International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 82-89
ISSN: 3071-3358

Real-Time Parking Slot Detection And Enhanced Security System For Public Parking Using IoT

Mr. Md Khaja Pasha[1], Md Ashraf[2], Mohammed Nomanullah[3], Mohammed Shaik Hussain[4], Mohammed Mustafa[5]

[1]Assistant professor; Department of Electronics and Communication Engineering, Lords Institute of Engineering and Technology, Hyderabad, Telangana, India.

[2,3,4,5]B.E.Students; Department of Electronics and Communication Engineering, Lords Institute of Engineering and Technology, Hyderabad, Telangana, India.

Corresponding Author Email ID: khajapasha@lords.ac.in

Abstract

The rapid growth of urbanization and vehicle ownership has intensified parking-related challenges in cities, leading to traffic congestion, increased fuel consumption, and inefficient utilization of parking spaces. This paper presents a comprehensive Internet of Things (IoT)-based smart parking system designed to address these challenges through real-time parking slot monitoring, cloud-based data management, and enhanced security mechanisms. The proposed system employs IoT sensors to detect parking slot occupancy and transmits the collected information to a cloud server, enabling users to monitor parking availability through a mobile application. Additionally, the system integrates surveillance cameras, automated alerts, and access control mechanisms to improve parking security and safety. By providing real-time updates and intelligent monitoring, the proposed solution minimizes search time for parking spaces, reduces traffic congestion, improves resource utilization, and enhances the overall user experience. The integration of cloud computing with IoT technology ensures scalability, reliability, and efficient data management, making the system suitable for deployment in smart cities and modern urban environments.

Keywords— *IoT, Smart Parking, Cloud Computing, Sensors, Security, Automation.*

Introduction

The rapid increase in urban population and vehicle ownership has created significant challenges in managing public parking facilities. Drivers often spend considerable time searching for vacant parking spaces, which contributes to traffic congestion, increased fuel consumption, environmental pollution, and driver frustration. Conventional parking systems generally rely on manual supervision or static information boards that are unable to provide real-time parking availability. As cities continue to expand, there is a growing demand for intelligent parking management systems capable of improving parking efficiency while reducing unnecessary vehicle movement. Recent advances in Internet of Things (IoT) technology have enabled the development of automated parking solutions that provide real-time monitoring and efficient resource utilization **[1], [2], [3].**

The Internet of Things has emerged as a key technology for connecting physical devices, sensors, controllers, and communication networks into an integrated environment capable of exchanging information automatically. IoT-based parking systems use sensors installed at individual parking slots to determine occupancy status and transmit the collected information to centralized servers. This real-time communication enables drivers to identify available parking spaces before reaching the destination, thereby minimizing traffic congestion and improving overall transportation efficiency. The scalability and flexibility of IoT technologies have made them suitable for smart city applications where continuous monitoring and automation are essential **[3], [4], [5].**

Received: *15-01-2026*
Revised: *21-02-2026*
Accepted: *18-03-2026*
Published: *25-03-2026*
Citation: *" Real-Time Parking Slot Detection And Enhanced Security System For Public Parking Using Iot ", ijaicn, vol. 2, no. 1, pp. 82–89, jan. 2026,*

Cloud computing further enhances IoT-based parking systems by providing centralized data storage, remote accessibility, and efficient processing of sensor information. Cloud platforms enable parking data to be stored securely while allowing users to access parking availability through mobile applications or web-based dashboards from any location. Historical parking records maintained in the cloud can also support traffic analysis, demand prediction, and efficient allocation of parking resources. The integration of cloud computing with IoT improves system reliability and supports large-scale deployment in urban environments **[2], [5], [9].**

Modern embedded controllers equipped with wireless communication capabilities have simplified the implementation of intelligent parking solutions. The Raspberry Pi Pico W provides integrated Wi-Fi connectivity, low power consumption, and sufficient processing capability to interface with various parking sensors and cloud services. When combined with surveillance cameras, automated access control, and mobile notification systems, such platforms not only monitor parking occupancy but also strengthen vehicle security and user safety. These technologies collectively contribute to the development of smart parking infrastructure suitable for future smart city environments **[7], [8], [10].**

