Journal of IoT in Social, Mobile, Analytics, and Cloud (ISSN: 2582-1369)
www.irojournals.com/iroismac/

IoT based Car Parking System using LoRaWAN Technology for CIT Campus

Dr. M. Poongothai[1], Chinmaya Mahadev. M.N [2], Shivananth.A[3], Vamsi Krishna. D [4], Vinesh. S. R[5]

[1] Professor, Department of ECE, Coimbatore Institute of Technology, Coimbatore, India

[2,3,4,5] Department of ECE, Coimbatore Institute of Technology, Coimbatore, India

E-mail: [1]poongothai@cit.edu.in, [2]2004060ece@cit.edu.in, [3]2004086ece@cit.edu.in, [4]2004097ece@cit.edu.in, [5]2004099ece@cit.edu.in

Abstract

The usage of four-wheeler vehicles has increased over time, and finding a parking spot to park the cars in is getting much more challenging. This issue also exists on the CIT CAMPUS, which led to developing a parking system using IoT technology to make it simpler to find parking places. An IoT-based car parking system based on LoRaWAN technology is suggested as a solution to this issue. The purpose of this research is to design and implement a well-organised parking system with a user-friendly application which can avoid cramming in the car parking area. In the proposed system, Arduino-LoRa transmitter boards, Ultrasonic sensor and LG01-LoRa gateway are used for the implementation. Ultrasonic sensor-equipped Arduino-LoRa transmitter boards are positioned in various parking lots. It is used as a processing element which detects the availability of parking space in the parking area and transmits the data to the gateway that is situated close to the parking lots. The data is received by the gateway and forwards the slot information to the Things Network. The vacant spaces in the parking area could be viewed using a mobile application. The proposed system includes a gate entry management system that reads the number plate of a vehicle using YOLO- V3 algorithm and stores the real-time vehicle log information in the database. This method makes it easier for drivers to identify the available parking spaces offering a streamlined parking experience, which helps users spend less time in parking their cars.

DOI: https://doi.org/10.36548/jismac.2023.3.003
Received: 12.07.2023, received in revised form: 16.08.2023, accepted: 03.09.2023, published: 12.09.2023

Keywords: Internet of Things, LoRaWAN Technology, Arduino UNO Processor, The Things Network, Sensor System and LoRa Gateway.

1. Introduction

Smart cities are developing quickly, and as a result, many technologies are put into place that have an impact on a variety of industries and social areas. The main application of the smart parking system is to find available parking spaces to park the cars [2]. The smart parking system can be implemented by integrating a variety of sensors and microcontroller or microprocessor-based processing units to aid in real-time parking information updates. Finding a vacant parking space may be difficult, notably in congested areas like cities, malls, and academic institutions. Locating a free parking spot, particularly during the peak hours, can be solved with real-time smart parking.

In this work, the idea has been narrowed down to focus on creating a smart parking system for the CIT College's premises as part of a developing Smart City [3]. The system's goal is to give visitors, staff, instructors, and students who drive and park their vehicles at the college a quick access and a reliable real-time parking information. Finding a parking spot is a daily issue for both students and employees. This ends up in wastage of time and energy causing delay in accomplishing their assigned duties. Therefore, IoT-based car parking systems can solve such issues rather than traditional parking management systems. Vehicle owners can be benefitted from smart systems within the campus to reduce pollution, save time, and utilise resources effectively [6].

The CIT campus has a few different car parking areas including visitor's car parking, student 's car parking area, staff's car parking area etc. Fig 1 shows the parking spaces that are available in the CIT campus. The two primary types of parking for cars are on-street parking and off-street parking. On-street parking is when vehicles are parked directly on the street. The various car parking types are depicted in Fig. 2. Typically, the government will be in charge of overseeing this. According to IRC, a car's standard dimensions are 5 m x 2.5 m, whereas a truck's standard dimensions are 3.75 m x 7.5 m. Off-street parking refers to parking a vehicle off the street. Private firms will normally be in charge of this. The CIT car parking is under off-street parking. Parking spaces adjacent to the library block building have been selected for the research proposed and implemented.

