LoRa Technology Enable Secure and Energy Efficient Smart Parking System

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***Abstract*—A smart parking system monitors the cars that are parked, their positions, and the condition of each parking space. A new technology is LoRa. The physical range of this smart parking system may be up to 10 kilometers, and the fact that it does not rely on any other networks for communication makes it even more desirable. Infrared sensors are being employed to detect the presence of the vehicles.**

In this research paper , we offer a cloud-integrated smart parking system that is IoT-based. The IoT module that is deployed on-site as part of the proposed smart parking system is utilized to track and signalize the availability of each individual parking space. Moreover, a smartphone application is offered, enabling users to check the availability of parking spaces and reserve a spot appropriately. A high-level perspective of the system architecture is also described in the article. The paper's discussion of the system's operation in the form of a use case at the conclusion serves to demonstrate the accuracy of the suggested model.

Keywords—Smart parking system, IOT, LoRa Technology

I. Introduction

Parking is currently a major issue at malls, event venues, and other places. It's because there aren't enough parking spaces. The number of automobiles per family now is more than the number of family members, and as a result, the number of vehicles in the nation has risen as well. This results in a parking situation that, regrettably, does not meet the country's present needs. This makes parking challenging and increases the time required to park the car as well as the fuel consumption of the car. Also, businesses and offices in metropolitan locations struggle with parking during working hours.

Long Range Wide Area Network (LoRaWAN) smart parking is a creative approach that employs IoT (Internet of Things) technology to streamline the parking procedure. By giving proper data regarding the availability of parking spots, the solution is intended to ease the parking issues that metropolitan regions encounter. This study examines how LoRaWAN technology may be used to develop smart parking.

II. Objective

Comparing the difficulty of finding parking spaces in the local region to what previous studies have shown for other big centers, this paper intends to examine the local parking situation. Using drivers' perspectives as its foundation, this study explores the necessity for smart parking solutions in the neighbourhood. To identify some of the difficulties that a practical parking system would encounter, a sensible parking system would be created, put into practise, and deployed in a local area[1]. Design, implementation, deployment, and operational issues are all parts of the search for answers.

III. Advantages

- Real-Time Parking Information: Information about parking availability in real-time is provided via smart parking systems that use LoRaWAN technology.
- Cost-effective: LoRaWAN technology is a low-cost, low-power wireless communication technology appropriate for Internet of Things applications like smart parking.
- Minimal power consumption: The smart parking system's sensors use relatively little electricity, extending battery life and lowering maintenance expenses.

IV. Literature Review

We will do a literature review for our research on LoRa Technology Enable Secure and Energy Efficient Smart Parking System by first determining where the research is coming from, what and how much have been researched about the issue, and what is yet to be addressed, the study may then be directed properly. This gives context to the study and will provide the project's developers the support and backbone they need. The researcher will get insight into how a similar study has been conducted in the past by reading previous publications and investigations linked to the topic [2]. This research may be able to reflect, compare itself to other studies,

learn from failures, and develop a better, more effective study in this way.

- In a paper titled as "An IOT based smart parking using LORA" [3] written by authors Ravi.Kishore.Kodali, Krishna Yogi Borra, Sharan Sai G. N. and Jehova Honey Domma in 2017 . The Esp32 TTGO LoRa transmitter, receiver, and ultrasonic sensors are used to implement the parking system that the author has proposed. Data packets can be received from many transmitters by a LoRa receiver. To eliminate the requirement for WiFi at every parking lot, the LoRa transmitter has been put in a number of parking lots to communicate information about parking availability.
- "IoT based sensor enabled smart car parking for advanced driver assistance system"[4] written by B M Mahendra, Savita Sonoli, Nagaraj Bhat, Raju, T. Raghu et al. (2017): This paper presents a smart parking system based on IR sensor , Raspberry model 3b for real time data processing to detect the presence of vehicles in parking spaces. The system provides real-time parking information to drivers and helps reduce traffic congestion and emissions.
- "Automatic car parking system with visual indicator along with IoT"[5] written by Sarthak Mendiratta, Debopam Dey, Deepika Rani Sona et al. (2017): This paper proposes a Automatic parking system to obtain the result they set ultrasonic threshold in the Arduino code using C programming.
- "An Efficient LoRaWAN-Based Smart Parking System" [6]written by Shyam Ravishankar, Nrithya Theetharappan et al. (2017).

V. Methodology

The methodology of a smart parking system using LoRaWAN technology involves installing sensors in parking spaces, configuring them to communicate with the LoRaWAN network, installing a gateway to receive sensor data, setting up a cloud server to store and process the data, analyzing the data to provide real-time parking information, and developing a user interface for drivers to access the information.Authors and Affiliations.

- Install sensors in parking spaces.
- Configure the sensors to communicate with the LoRaWAN network.
- Install a LoRaWAN gateway to receive sensor data.
- Analyze the data to provide real-time parking information.
- Develop a user interface for drivers to access the information.