The proposed work presents a real-time parking slot detection and enhanced security system that integrates IoT sensors, cloud computing, surveillance mechanisms, and mobile communication into a unified platform. The system continuously monitors parking slot occupancy, updates the cloud database in real time, provides parking availability through a mobile application, and enhances security using surveillance cameras and automated alerts. This integrated approach aims to reduce parking search time, improve parking space utilization, strengthen vehicle security, and provide a convenient parking experience for users in modern urban areas **[1], [2], [10], [12].**

Literature Review

Chawla et al. proposed an IoT-based smart parking system capable of monitoring parking slot occupancy in real time using cloud connectivity. The developed system continuously collected occupancy information from parking sensors and updated the cloud database, enabling users to identify available parking spaces through remote applications. The authors reported improved parking management efficiency and reduced vehicle search time through continuous monitoring and cloud integration **[1].**

Patil et al. developed a smart parking management framework that combined IoT devices with cloud computing for efficient parking administration. Their work demonstrated that centralized cloud storage simplified real-time monitoring while improving data accessibility and scalability. The proposed architecture also reduced manual intervention and enhanced parking resource utilization through automated occupancy monitoring **[2].**

Khanna and Kaur presented a comprehensive review of Internet of Things technologies and discussed their applications in transportation, healthcare, agriculture, industrial automation, and smart city infrastructure. The authors highlighted that IoT enables continuous communication among connected devices, making it suitable for intelligent parking systems that require real-time data acquisition and remote monitoring **[3].**

Hassoune et al. conducted an extensive survey on smart parking systems by analyzing various sensing technologies, wireless communication protocols, cloud platforms, and mobile applications. The review identified real-time parking detection, efficient space allocation, and intelligent user guidance as essential features for future smart parking solutions while emphasizing the importance of system scalability and reliability **[9].**

Bock et al. proposed an IoT-enabled parking architecture for intelligent transportation systems that integrated wireless sensors with cloud-based data management. Their architecture supported real-time parking availability, centralized monitoring, and efficient communication between parking infrastructure and end users. Experimental evaluation demonstrated improvements in traffic flow and parking efficiency within urban environments **[10].**

Revathi and Dhulipala designed a cloud-assisted smart parking system integrated with mobile applications and vehicle security mechanisms. Their system enabled users to monitor parking availability remotely while incorporating security features that enhanced vehicle protection. The authors concluded that combining cloud services with IoT improved user convenience and overall parking management efficiency **[12].**

Ahmed et al. introduced an intelligent parking management system based on wireless sensor networks and IoT technology. The proposed system accurately detected parking slot occupancy and transmitted sensor information to centralized servers for real-time monitoring. The study demonstrated that wireless sensing technologies significantly improved parking detection accuracy and optimized parking space utilization **[13].**

Ghai et al. presented a cloud-based IoT architecture designed for smart city monitoring and automation. Their framework emphasized centralized data processing, secure cloud communication, and scalable deployment of IoT applications. The proposed architecture provided an effective foundation for integrating parking management systems into larger smart city infrastructures **[15].**

Singh et al. proposed a real-time parking slot detection and security monitoring system that combined IoT devices with cloud analytics. The system integrated parking occupancy detection, surveillance mechanisms, automated notifications, and cloud-based monitoring into a unified platform. Experimental results demonstrated improved parking efficiency, reduced search time, and enhanced security through intelligent monitoring and real-time communication **[16].**

Sultana et al. analyzed routing performance in infrastructure-less wireless networks containing intermediate bottleneck nodes. The study evaluated communication efficiency under varying network conditions and highlighted the importance of reliable routing mechanisms for maintaining uninterrupted data transmission. Although the work focused on wireless network performance, its findings provide useful insights for designing dependable IoT communication infrastructures required in smart parking applications **[17].**

Existing System

Existing parking systems mainly rely on manual parking management or standalone sensor-based solutions with limited functionality. Such systems generally lack centralized monitoring, real-time parking information, and intelligent decision-making capabilities. As a result, users experience longer parking search times, increased traffic congestion, inefficient utilization of parking spaces, and poor security.