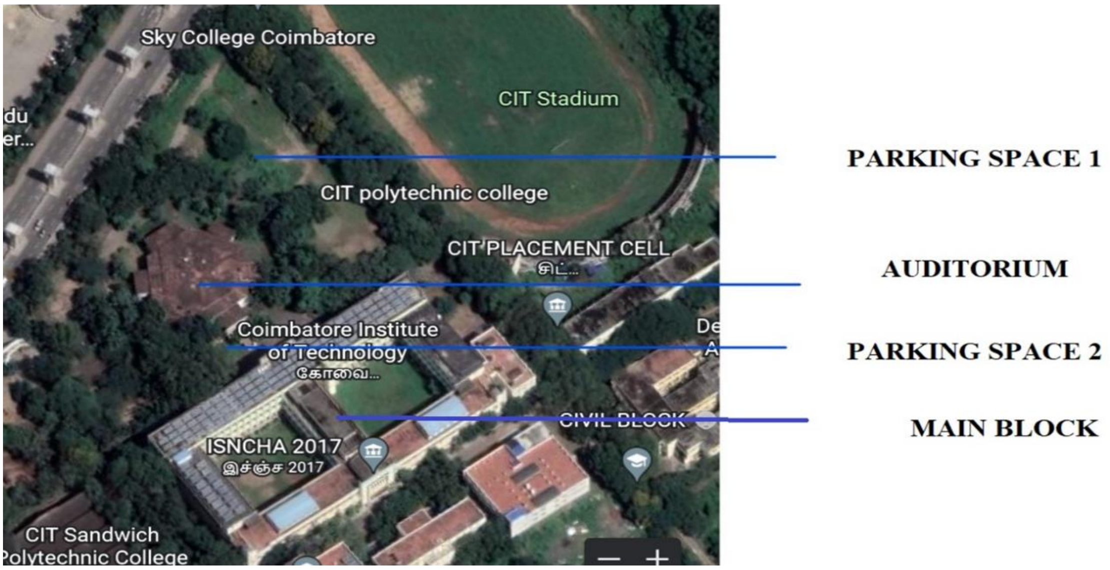

Figure 1. Parking Spaces in CIT Campus

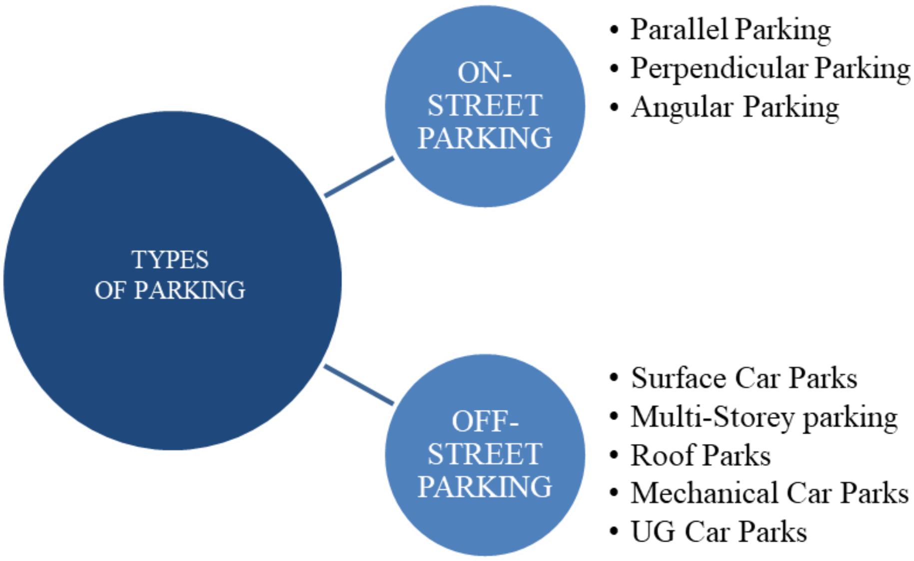

Figure 2. Types of Parking

There are numerous parking spaces scattered all throughout the premises. These parking spaces are manually run by cashiers and security personnel and lack intelligence. Due to the characteristics of the campus in terms of size, Internet connectivity, and the presence of open spaces like outdoor parking lots, the LoRaWAN-based IoT system is a strong solution to support parking management for the smart campus. [4].