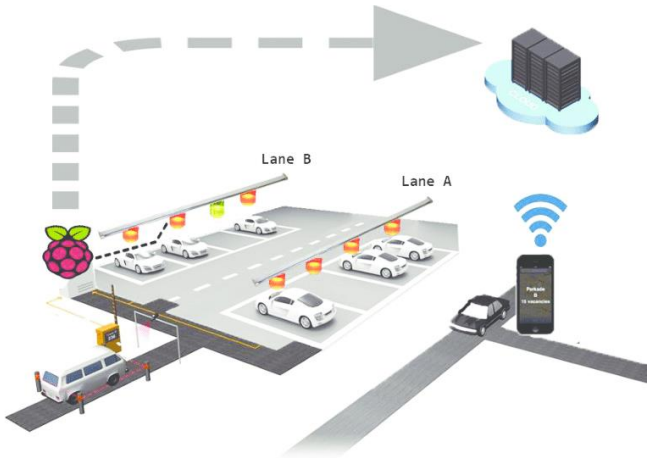

Fig. 1. Car Parking

VI. System Design

The following elements are commonly included in the system architecture of a smart parking system employing LoRaWAN technology:

- Sensors: The sensors are used to identify the presence of cars and are placed in each parking spot. Depending on the application, several sensor types, such as ultrasonic, magnetic, or infrared sensors, may be employed.
- LoRaWAN Gateway: The gateway collects data from the sensors and sends it across the LoRaWAN network to the cloud server. Data from several sensors can be received by the gateway, which is normally situated in a central position.
- Cloud Server: Data is sent from the gateway to the cloud server, where it is then stored in a database. Drivers can receive real-time parking information from the server by doing data analysis.
- User Interface: Drivers may get real-time parking information through the user interface. This might be an online dashboard or a mobile app that shows parking availability, location, and cost.
- LoRaWAN Network: The LoRaWAN network connects the cloud server, gateway, and sensors across a long distance using wireless technology. It is made to accommodate a lot of devices and use little power.

Sensors, a LoRaWAN gateway, a cloud server, a user interface, and a LoRaWAN network make up the system architecture of a smart parking system that uses LoRaWAN technology. The system is perfect for smart parking applications since it is made to be expandable, dependable, and economical.

Fig. 2. System Design

VII. System Parking Mobile Application

Users may have easy access to available parking spaces with a smartphone application that uses LoRa technology for smart parking. Here is how such a programme would operate:

1. Each parking place has parking sensors using LoRa technology installed.
2. The sensors wireless send the information to a centralized server after determining whether a parking place is occupied or available.
3. A smartphone application is created that enables users to see real-time parking space availability.
4. To connect to the centralized server and get the most recent parking availability information, the mobile application employs LoRa technology.
5. Customers may search for parking spots using several parameters, including distance, price, and location.
6. With the smartphone application, users may book a parking place once they locate one that is open.
7. The parking sensor receives the reservation information and broadcasts a "Reserved" status to other users.
8. The user may then utilize GPS and the mobile application's built-in map capability to find the parking place.
9. The user may utilize the mobile application to confirm their reservation and pay for the parking spot after they have reached the parking area.
10. The parking sensor transmits the payment information back to the central server, which updates the status to "Paid" for other users.

Making parking management systems more effective, utilizing a mobile application for smart parking that uses LoRa technology may give consumers a simple and pleasant parking experience.

VIII. Result

For Internet of Things (IoT) applications, LoRa (Long Range) is a low-power, long-range wireless communication technology. One of the numerous possible uses for LoRa technology, which allows for the wireless connection of parking sensors and the transmission of data to a centralized system, is smart parking.

1. The LoRa Smart Parking System's final output can be viewed in real-time on the Smart Parking Application.
2. There are parking spaces available in the Smart Parking application, and for each parking space, the availability status—whether it is "OCCUPIED" or "VACANT"—can be viewed.
3. With the help of LoRa, sensor data can be transmitted over 10 kilometers, up to 20 kilometers, using the frequency band 923 MHz (Asia).

There are several advantages of using LoRa technology for smart parking, including:

- LoRa technology is an economical solution for smart parking systems since it is low-cost and requires little infrastructure.
- Long-range communication: LoRa technology has the potential to communicate across long distances without the use of additional infrastructure.
- Reduced power consumption: Since LoRa technology uses less power, devices may run for extended periods of time without needing to be often recharged.
- Real-time monitoring: LoRa technology can monitor parking places in real-time, enabling customers to locate available spaces rapidly.

IX. Application Of LoRa

A wireless system called LoRa (Long Range) is meant for long-distance, low-power communications between devices. Here are a few uses for LoRa:

- **Smart cities**: LoRa may be used to link a variety of devices, such as sensors for noise, temperature, humidity, and air quality. These gadgets have the ability to transmit data to a central platform, which may be utilized to enhance city services.
- **Agriculture**: Farmers may improve irrigation and fertilizer by using sensors that assess soil moisture, temperature, and humidity by connecting them via LoRa.
- **Asset tracking**: LoRa may be used to track an asset's position in real-time, such as a shipping container or a car. Business supply chains and logistical operations may benefit from this.
- **Industrial automation**: In industrial contexts, such as manufacturing plants and storage facilities, LoRa may be utilized to connect sensors and equipment. This might increase productivity, decrease downtime, and increase security.
- **Healthcare**: Using sensors that assess vital indicators like heart rate, blood pressure, and oxygen levels, LoRa may be used to monitor patients in real-time. This can facilitate faster emergency intervention by medical professionals and improved patient care.
- **Home automation**: LoRa may be used to link smart home components like thermostats, door locks, and security cameras, giving homeowners remote access to and control over their properties.

X. Conclusion

The conclusion of this study is to identify the most critical parking issue, which is locating an empty place, and to provide a solution. EMI sensors are frequently utilized for both inappropriate parking detection and parking lot detection. The suggested architecture for a parking detecting system will minimize the amount of time needed to look for vacant spots and ease the difficulties of parking a single vehicle improperly in two slots. Future studies might look at how parking lots are booked and how to best use sensors. Marketing and cost effectiveness might both be researched. Future applications can benefit greatly from a practical, affordable, and highly effective network that LoRa can help create.

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