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IoT Based Smart Parking System

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Abstract—This paper presents a detailed analysis of a Smart Parking System that incorporates RFID technology, IR sensors, and Node MCU. The system aims to revolutionize parking management by optimizing space utilization, improving user experience, and enhancing overall efficiency. By leveraging RFID technology, authorized personnel can gain access to parking areas, while IR sensors accurately detect vehicle occupancy in parking slots. Node MCU acts as the central control unit, facilitating seamless communication between the various components and the cloud server. The paper provides insights into the system setup, functional and non-functional testing, types of tests conducted, and the development of test cases. The integration of these technologies offers benefits such as improved security, reduced traffic congestion, and enhanced parking space management. The findings of this report contribute to the advancement of smart city technologies and offer valuable recommendations for future implementations in the field of smart parking solutions.

Key words: *RFID, Node MCU, IR sensors , Mobile application, Iot.*

I. INTRODUCTION

IoT(Internet of Things) on a broad and specialized base is a new paradigm of interrelated computing bias, technological inventions, digital as well as mechanical machines, detectors, creatures and humans with the capability to transfer data over network without any real time aid of any kind of commerce whether man to man or machine to man. Internet of effects is an connected network of millions of electronic bias like detectors, RFID markers, and numerous others connected to communicate with one another.

RFID is the most abecedarian technology enabling wireless data transmissions over networks. Though this technology was available for a long time, recent standardizations and affordability have

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significantly added to its mileage. This technology uses electromagnetic fields for communication and collection of data from the objects with RFID markers attached to them.

Any sector involving the use of RFID markers has witnessed a drastic increase in both effectiveness and productivity. It has been extensively used in tracking systems, covering systems and parking systems, RFID finds its vast and necessary operation in robotization which is established using technologies like RFID compendiums , RFID detectors, RFID regulators, RFID pens and numerous.

From operation, controlling, bill generation to operations, all tasks can be performed with this technology. Check- sways and check- outs get a pace cutting down the time for the buses to stop helping reduce business logjams, aggression problems in the motorist as well as the air pollution. RFID technology combined with automated bill generation system will enable motorists to pay online without having to stop at the exit gate, making the whole process briskly than usual.

Figure 1. Smart Parking Module

II. LITERATURE SURVEY

The literature survey on smart parking systems using RFID and IR sensors reveals several studies and research works conducted in this field. Many researchers have explored the benefits and challenges of implementing smart parking systems and have proposed innovative solutions to address parking-related issues.

III. PROPOSED WORK

The proposed work for the smart parking system using RFID and IR sensors can include the following:

3.1 Design and Development: Design an architecture for the smart parking system, considering the integration of RFID readers, IR sensors, and NodeMCU for data collection and transmission. Develop the necessary hardware and software components, including the central server, mobile application, and backend system.

3.2 Sensor Installation and Integration: Install RFID readers and IR sensors in parking spaces to detect vehicle presence and identify vehicles. Integrate the sensors with the central system to transmit real-time data on parking space occupancy.

3.3 IoT Connectivity: Establish an IoT network using technologies such as Wi-Fi or cellular networks to enable seamless communication between sensors, microcontrollers, and the central system. Ensure secure and reliable data transmission.

3.4 Mobile Application Development: Develop a user-friendly mobile application that allows drivers to search for available parking spaces, make reservations, and facilitate cashless payments. Integrate the application with the smart parking system's backend to provide real-time updates and seamless user interactions.

3.5 Testing and Evaluation: Conduct comprehensive testing of the smart parking system, including functional and non-functional testing, to ensure its reliability, accuracy, and usability. Evaluate the system's performance, responsiveness, and scalability under various scenarios.

3.6 Deployment and Demonstration: Deploy the smart parking system in a real-world parking facility and demonstrate its effectiveness in improving parking space utilization, reducing congestion, and enhancing user experience. Gather user feedback and assess the system's impact on parking operations.

