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Smart Parking using LoRa

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Abstract - LoRa is an efficient WAN technology. It is based on spread spectrum modulation techniques derived from chirp spread spectrum technology. The R&D was done by Cycleo of Grenoble, France and acquired by Semtech the founding member of the LoRa Alliance. LoRa can be used as a stand-alone communication technology. It's biggest advantage is it's range. This concept is amalgamated with the idea of implementing a smart parking system and the concept of making a Smart Parking System using LoRa.

A Smart Parking System involves keeping track of the vehicles parked, their locations and the current status of a parking spot. LoRa is an emerging technology. It's physical range can be roughly 10 kilometres and the fact that it does not depend on any other network for communication adds to the desirability of the same for this smart parking system. Currently, for sensing the presence of the vehicles, IR sensors are used.

Key Words: **smart parking for smart cities, LoRa technology**

1. INTRODUCTION

With the extremely rapid increase in the number of cars on the streets, there has to be some kind of system to maintain and keep track of parking in a region. Finding a free parking lot in urban cities especially during peak hours is more or less impossible, in many cases. Looking for a vacant parking zone during a busy city like

Mumbai, at a peak hour may be a nightmare to drivers. They have to drive around trying to find a free parking spot, something that's believed to extend traffic jam.

The cycling around not only frustrates drivers but also increases the typical consumption of gas and hence the pollution that affect the environment. It's also believed that, as drivers' attention is partly on trying to find a free spot during a busy city, the likelihood of causing an accident is higher[2]. Another challenge is related to paying for the parking, most of the time, the machines from which to urge the payment ticket are located long distances from the car. The ticket machines too, present some complications since they're not the same; some machines take only coins, or coins plus credit/debit cards or only credit/debit cards [3]. The situation seems like drivers need to steel oneself against the likelihood of any of the above sort of ticket machines.

2. OBJECTIVE

This work aims to review how challenging it's to seek out parking lot in Mumbai area as compared to what research works have acknowledged for other urban cities. This research investigates whether there's need for smart parking systems in Mumbai area basing on driver's point of view. A sensible parking system would be designed, implemented and deployed at Mumbai, with the aim of identifying a number of the challenges a sensible parking system would face[1]. The challenges to find out includes design, implementation, deployment and operations challenges.

3. ADVANTAGES

• Sensors detect the absence and presence of vehicles. They will even be used with statistical software to make solutions for traffic and parking congestion.

•Each sensor requires no external wiring. Additionally, the low power design means the sensor can run up to 10 years at a time.

• Sensors boast a coffee operating expense because several maintenance tests are often done remotely.

4. LITERATURE SURVEY

Our project will review the literature related to the area of study – Smart Parking using LORA. By doing so, the research may be guided accordingly by firstly discovering where the research is coming from, what and how much have been studied regarding the topic and what it is yet to tackle. This provides background to the research, it will provide the necessary backbone and support to the project developers. By reviewing the past publications and researches related to the study, the researcher will have an idea of how such a study has been done in the past [3]. In this way, this research may be able to reflect, compare itself, learn from setbacks and produce a stronger and more efficient study.

One of the significant issues that we are looking in the present society is traffic congestion mainly because of the unavailability of sufficient parking lots. This has become a major problem in urban cities where there are shopping malls, cinema theatres, metro stations, etc.

In a paper titled as "An IOT based smart parking using LORA" [4] written by authors Ravi.Kishore.Kodali, Krishna Yogi Borra, Sharan Sai G. N. and Jehova Honey Domma in 2017.The parking system author has propose is implemented using Esp32 TTGO LoRa transmitter, receiver and ultrasonic sensors. LoRa receiver can receive the data from multiple transmitters as packets. The LoRa transmitter is installed in various parking lots to transmit the data of parking availability so that we don't need to use WiFi at every parking lot.