Furthermore, conventional parking systems often do not provide automated notifications, cloud-based data storage, or effective surveillance mechanisms, making them less suitable for modern smart city applications.

Proposed System

The proposed IoT-based smart parking system utilizes IoT sensors installed in each parking slot to detect vehicle occupancy accurately. The sensor data is continuously transmitted to a cloud server, where parking availability is processed and updated in real time. Users can access current parking information through a mobile application, allowing them to identify available parking spaces before reaching the parking facility.

To enhance safety and security, the system incorporates surveillance cameras, automated alert generation, and access control mechanisms. These features help monitor parking activities, prevent unauthorized access, and improve overall parking security. The integration of cloud computing enables centralized data storage, remote monitoring, scalability, and efficient management of parking resources.

The proposed system significantly reduces vehicle searching time, minimizes traffic congestion, optimizes parking space utilization, improves user convenience, and supports the development of smart transportation infrastructure for future smart cities.

Block Diagram Overview

Figure 1 illustrates the overall architecture of the proposed Real-Time Parking Slot Detection and Enhanced Security System for Public Parking Using IoT. The system is divided into three major sections: the input unit, the processing unit, and the output unit. A regulated power supply delivers the required electrical power to the microcontroller and all connected components, ensuring stable and continuous operation of the system.

The input unit consists of a DHT11 sensor, IR and LDR sensors, an RFID tag and reader, and a GPS module. The DHT11 sensor continuously measures the temperature and humidity within the parking environment. The IR and LDR sensors work together to identify whether a parking slot is occupied or vacant by detecting the presence of a vehicle under different lighting conditions. The RFID reader scans the RFID tag of an approaching vehicle to verify user authorization before allowing entry into the parking area. The GPS module provides location information that can be used for tracking and monitoring the parking facility or registered vehicles whenever required.

The microcontroller functions as the central processing unit of the system. It receives data from all input devices, processes the collected information, compares the sensor readings with predefined operating conditions, and performs the required control operations. The microcontroller also communicates with the IoT cloud platform through wireless connectivity, enabling real-time transmission of parking information and system status.

The IoT cloud platform stores parking slot information, environmental data, vehicle access records, and location details in a centralized database. Users can access this information through a mobile application or web interface to view parking slot availability, monitor vehicle movement, and receive real-time updates. The cloud platform also maintains

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 82-89
ISSN: 3071-3358

historical records that can be used for efficient parking management and future analysis.
The output unit consists of an OLED display, a driver circuit, an automatic door and appliance control mechanism, and a buzzer. The OLED display presents real-time information such as available parking slots, temperature, humidity, and system status. The driver circuit provides the required electrical interface between the microcontroller and high-power devices, allowing safe operation of the automatic parking gate and other electrical appliances. The automatic door opens when an authorized RFID tag is detected and remains closed for unauthorized users. The buzzer generates an audible alert whenever unauthorized access attempts or abnormal operating conditions are detected, thereby improving the overall security of the parking facility.
Overall, the proposed block diagram integrates intelligent sensing, RFID-based authentication, GPS tracking, cloud connectivity, and automated control into a unified IoT-enabled parking management system. The coordinated operation of these components enables real-time parking slot detection, secure vehicle access, remote monitoring, automated gate control, and enhanced parking security, making the system suitable for deployment in public parking areas and smart city environments.

