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RFID-ENABLED IOT-BASED SMART PARKING MANAGEMENT SYSTEM

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Abstract

Finding a parking spot is getting harder and harder as a result of the exponential growth in the number of vehicles and the population of the world, as well as the availability and use of vehicles on the road in recent years. This has led to an increase in conflicts like traffic issues even in smart cities. It is observed that a driver requires approximately eight minutes to park his vehicle because he spends more time looking for a parking space. Consumers are encouraged to prefer mobile application-based solutions by the pervasiveness of smartphones. The development of smart vehicle and Smart Parking System (SPS) is a result of the Internet of Things' (IoT) connection with smart transportation and the transformation it has brought about in how people engage with technology. This study suggests an Internet of Things (IoT) based smart parking system that assumes responsibility for locating vacant spaces in a parking lot and maintaining a meticulous record of the vehicles parked there. This initiative significantly reduces human work at the parking lot, such as when a driver searches for open spaces and figures out how much to charge each vehicle that uses the lot. With this system, parking spaces are monitored and managed enabled with Radio Frequency Identification (RFID) technology. This proposed system is intended to reduce parking congestion in crowded places and do away with the necessity for manual parking inspections. A central database system, RFID readers, tags, and a smart parking application are all part of the proposed system. The RFID reader scans the vehicle's tag as it pulls into the parking space, sending the information to the central database system. The real-time parking space availability is then displayed by the smart parking app, making it simple for drivers to locate open spots. This system may ease traffic congestion and enhance drivers' parking experiences in general.

Keywords: Smart City, Smart vehicle, Smart Parking Systems, Smart transportation, IoT, RFID.

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Introduction

Smart cities use information, communication, and technology to increase operational efficiency for the public, hence speeding the development of inhabitants' quality of life. With the rise of the Internet of Things, the dream of building a Smart City is becoming a reality. The basic idea of an Internet of Things (IoT) is anything that can be connected to the internet results in the "Internet of Things." Sensors, actuators, and RFID tags are examples of things in the Internet of Things. Remote computers connected to the Internet could track, control, or monitor the items. IoT expands the usage of the Internet by enabling communication and, as a result, inter-networking of devices and physical things, or Things. The Internet of Things (IoT) technology has revolutionised many aspects of life, including smart parking system (SPS) technology. As parking becomes an increasingly important part of our daily lives.

In general, a finder is a network of devices and physical things that may gather data at remote locations and interact with units that manage, acquire, organise, and analyse data in processes and services. It depicts a world in which items (wearables, watches, alarm clocks, household devices,

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and surrounding objects) become smart and behave, coming to life through sense computing and communication with embedded small devices that interact with remote objects or people via connectivity. Because of the cloud's high scalability, any number of nodes might be added or withdrawn from the IoT system in real time, and IoT is well known for reducing human work and storage to some level.

As a result, this system anticipates planning and acquiring a smart parking system before departing for our destination in order to reduce the hassle of driving around looking for a parking spot during peak hours. Finding an available parking spot in today's cities is always difficult for drivers, and it only gets more difficult as the number of private car users grows. This circumstance might be viewed as an opportunity for smart cities to take efforts to improve the efficiency of their parking resources, resulting in decreased seeking times, traffic congestion, and road accidents.

Current advancements in the development of low-cost, low-power embedded systems are assisting developers in the development of new Internet of Things applications. As the population density of metropolitan cities grew, so did the demand for vehicles. It eventually generates parking issues, which contributes to traffic congestion, driver irritation, and air pollution. When we visit various public venues such as retail malls, multiplex cinema halls, and hotels during the festival season or on weekends, it generates a significant parking difficulty.

According to a recent study, a driver requires approximately eight minutes to park his vehicle because he spends more time looking for a parking space. This searching contributes to 30 to 40 % of traffic congestion. The primary goal of a smart parking system is to shorten the time required to locate parking places, hence lowering fuel usage. Sensors would be installed in the parking space, and users would be able to schedule parking slots and pay online using the smartphone app.

Literature Review:

RFID-enabled IoT-based Smart Parking Management System establishes a network architecture based on Internet of Things technology and proposes a unique algorithm that boosts the capability of the current cloud-based smart Parking system [1].

Smart parking has developed a solution that makes use of the Google Maps application. The ultrasonic sensor and the data collected are saved in the cloud. The Android application map provides user-friendly information about unoccupied spaces. Each slot includes one LED display that aids in finding the proper parking spot. To allow the user to reserve a parking space, an IoT-based parking system based on Google was proposed. The mobile application locates the current parking spot. With this technology, an infrared (IR) sensor detects a vacant space and displays it at the entry and departure gates. An RFID tag is issued to allow a person access to a parking space. A signal is delivered to open the gate if the individual is permitted [2].

