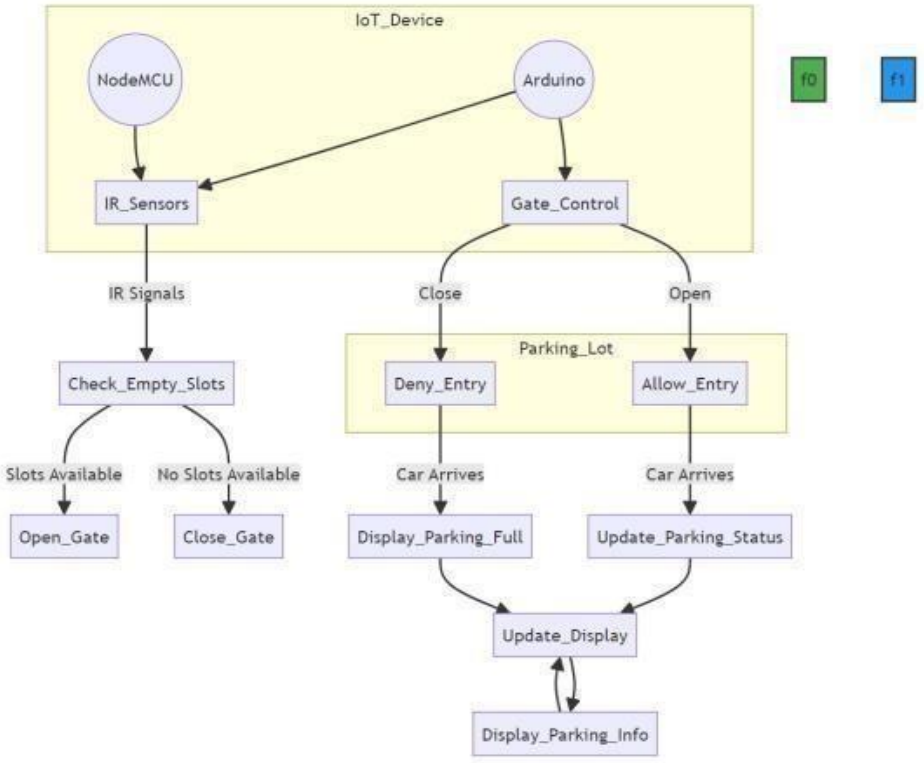

FIGURE 8: Work flow & Implementation of First Objective

The initial focus of objective 2, is the implementation of a sensor mechanism to detect and address improper parking instances. This component is critical for maintaining order in the parking area and triggering immediate real-time alerts for swiftintervention. The sensor mechanism, in conjunction with the overall IoT system, plays a key role in enhancing the efficiency and security of the parking management system.

In the second part of Objective 2, the emphasis shifts to the practical implementation of the system's capabilities. Violations such as occupying multiple slots, parking in restricted zones, or exceeding time limits lead to immediate alerts. These real-timenotifications, including buzzer alerts, are transmitted to security personnel or administrators. This part underscores the system'sability to actively address and rectify improper parking behavior promptly, contributing to the overall effectiveness of the IoT-based parking management system.