Block Diagram

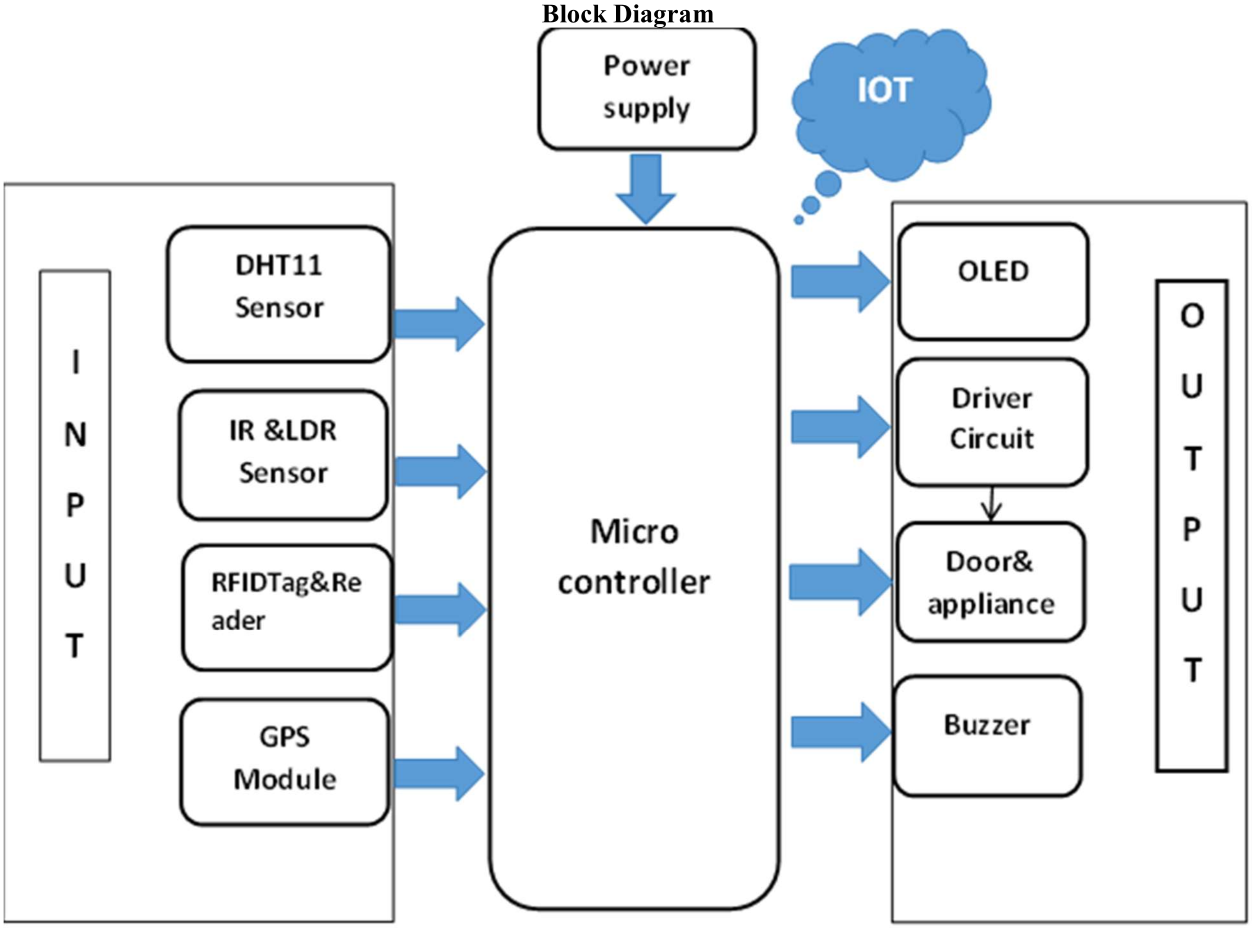


Figure 1: Block Diagram

Working Process

The proposed system operates by integrating multiple sensors, an RFID-based authentication mechanism, GPS tracking, IoT communication, and automated control devices to provide real-time parking management and enhanced vehicle security. The entire system is controlled by a microcontroller, which continuously collects data from the input devices, processes the received information, and controls the output devices based on predefined operating conditions.

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 82-89
ISSN: 3071-3358

Initially, the **power supply** provides the required regulated voltage to the microcontroller, sensors, communication modules, and output devices. Once powered, the microcontroller initializes all connected peripherals and establishes communication with the IoT cloud platform through its wireless connectivity.