The parking recommendations and information were proposed by the smart parking guidance system. Using the vendor management system (VMS) on the internet, the system delivers driver information and parking slot availability. This system is divided into two types: off-road and on-road. Off-road Pneumatic tube, loop deducted, Pneumatic tube to deduct vehicle presence Acoustic sensor-noise level to identify vehicle presence, piezoelectric sensor-vibration to indicate vehicle presence, RFID utilised for security purposes. On-roadway ultrasonic sensor transmits wave to identify, IR sensor emits reflected wave to determine whether or not a vehicle is present [3].

A Pay-by-Phone parking system with privacy protection was suggested. The parking system can be reserved by phone payment. A mobile application that accepts credit card payments has been developed. A new user can register and contact the system server to purchase new e-coins. Each

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e-coin has a slot parking duration time. Parking officers execute RFID inquiries on on-board devices [4].

Smart Parking System (SPS) uses an Embedded System and sensor network with android and windows applications. In the method, a Raspberry PI is employed, and an infrared sensor is used to locate a vacant parking space. V2I (Vehicle to Infrastructure) contact with the driver, making the parking request and informing the user of the status of the conform reservation. Infrastructure to Vehicle (I2V) communication is used for reserving parking spaces and displaying directions. The JavaScript Object Notation (JSON) format is used to interchange data. QR codes are employed for security, and webcams are used to scan the codes and offer parking lot directions [5].

ZigBee is a wireless communication protocol. Smart Vehicle Parking System Based on Android An Android-based application that obtains information about available empty parking slots. The android application would feature customer information such as area, state, and car number. The application allows the user to enter and depart times as well as select a parking place. The user information is saved in the My Structured Query Language (MYSQL) database. The LED indicates whether the parking spaces are empty or full. A camera is used to capture the vehicle's license plate and transform the image to determine if the vehicle is an authorized user vehicle or not [6].

Advanced car parking system recognizing free slots with Arduino and Raspberry PI. For booking, this system employs a web server and Google Maps with GPS. The results are graphically displayed in the mark. An effective car parking system using IR sensors and RFID tag validation was proposed [7].

Proposed Work:

For efficient operation, we proposed the following architecture components for RFID-enabled IoT-based Smart Parking Management System:

1. Mobile Application.
2. Detection of Slots Using Infrared (IR) Sensors.
3. RFID-Based Vehicle Detection.
4. Payment using online banking.
5. The database.
6. Raspberry Pi 3.
7. Vehicle tracking.

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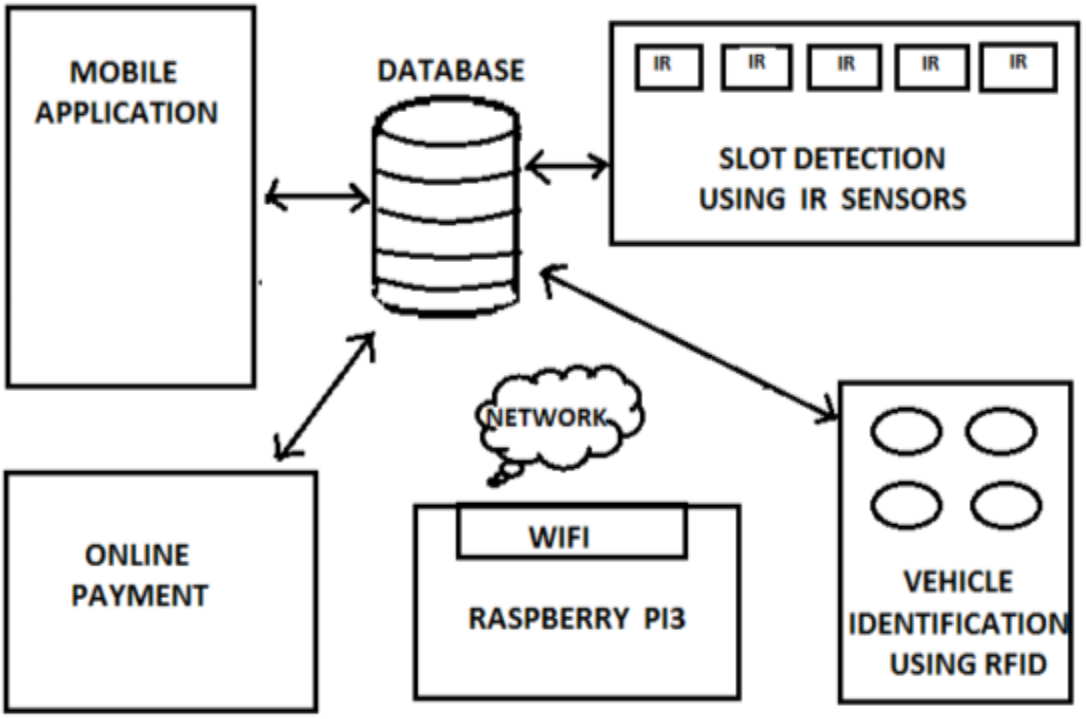

Figure 1: Architecture proposed

Infrared (IR) sensors are deployed for each parking region, and IR sensors detect the number of parking slots. The number of free and booked slots is visually shown on an LCD panel, and a WIFI module is utilised for communication between the mobile app and the sensors. This depicts recognising an empty parking space and communicating with a Raspberry Pi through Wi-Fi.