In this study, a parking system based on LoRaWAN is presented for real-time monitoring and control of outdoor parking spaces on a smart campus. The number of available parking spaces is identified by placing Arduino-LoRa transmitter boards with ultrasonic sensors on each parking slot. The available parking slots are updated to The Things Network server and are accessible to users as well as the management office. The two key contributions of the work planned are listed as follows:

- To determine whether an outdoor parking place is used, an Internet of Things (IoT)-based car parking system using LoRaWAN technology has been developed.
- The deployed sensors have been placed in parking lots, and code for the Arduino IDE has been created to collect data from those sensors and communicate it to The Things network in real-time. A mobile-based IoT dashboard that displays parking space status is available to employees, pupils, visitors, and management.

The rest of the paper is organised as follows: Section II provides background information and associated literature. The suggested system model and system implementation are described in Section III. Section IV discusses the findings. Section V contains the conclusions.

2. Related Work

Researchers have focused a lot of attention on the creation of "smart parking systems" as part of the development of smart cities. Most of the smart parking systems explained in the literature are based on Wi-Fi, Bluetooth, Zigbee, Radio Frequency Identification, Wireless Sensor Network technologies. The following are a few of the relevant works in the literature survey that are based on IoT-based smart car parking systems.

"Abhirup Khanna & Rishi Anand"[1] presented an Internet of Things (IoT)-based smart parking system utilising a Raspberry Pi, ultrasonic sensors, and an ESP8266 Wi-Fi module with the purpose of developing a prototype system that offers details on parking entry time, parking time span and payment type. The proposed system in this work is implemented using IBM MQTT Server. Since the server requires a subscription, the system implementation cost will be increased.

In [2], a Smart parking system is proposed. Here, an ultrasonic sensor is connected to an Arduino UNO, which examines the parking situation and uses a GSM module to communicate information about the parking situation to the cloud. The cost of implementing the system will increase due to the need of an GSM module for each node.

The creators of [3] created a mechanism that enables user authentication for a legitimate parking slot reservation. Here, an infrared IR sensor is coupled to a computing device called a Raspberry Pi. The sensor determines whether a car is available and sends that information to an Amazon web server. The parking lots can be reserved by a smartphone app, and a DC gear motor controls the parking based on the reservation. The biggest drawback of this system is that real-time testing was not done on it.

Kianpisheh et.al [4] proposed an automatic smart parking system. In this research, the parking information is received by a PIC microcontroller equipped with an IR proximity sensor and sent to the webpage via the Wi-Fi module. The system's main constraint is the microcontroller selection, and Wi-Fi connectivity needs a separate module.

An automatic parking system for smart campuses that uses the cloud [5] authored by Yee O.C et.al addresses the concept of a smart campus within the context of digital transformation and emerging technologies. It conducts a systematic review categorising research into societal, economic, environmental, and governance domains, supported by digital tech and big data.

Suthir S et.al [7] proposed a conceptual framework for an internet of things aided industry 4.0 smart parking system. The system proposed in this work makes use of sensors and embedded technologies for each parking spot in order to enable automated parking and to maximise efficiency and user convenience within the framework of industry 4.0 and IoT-assisted networks.

Arshad Farhad and Jae-Young Pyu proposed an in-depth analysis of how machine learning (ML) is applied to enhance Long Range Wide Area Network (LoRaWAN) performance in the Internet of Things is found in LoRaWAN Meets ML: A Survey on Enhancing Performance with Machine Learning [10].