The **DHT11 sensor** continuously measures the ambient temperature and humidity within the parking area. These environmental parameters are periodically transmitted to the microcontroller, where they are monitored to ensure suitable operating conditions and stored on the cloud platform for remote observation and future analysis.

The **IR and LDR sensors** work together to detect vehicle occupancy in each parking slot. The IR sensor identifies the presence or absence of a vehicle by detecting interruptions in the infrared beam, while the LDR sensor assists in monitoring light intensity and confirms slot occupancy under varying lighting conditions. Based on the sensor readings, the microcontroller determines whether a parking space is occupied or vacant and updates the parking status in real time.

The **RFID tag and RFID reader** provide secure access control to the parking facility. When a vehicle approaches the entrance, the RFID reader scans the RFID tag attached to the authorized vehicle. The microcontroller compares the received identification data with the registered database. If the tag is authenticated successfully, access permission is granted; otherwise, entry is denied, thereby preventing unauthorized vehicle access.

The **GPS module** continuously acquires the geographical location of the parking facility or registered vehicle. During emergency situations or security incidents, the location information is transmitted to the IoT cloud platform, enabling administrators or users to track the vehicle or parking location remotely through the monitoring application.

The **microcontroller** serves as the central processing unit of the entire system. It continuously receives information from the DHT11 sensor, IR sensor, LDR sensor, RFID reader, and GPS module. After analyzing all incoming data, it determines the occupancy status of parking slots, validates user authentication, monitors environmental conditions, and controls the connected output devices accordingly. The processed information is simultaneously transmitted to the IoT cloud platform for real-time monitoring.

The **IoT cloud platform** stores the received sensor information and parking status in a centralized database. Users can access the cloud through a mobile application or web interface to view real-time parking availability, environmental conditions, and security information. The cloud platform also maintains historical records, enabling administrators to analyze parking usage patterns and improve resource management.

The **OLED display** provides local visualization of the system status. It continuously displays the number of available parking slots, occupancy status, authorized vehicle information, temperature, humidity, and other system messages, allowing users and administrators to obtain immediate information directly at the parking facility.

The **driver circuit** functions as an interface between the microcontroller and the higher-power output devices. Since the microcontroller cannot directly drive electrical loads, the driver circuit amplifies the control signals and safely operates the automated door mechanism and other connected appliances.

The **automatic door and appliance control** mechanism operates based on RFID authentication. When an authorized RFID tag is detected, the microcontroller instructs the driver circuit to open the parking gate automatically. After the vehicle enters or exits the parking area, the gate closes automatically to maintain security. Additional electrical appliances such as lighting or ventilation systems can also be controlled automatically depending on occupancy and environmental conditions.

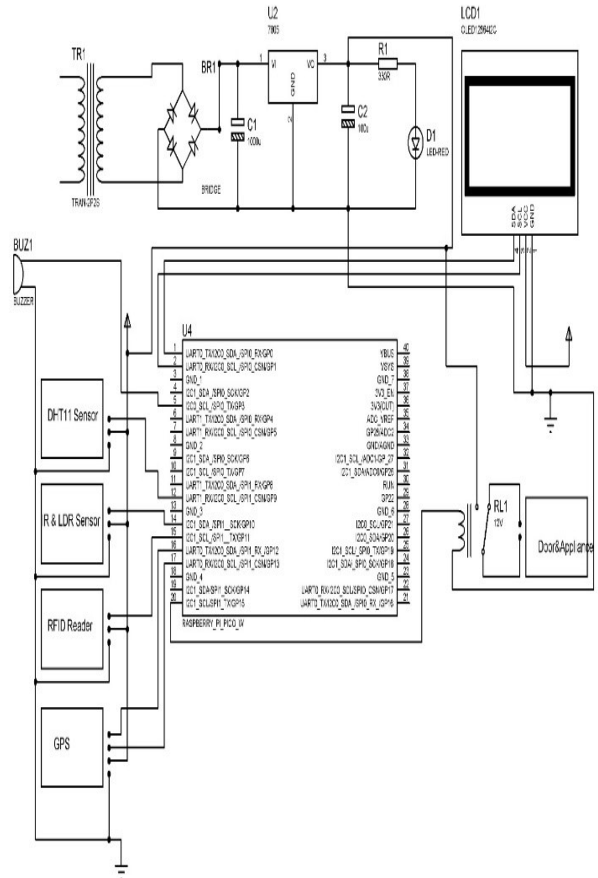
The **buzzer** serves as the audible warning device of the system. It is activated whenever unauthorized access is attempted, abnormal operating conditions are detected, or emergency situations occur. The buzzer immediately alerts nearby security personnel and users, allowing quick response to potential security threats.