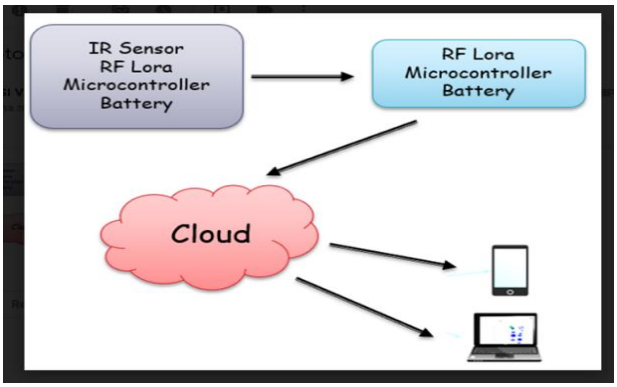
LoRa Esp32 module can transfer the data upto 5 km range. They have kept a LoRa recevier at that range to receive the data from multiple parking lots. So, if there are three parking lots and find a point which is nearly in the range from the three lots then we place the LoRa receiver at that point. Instead of three Wifi modules at three parking lots, they have kept three LoRa transmitters and a receiver. This reduces the cost of using internet provided by Internet service providers(ISP). WiFi protocol is used only at the receiver side i.e.,ESP32 LoRa receiver to transfer the received data onto the cloud and also to a local wifi server to accessthe data in our android phone [4].

The receiver is placed such that it is equally nearer to the transmitters. The rest of the paper is organized as follows: Section II gives us the fundamental survey of the past work done in this area Section III includes the advantages of the proposed system over the current ones and also the advantages of using LoRa. Section IV describes the design of the proposed system and how it is implemented. Section V and VI presents the hardware and software realizations respectively of the proposed system. The results are given in Section VII.[4]

In paper titled as The Efficient Parking Bay Allocation and Management System Using LoRaWAN" [5] authored by Saifil Allif A'ssri, H. K. Zaman The whole system of this project is based on LoRaWAN. The end nodes consist of sensor, microcontroller and Lipo Bettery. For this project, a HMC5883L, 3-axis magnetic sensor to collect and send the data to the gateway Microcontroller also set the network id to be transfer to the gateway along with the data. The data send from microcontroller is encrypted. In the gateway, devices that are being use is Dragino LoRa/GPS HAT. The connector/gateway are attached with the Raspberry Pi 3. The gateway is created onto the SX1276/SX1278 transceiver. By adding on L80 GPS (base on MTK MT3339) is developed for the applications that are using a GPS which connected via the serial ports of the Raspberry Pi that required GPS information such as timing applications or general applications. The gateway will receive the data in UDP packet[5].

5. METHODOLOGY

At TX side there is a sensor node that detects whether the parking slot is vacant or occupied. The output of the sensor is transmitted as packets through LoRa TX to LoRa RX. At receiver side, the Lora RX receives the output of sensor. The output is then transmitted to Smart parking application via wireless HC-05 Bluetooth module. At the application side, each parking slot indicates vacant or occupied and the users can easily identify which parking slot is available.



6. SYSTEM DESIGN

LoRa Technology enables connections, real-time operations and activity observations, resource improvement, and integration with smart cities service

1. Each parking space is equipped with a battery powered occupancy sensor that can detect the absence and presence of a vehicle. The sensors are self- provisioning, with a unique address assigned to each unit that is associated with its sensor output.

2. During the sensor detection of vehicular activities, its embedded LoRa transceiver sends a short message packet carrying the change in level to any wireless Internet gateway within its range. The gateway are often a part of a personal LoRa network or a node during a public LoRaWAN service provider.

3. This LoRa forwards the packets to the other LoRa node with contains the output of the sensor.

4. The LoRa then further forward the packets to Smart Parking application that can reside either on a Cloud-based or dedicated server. This turnkey parking management solution uses the sensors' messages to stay track of open and occupied spaces. It can present parking events on an internet interface, and supply parking data to third-party applications that generate billing information, and advertise available parking spaces to motorists via their smartphones or other wireless devices. It can also be customized to support a wider range of specialized services.

5. The Lora WAN protocol support for two-way communication capabilities allows the parking manager to query the sensors.

6. This Parking App service may also share real-time parking data with other smart cities services operated by a municipal or regional government[2].The services use information collected from several parts of a city's infrastructure to deliver unique applications, like remote parking enforcement. Sensor-based parking observing works hand in hand with street cameras and other various parking technology to remove "camping" in short-term parking, remains in loading zones and other infractions that keep drivers circling in search of a permitted parking space.

7. This app displays real time data (live information) to the user operating the application and the parking spots are reserved only once the user parks their vehicle in a particular assigned spot[1].

8. This parking data statistics may also be used for reasearch/survey purposes in collaboration with the Government for understanding the nature of traffic, vehicle density variation in different time intervals and also the general road traffic behaviour in particular areas.