The commercial parking systems found in literature survey are listed below:

The Aida Engineering, Ltd. self-service car parking control system's automatic parking flap removed the workers from the parking lot. [16]. Daimler AG has developed the Parking Reservation App for Mercedes subscribers, which facilitates parking space reservations. The self-check-in/check-out parking service system from Advantech Co., Ltd. aims to reduce the number of staff in the parking building. [17]. to ascertain whether a side-of-the-road parking lot is occupied, sensors are used by Siemens' intelligent parking systems [18]. The Smart Parking Ltd. automatic parking system. [19] is a car parking solution that enables users to view the parking lot's occupancy.

The authors also cover a smart parking system that controls the parking space using mobile apps and IoT devices. A smartphone application is used in another smart parking system that is discussed to reserve the parking space. Additionally, Cloudparc [20] incorporates data analytics into their smart parking solution. Shin Woo UBiCos' automatic parking system [21] is a vertical-type tower.

According to the literature review, there are certain constraints with the current systems in terms of connectivity issues, appropriate microcontroller selection, Gateway integration, system complexity, power usage, cost, and accuracy. Regarding the enhancement, the proposed work seeks to establish an intelligent parking system based on LoRa technology on the CIT campus using IoT and mobile application technologies. Using this method, an electronic QR code can take the place of the conventional parking sticker or paper.

The cashless society theme and the smart campus projects that are being implemented on numerous university campuses across the world are also consistent with the prototyped smart parking system.

3. Proposed System

In the section discussed below, the infrastructure of LoRa, Block diagram and system architecture for system proposed are described. Fig 3 depicts the infrastructure of LoRa which is used in the system proposed. The architecture is composed of mainly three layers; LoRa nodes with sensors, Wireless gateway and end users. The LG01N Gateway is employed in this work. The LG01N is a single channel LoRa gateway that is open-source. Through WiFi, Ethernet, or cellular networks, the wireless network LoRa is connected to the IP network. LoRa enables its user to communicate to a longer distance using low data rates. It offers great interference immunity and communication via ultra-long-range spread spectrum. The LG01N provides a variety of internet connection options, including WiFi, an Ethernet port, and cellular. Users can link their sensor networks to the Internet using these interfaces' adaptable approaches.