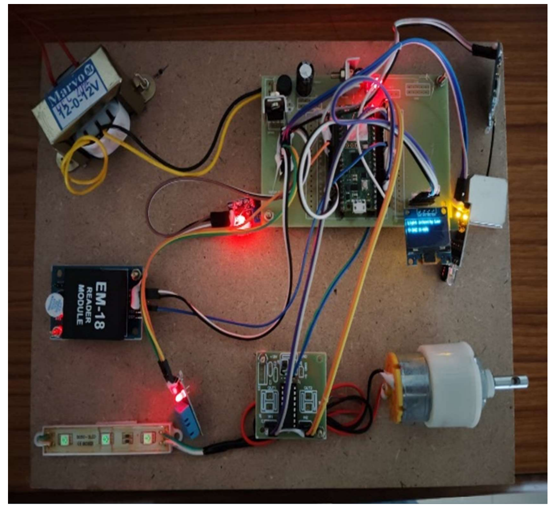
Throughout system operation, sensor data, parking occupancy information, access records, and GPS location are continuously synchronized with the IoT cloud platform. This enables users to remotely monitor parking availability, verify vehicle entry records, and receive real-time updates using Internet-connected devices.

Overall, the proposed system integrates real-time parking slot detection, RFID-based authentication, GPS location tracking, environmental monitoring, cloud-based data management, automated gate control, and intelligent alert mechanisms into a unified IoT platform. This integrated approach improves parking efficiency, enhances vehicle security, reduces unauthorized access, minimizes parking search time, and supports intelligent parking management for modern smart city applications.

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 82-89
ISSN: 3071-3358

Schematic Diagram

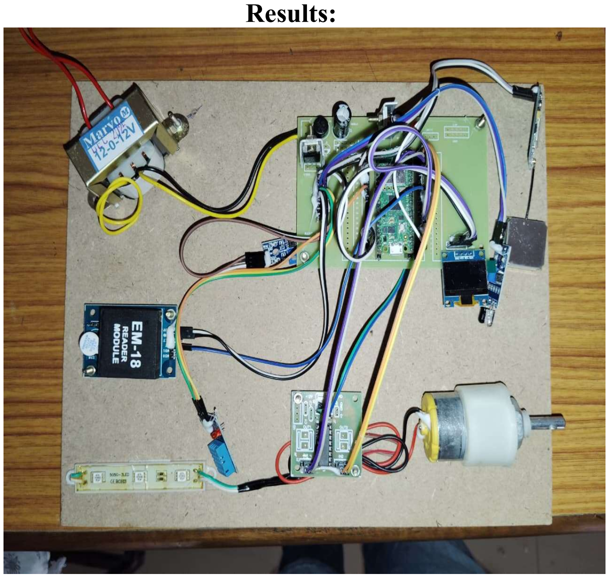




Hardware Kit in ON Condition

Displaying Slot is Free & Light Intensity

Results:



Hardware Kit in OFF Condition

Displaying Swipe RFID Tag

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 82-89
ISSN: 3071-3358

Displaying Temperature and Humidity Levels

Conclusion:

The proposed system, Real-Time Parking Slot Detection and Enhanced Security System for Public Parking using IoT, successfully addresses the growing challenges of urban parking management and vehicle security. By integrating IoT-based sensors, real-time data processing, and wireless communication, the system enables efficient monitoring of parking slot availability and provides instant updates to users.