7.SMART PARKING MOBILE APPLICATION

It is a feature-rich application that can be programmed to have as many or as few of the suite of capabilities as your site requires. At its most primary it displays directional way finding to accessible bays and tariff details such as parking hours and charges. You can also filter for parking bay types including occupied or vacant.

The Smart Parking application is available for Android and it can be used by connecting with Bluetooth.

As you open the Smart Parking application, it flashes the message that device Bluetooth is turned off.

After turning on the Bluetooth we have to select devices to connect. It will open list of available Bluetooth devices. Select the HC-05 Bluetooth device.

The Smart Parking application is connected to the HC-05 Bluetooth terminal which is present at the receiver LoRa node.

The output that is the status of sensor, occupied or vacant, is displayed on the particular parking slot at real-time.

8. RESULT

1. The final output of Smart Parking System using LoRa can be seen in real-time on the Smart Parking Application.

2. There are slots present in the Smart Parking application and at particular parking slot the status of availability can be viewed i.e., whether that parking slot is 'OCCUPIED' or 'VACANT'.

3. Using LoRa, the sensor data can be transmitted in the range more than 10km, between 15 to 20 km with frequency band 923MHz (Asia).

4. Using HC-05 Bluetooth Module, we can send the data in the range of 20-30 meters with frequency band 2.45GHz.

5. In the parking area at each parking slot there is an IR sensor which detects the coming and leaving of the vehicle. The IR sensor is connected with the LoRa module using Arduino. This whole acts as transmitter side.

6. As the vehicle is parked in that particular parking slot, the IR sensor detects coming of the vehicle and sends the output data value as 0. And as the vehicle leaves the parking slot, the IR sensor detects the leaving vehicle and sends the output data value as 1. The IR sensor sends all these data values in the form of packets.

7. With the help of LoRa module we have transmitted the IR sensor data from parking lot to the receiver side LoRa module.

8. At the receiving side there is a LoRa module which is connected to the HC-05 Bluetooth Module using Arduino. The receiver LoRa module is kept in the range more than 10 km and it receives the IR sensor data as 1 and 0 values, which is then programmed using Arduino as 'VACANT' and 'OCCUPIED' respectively.

9. All these values are then transmitted to the Smart Parking application via wireless Bluetooth connection. The Bluetooth connection can be established within the range of 20-30 meters.

10. The users in that range can easily find the available parking area using the Smart Parking application. As the user turn on the Bluetooth in their phones, they get connected with the HC-05 Bluetooth Module and starts receiving the IR sensor data from the parking area in real-time.

11. They can easily identify in the Smart Parking Application that which particular parking slot is available in the parking area.

12. The output of a particular parking slot, at the application end, is 'OCCUPIED' if IR sensor data is 0 and 'VACANT' if the IR sensor data is 1.

13.The users can conveniently use the Smart Parking Application and view the availability of parking area on their phones using LoRa module.

9. APPLICATION OF LORA

Smart Parking System Using LoRa. It helps us monitor the parameters of the Connection the usage of sensors that are familiarize for remote sensing of the specific data and forward the information over the network cloud by means of Internet Connection

INDUSTRIAL APPLICATIONS:

- Radiation and leak detection
- Smart sensor technology
- Item location and tracking
- Shipping and transportation

SMART HOME APPLICATIONS:

- Enhanced home security
- Smart Door Locks
- Smart home management

HEALTHCARE APPLICATIONS:

- Health monitoring devices and management
- LoRa-based temperature sensors

AGRICULTURAL APPLICATION:-

- Smart farming and livestock management
- Temperature and moisture monitoring
- Water level sensors and irrigation control.

10. CONCLUSION

The main contribution of this study is to introduce the foremost significant parking problem — i.e., finding an empty space — and propose an answer. Ultrasonic sensors are often used both for parking lot detection and improper parking detection. The proposed architecture for a parking detection system would take less searching time for the empty spaces and reduce difficulty of single cars with no proper parking across two spaces. Future research might examine parking lot booking procedures and optimization of sensor usage. Cost effectiveness and marketing could be studied as well. In future, our global, national and regional networks have to support billions or even trillions of devices. LoRa can play a big role for providing a sensible, low cost and highly efficient network for future applications. It has an association of quite 400 companies globally to contribute.

11. REFERENCES

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