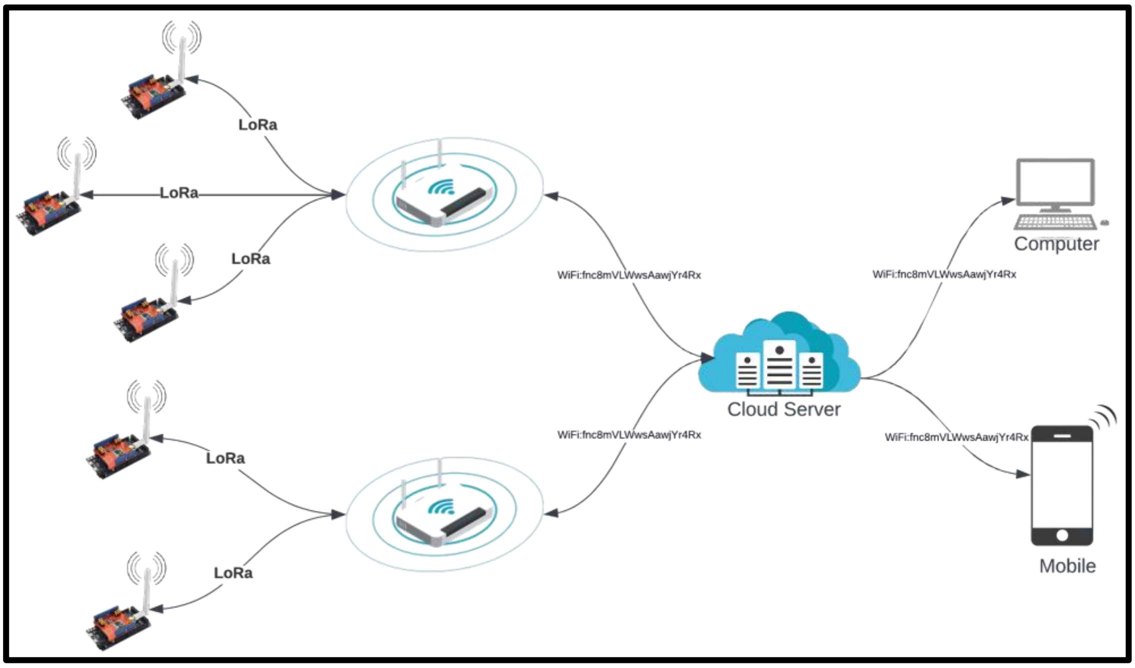

Figure 3. Infrastructure of LoRa

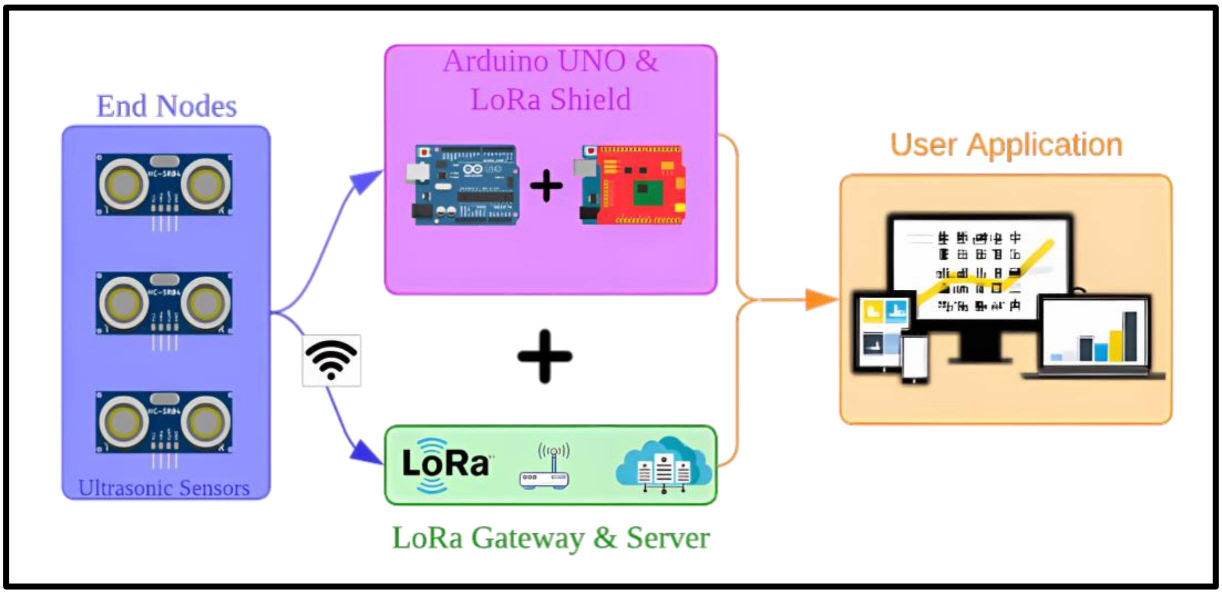

Figure 4. Block Diagram of Proposed Model

There are numerous parking lots spread all throughout the premises. These parking lots are manually run by security personnel and lack any intelligence. Due to the size, Internet infrastructure, and open spaces in the CIT campus that serve as outdoor parking lots, a LoRaWAN-based IoT system is an appropriate choice to provide parking management for the smart campus. Fig 4 depicts the proposed system block diagram. The hardware setup consists of Arduino UNO, Dragino LoRa LG01N, Wireless Transmitter 915Mhz Lora Shield for

Arduino, HSC-SR04 ultrasonic sensor, LEDs. The software tools used in this work are Arduino IDE, and The Things Network IoT platform [11].