This approach significantly reduces the time spent searching for parking, minimizes traffic congestion, and improves fuel efficiency. In addition, the incorporation of security features such as surveillance, unauthorized access detection, and alert mechanisms enhances the safety of parked vehicles, making the system more reliable for public use.

References:

[1]. S. Chawla, R. Gupta, and A. Kumar, "IoT-based smart parking system with real-time slot monitoring and cloud integration," *International Journal of Intelligent Systems and Applications in Engineering*, vol. 12, no. 3, pp. 1145–1156, 2024.

[2]. M. R. Patil, P. S. Kulkarni, and V. S. Deshmukh, "Smart parking management using Internet of Things and cloud computing," *International Journal of Advanced Computer Science and Applications*, vol. 13, no. 8, pp. 483–491, 2022.

[3]. A. Khanna and S. Kaur, "Internet of Things (IoT), applications and challenges: A comprehensive review," *Wireless Personal Communications*, vol. 114, no. 2, pp. 1687–1762, 2020.

[4]. L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A survey," *Computer Networks*, vol. 54, no. 15, pp. 2787–2805, 2010.

[5]. A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of Things: A survey on enabling technologies, protocols, and applications," *IEEE Communications Surveys & Tutorials*, vol. 17, no. 4, pp. 2347–2376, 2015.

[6]. K. Ashton, "That 'Internet of Things' Thing," *RFID Journal*, vol. 22, no. 7, pp. 97–114, 2009.

[7]. M. Banzi and M. Shiloh, *Getting Started with Arduino*, 4th ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

[8]. Raspberry Pi Foundation, *Raspberry Pi Pico W Datasheet*, Cambridge, U.K.: Raspberry Pi Foundation, 2023.

[9]. H. Hassoune, W. Dachry, A. Moutaouakkil, and H. Medromi, "Smart parking systems: A survey," *Journal of King Saud University – Computer and Information Sciences*, vol. 34, no. 8, pp. 6278–6293, 2022.

[10]. N. Bock, S. Di Martino, and A. Origlia, "IoT-enabled smart parking architecture for intelligent transportation systems," *IEEE Access*, vol. 10, pp. 102113–102127, 2022.

[11]. Y. Geng and C. G. Cassandras, "A new smart parking system infrastructure and implementation," *Procedia – Social and Behavioral Sciences*, vol. 54, pp. 1278–1287, 2012.

[12]. S. Revathi and R. Dhulipala, "Cloud-assisted IoT smart parking system with vehicle security and mobile application," *International Journal of Electrical and Computer Engineering*, vol. 13, no. 1, pp. 748–758, 2023.

[13]. A. M. Ahmed, M. A. Elhoseny, and A. E. Hassanien, "Intelligent IoT-based parking management system using wireless sensor networks," *Sensors*, vol. 21, no. 14, Art. no. 4829, 2021.

[14]. H. Ning and H. Liu, "Cyber-physical-social-thinking space based intelligent IoT framework for smart city applications," *Future Generation Computer Systems*, vol. 95, pp. 1–10, 2019.

[15]. S. K. Ghai, A. Kumar, and P. K. Sharma, "Cloud-based IoT architecture for smart city monitoring and automation," *Sensors*, vol. 21, no. 9, Art. no. 3182, 2021.

[16]. P. Singh, R. Sharma, and N. Verma, "Real-time smart parking slot detection and security

monitoring using IoT and cloud analytics," *IEEE Access*, vol. 12, pp. 44215–44231, 2024.

[17]. Ijteba Sultana, Dr. Mohd Abdul Bari ,Dr. Sanjay," Routing Performance Analysis of Infrastructure-less Wireless Networks with Intermediate Bottleneck Nodes", International Journal of Intelligent Systems and Applications in Engineering, ISSN no: 2147-6799 IJISAE,Vol 12 issue 3, 2024, Nov 2023