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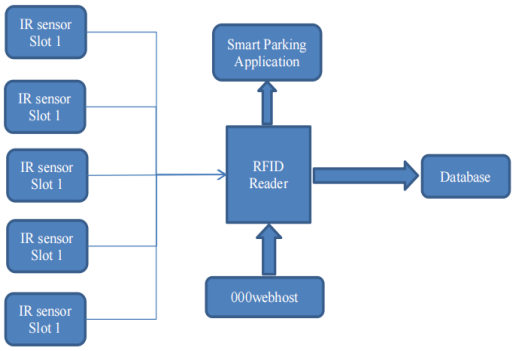
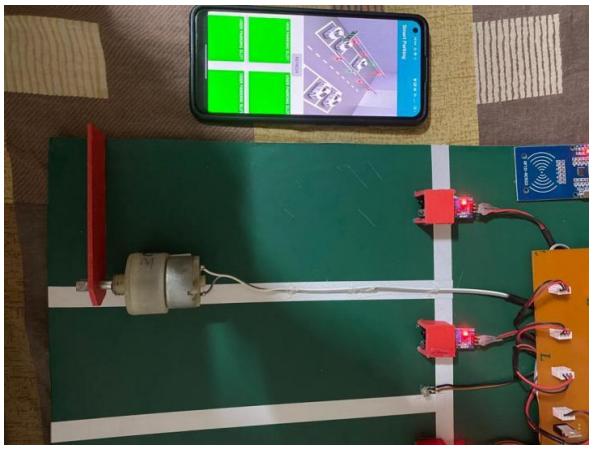
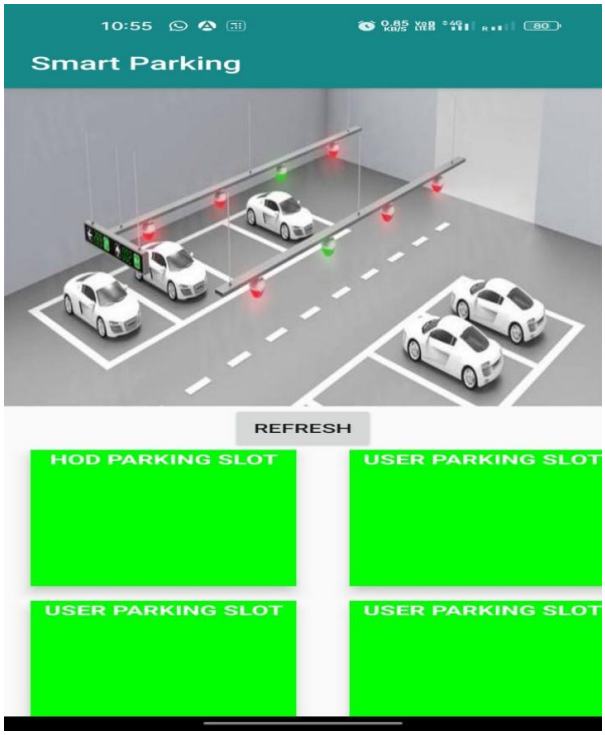


Figure 1: Workflow of Parking System

IV. EXPERIMENTAL RESULT



The above figure shows the working model of smart parking system. It shows the different parking planes of the model.



The above figure shows the main page of Smart Parking System for online processing.

The above figure shows the user interface of mobile application which connects with the implementation module through Node MCU(wifi connectivity).

V. CONCLUSION AND FUTURE SCOPE

In conclusion, the implementation of a smart parking system offers significant benefits in addressing the parking challenges faced in urban areas. By leveraging advanced technologies such as RFID, IR sensors, and IoT connectivity, the smart parking system optimizes parking space utilization, improves traffic flow, and enhances user convenience. Real-time availability information, reservation capabilities, cashless payments, and mobile application integration contribute to a seamless and efficient parking experience for drivers. The system also provides parking operators with better management tools and insights into parking space utilization.

The future scope of smart parking systems is promising, with opportunities for further advancements and integration with emerging technologies. This includes integration with electric vehicle charging infrastructure, multi-level and underground parking facilities, advanced data analytics for predictive modeling and optimization, integration with navigation systems and vehicle-to-infrastructure communication, and alignment with broader smart city initiatives. Additionally, enhancing security measures and focusing on user-centric features will contribute to the continued development and adoption of smart parking systems, ultimately improving parking efficiency, reducing congestion, and promoting sustainable urban mobility.

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