The proposed system is designed to perceive the existence of a car using an ultrasonic sensor and transmit the data via a LoRa shield to a LoRa gateway. The system is intended to be used in a college parking lot to help students and staff find available parking spaces more easily. The system consists of two main components: the Ultrasonic sensor and the LoRa shield.

The LoRa shield is a low-power, long-range wireless communication module that is used to transmit data over long distances. The shield is linked with an Arduino board, which is used to regulate the sensor and process the data. The LoRa gateway is located at a central location and is used to receive the data from the LoRa shield and store it in a database.

The existence of an automobile in a parking space is determined by the use of an ultrasonic sensor. When a car is present, the Arduino senses the space using the sensors and then sends the status to the LoRa shield, which then transmits the status to the LoRa gateway, further the information is transmitted to a cloud based service to analyse the data systematically and represent the data graphically or pictorially to view the data.

Chirp Spread Spectrum (CSS) technology has been adapted for usage in LoRa as a wireless modulation technique. It uses chirp pulses to encode information on radio waves, much like bats and dolphins do. LoRa modulated transmission may be received across a wide range of distances and is resistant to disruptions.

The suggested gate level entry management system is intended to actively use camera modules and a licence plate recognition system for authentication to track the vehicles entering the campus and save the data. It aims to increase security and simplify access control for visitors, employees, and students [14].

The camera module and the licence plate recognition system are the two primary parts of the system. The camera module is used to take pictures of cars driving through the gate and into the campus. Following that, the photos are processed with the aid of OpenCV-Python, a potent open-source computer vision toolkit [15] that can be used for image processing and analysis. Using the Haar Cascade classifier, the licence plate region is initially identified in the image processing process [8]. The licence plate is retrieved and preprocessed to remove noise and distortions after the region has been determined.

Utilising OCR to decipher the characters on the licence plate is the following step in the procedure. To do this, machine learning methods like convolutional neural networks (CNNs) and support vector machines (SVMs) are applied. The characters are classified using SVMs, while the features from the licence plate image are extracted using CNNs [9].

After recognizing the characters on the licence plate, the system decides if the car can proceed into the campus. By matching the number plate number to a registry of registered automobiles, this is accomplished. The mechanism allows entry to the car if the registration number matches a record in the directory. If not, the system refuses entry and notifies the security staff [13].

The system is made to be expandable, allowing new camera modules and LPR systems to be installed as necessary to cover more entrance points. To keep details about authorised vehicles and their owners, the system can also be integrated with a database. The gate level entry management model is shown in Fig 5.