Module 2

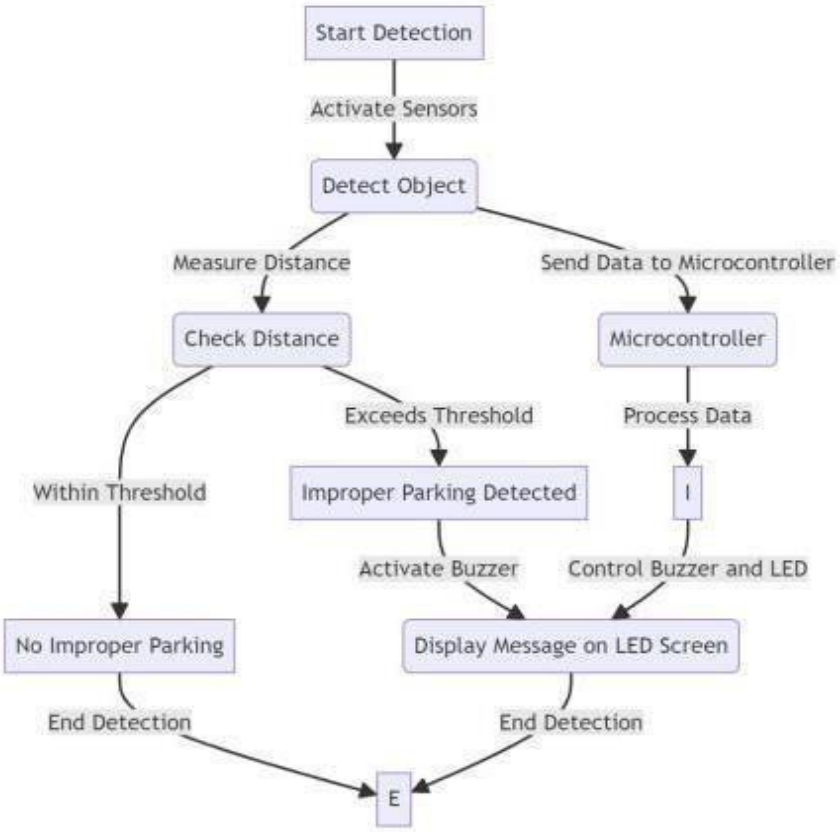

FIGURE 9: Work flow &Implementation of Second Objective

The combination of these two objectives enables the proposed system to operate effectively and improve the urban parking system compared to traditional approaches.

RESULT AND DISCUSSIONS

The IoT-Based Advanced Parking System has demonstrated significant success in urban parking management. Real-time monitoringusing advanced sensors has reduced the search time for parking spaces. Integration of a Gate System enhances security, regulating entryand exit based on current parking conditions. User-friendly Blynk applications provide convenient access to real-time information and allow for advance parking slot reservations.

The system's swift detection of improper parking instances, coupled with immediate alerts, has led to improved traffic flow and overall parking efficiency. Continuous monitoring ensures optimal hardware and software performance, with ongoing evaluations showing reduced Traffic congestion and increased user satisfaction which in results in an Effective vehicle park.

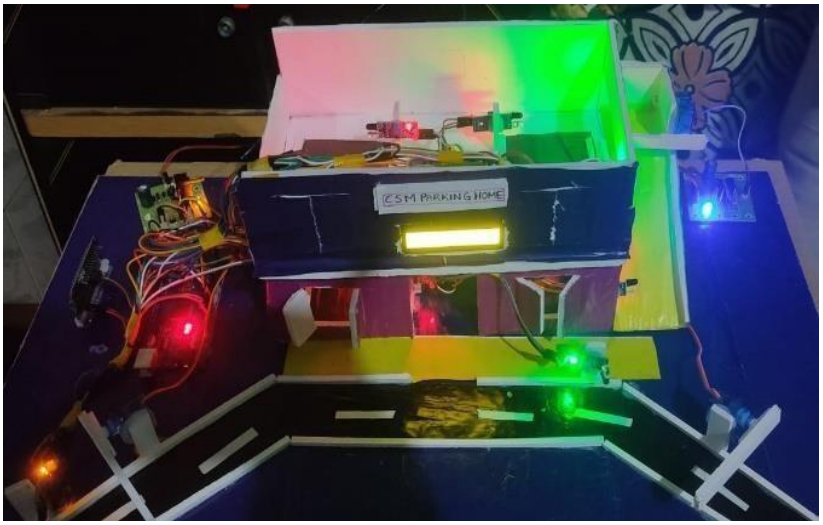

FIGURE 10: Final Hardware Prototype of Proposed System.