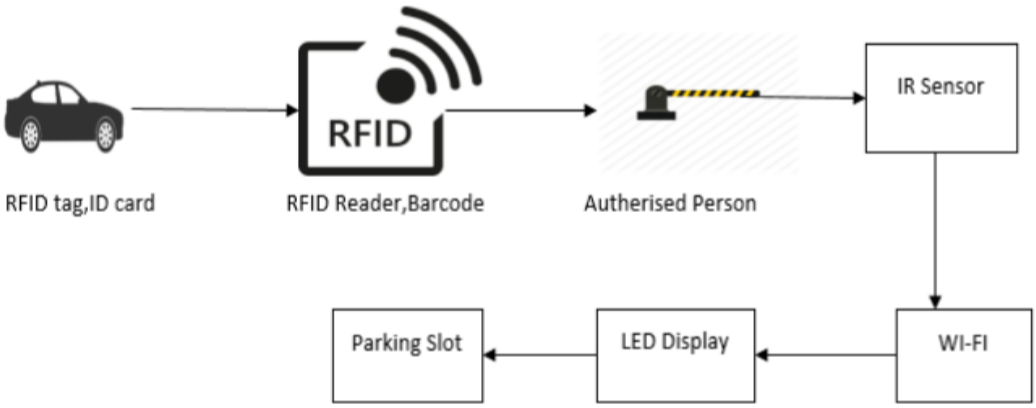

Figure 2: Deducting Empty Parking Slots Architecture

The database stores and retrieves all of the data generated above. The tracking system combines a number of sophisticated embedded and communication technologies. The Global Positioning System (GPS) is a space-based global navigation satellite system that provides location and timing information anywhere on Earth. Google Earth technology can be used to show the location

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information provided by our GPS units. The tracking system that has been implemented can be utilized to monitor numerous parameters relating to safety, emergency services, and engine stall.

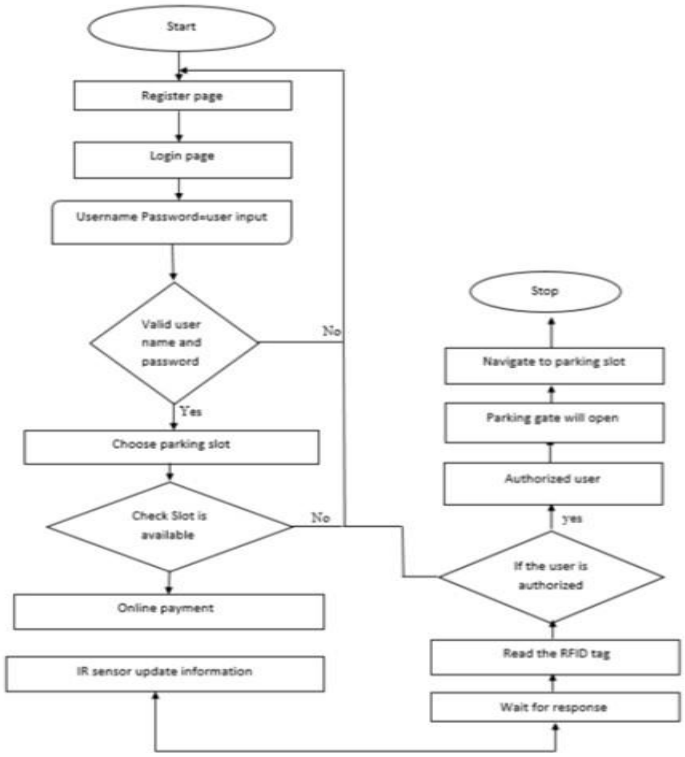

Figure 3: Flow chart for Overall System

Result and discussion:

Our proposed method, which makes use of the Raspberry Pi, reduces parking wait time in a large parking facility. It also aids parking facility operators in increasing their venue generation. It would also help to eliminate the need for people in the parking facility, lowering costs and errors in the process. This strategy would also reduce the use of paper, assuring a green system. This work can be expanded to include scheduling parking lots ahead of time. Other operating systems, such as iOS and Windows, can be added to the mobile application. Services on the server can even be extended to include safety precautions such as fire and theft.

The following are some of the possible advantages and disadvantages of the proposed RFID-enabled IoT-based Smart Parking Management System.

Advantages:

1. Increased security owing to password requirements.
2. Because of its simplicity, the system can be utilised and deployed everywhere.
3. The system takes and interprets the circular picture created in a parking lot, producing information about the available parking places.
4. A camera is utilised as a sensor to capture images of car park occupancy.
5. A single camera may detect the presence of multiple cars at the same time.

Disadvantages:

1. The implementation cost is expensive.

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2. The GSM feature causes bottlenecks.
3. The microcontroller will have to handle a large portion of the load, which may cause the system to crash.
4. Incompatible with the existing parking system.

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