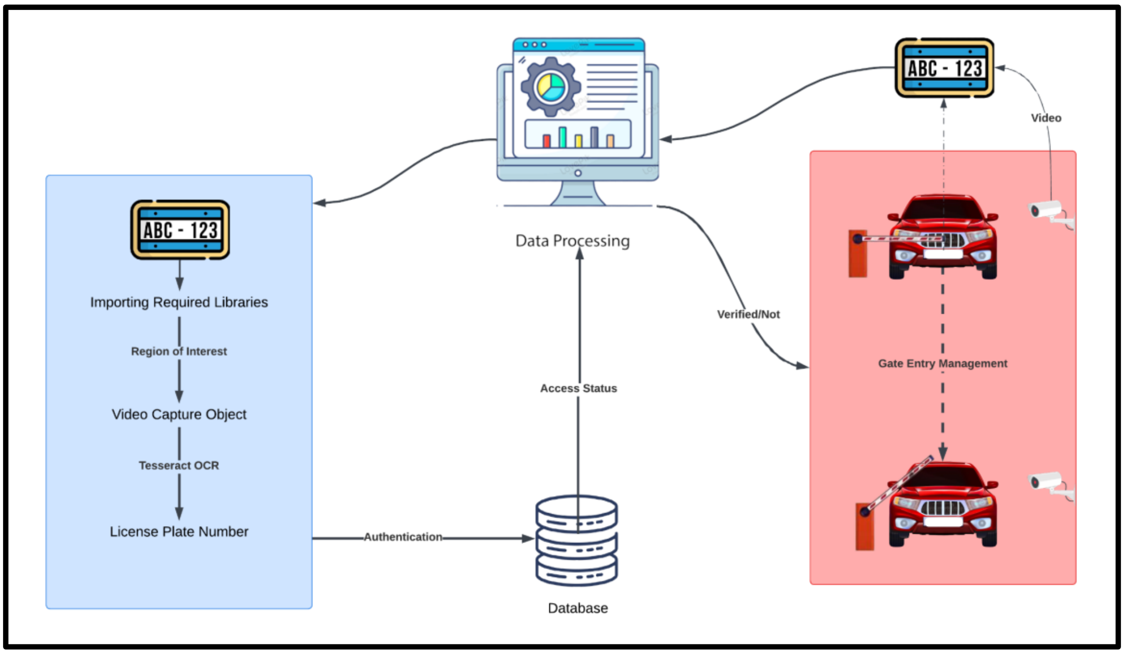

Figure 5. Proposed Gate Entry System Model

3.1 Algorithm for Proposed Gate Entry System

Step 1: Import the required libraries - NumPy, Pillow (PIL), Matplotlib, OpenCV, and Pytesseract

Step 2: Set the path for the Tesseract OCR executable using the pytesseract.pytesseract.tesseract_cmd attribute

Step 3: Set the path for the Haar Cascade XML file, which contains the pre-trained classifier for licence plate detection

Step 4: Create a Video Capture object to capture video from the default camera

Step 5: Set the frame size of the video capture to 640x480

Step 6: Set the minimum area for licence plate detection to 500 pixels

Step 7: Enter an infinite loop to continuously read frames from the video capture

Step 8: Convert each frame from BGR to grey-scale

Step 9: To identify licence plates in the grayscale frame, use the Haar Cascade classifier.

Step 10: For each detected licence plate, calculate its area and check if it exceeds the minimum area threshold

Step 11: If the area exceeds the minimum threshold, draw a rectangle around the licence plate on the original colour frame, add a text label, and create a region of interest (ROI) by cropping the licence plate region from the colour frame

Step 12: Display the ROI in a separate window for visual inspection

Step 13: Display modified colour frame with the detected licence plates

Step 14: If the user presses the 'a' key, exit the infinite loop and release the video capture resources

Step 15: If the user presses the 's' key, save the current ROI as a JPEG image with a filename that includes a counter (to avoid overwriting previous images), draw a green rectangle with text indicating that the plate has been saved, and display the modified colour frame with the saved plate indicator

Step 16: Wait for 500 milliseconds and increment the counter for saved images

Step 17: After the infinite loop ends, release the video capture resources and destroy all open windows

Step 18: Open the last saved image and use Pytesseract to extract text from the licence plate region of interest

Step 19: Print the extracted text.

3.2 Prototype Model of Proposed System

The hardware configuration and prototype model of the suggested system are shown in Figs. 6 and Fig 7. Data from the end devices linked to the Dragino LoRaWAN gateway (LG01N) are received by the proposed system. An individual identification code known as an EUI is given to each end device.

The end device is an Arduino atmega328 microcontroller with a LoRa shield added on top of the Arduino, the LoRa shield performs LoRa modulation to send the data from the device to the gateway. LoRa shield converts the raw data from the sensor to LoRa packets, The LoRa packets consist of source address and destination address. The data is transmitted to the gateway [7].

Gateway knows which device is sending the data because of the EUI. Then the gateway sends the data to a LoRa protocol supported cloud platform, the cloud platform used is The Things Network where the end devices connected to the gateway are listed and live data are displayed.

Qubitro is one of the integration options available under the webhooks section in the TTN (The Things Network), Qubitro is a IoT platform for building and managing IoT applications it supports protocols such as MQTT, HTTP, CoAP and LoRaWAN [10]. The

Things network forwards data packets to Qubitro whenever the data is received to the TTN, the data is graphically represented in Qubitro.