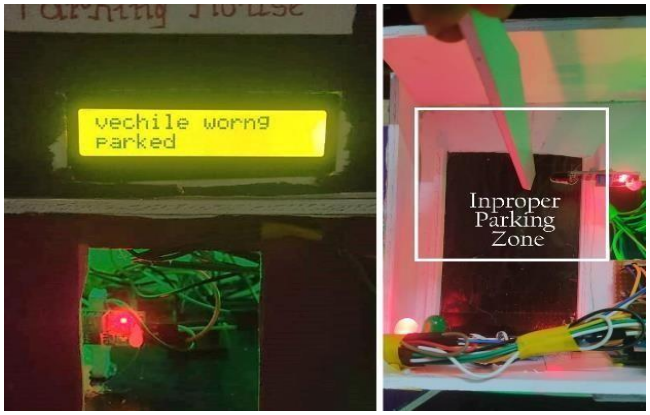

FIGURE 11: Improper Parking Instances and Alert Mechanisms.

FIGURE 12: Gate System Mechanism for Prototype.

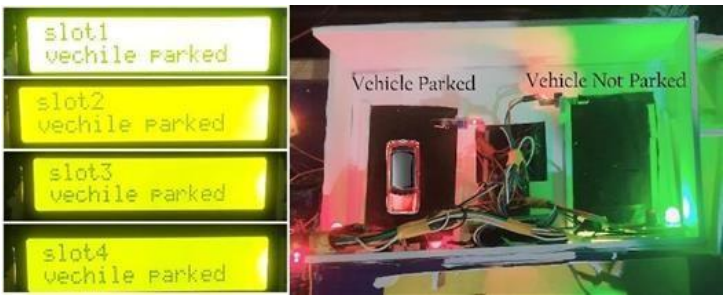

FIGURE 13: Availability Of Parking Slot Checking.

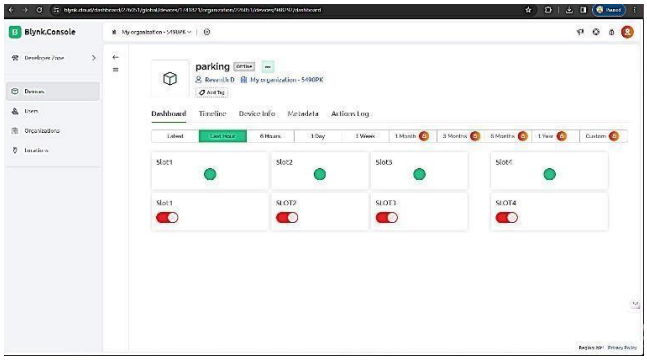

FIGURE 14: Slot Booking System using Blynk IoT Application.

Table 1: Differences between Proposed System and Existing Systems.

	Parking Slots Availability Checking	**Smart Gate System Mechanism**	**Improper Parking Instances Alert Mechanism**	**Advanced Slot Booking System**
Proposed System	✓	✓	✓	✓
Reference Paper [1]	✓	✓	**x**	**x**
Reference Paper [2]	✓	**x**	**x**	**x**
Reference Paper [3]	✓	✓	**x**	**x**
Reference Paper [4]	✓	✓	**x**	**x**
Reference Paper [5]	✓	✓	**x**	✓
Reference Paper [6]	✓	✓	**x**	**x**

CONCLUSION

In conclusion, the IoT-Based Advanced Parking System offers a comprehensive solution to urban parking challenges. Utilizing sensors and IoT technology, the system provides real-time parking information, secure entry/exit regulation, andthe ability to reserve parking slots. Swift detection of improper parking triggers immediate alerts for intervention. Continuous monitoring and evaluation metrics ensure ongoing improvements, making the system efficient, secure, and user-friendly Approach.

FUTURE SCOPE

The future scope of the proposed IoT-based parking management system introduces groundbreaking features, including real-time parking slot detection, automated gate systems, and advanced sensor mechanisms. To fortify this innovation, future endeavors will concentrate on refining AI algorithms for heightened accuracy and seamless integration with smart city infrastructure. To enhance the user experience, it would be beneficial to include a route direction feature. This feature would provide step-by-step instructions to guide the user to the available parking space. Additionally, it would keep the reserved spot on hold until the user arrives at the location. This would not only save the user's time but also provide them with a hassle-free parking experience. The system can be further developed to automate the billing process, streamlining transactions for users and providing a seamless financial aspect to the parking experience. By integrating route detection, the system aims to provide users with optimal navigation to available parking slots, enhancing overall traffic flow and reducing congestion.

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