Figure 6. Hardware Setup of Proposed System

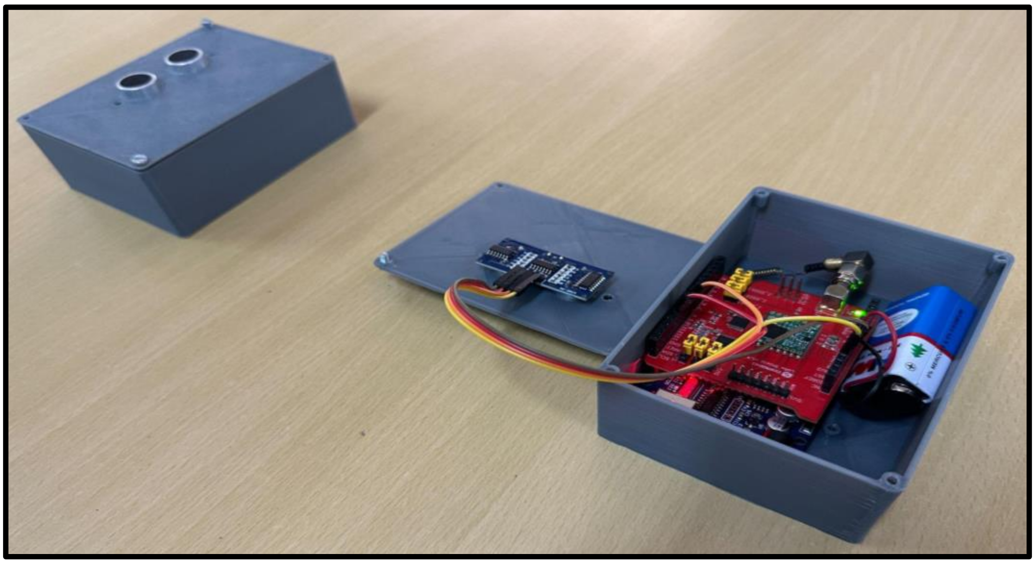

Figure 7. Prototype Model of Proposed System

4. Results and Discussion

The implementation of an IoT based car parking system using a LoRa gateway and Qubitro yielded promising results [12]. The system successfully detected the presence of cars in parking spaces using ultrasonic sensors and transmitted the data through the LoRa shield to the Dragino LoRa gateway. The gateway effectively received the data from multiple end devices and securely transmitted it to The Things Network, a global IoT network infrastructure.

Qubitro, an IoT platform for building and managing applications, played a crucial part in receiving and visualising the data in a graphical format.

The integration of the LoRa gateway and Qubitro provided instant updates about the information of parking availability to users, enabling them to effortlessly locate unoccupied parking slots. The scalability of the model allowed for the addition of more sensors and LoRa shields to cover a larger number of parking spaces. The use of LoRa technology ensured long-range, low-power communication, making it suitable for large-scale parking management.

Overall, the car parking system which is based on IoT demonstrated the potential to enhance parking management by providing accurate and timely information to users. It improved efficiency, reduced congestion, and enhanced the overall user experience. The combination of LoRa gateway[8,10] and Qubitro proved to be an effective solution for data transmission and visualisation, making it a viable choice for implementing similar IoT applications in various domains.

4.1 Arduino IDE Results

From Fig 8, it has been inferred that "1" represents an occupied parking slot, while "0" indicates an empty slot. "EV_TXSTART" signifies the start of a LoRa transmission, while "Packet queued" confirms that the data packet is prepared and waiting to be sent. Finally, "EV_TXCOMPLETE (includes waiting for RX windows)" indicates the completion of transmission, encompassing any necessary waiting periods for potential receive windows. These outputs enable monitoring of slot occupancy and provide insight into the status of transmission processes within the smart parking system.

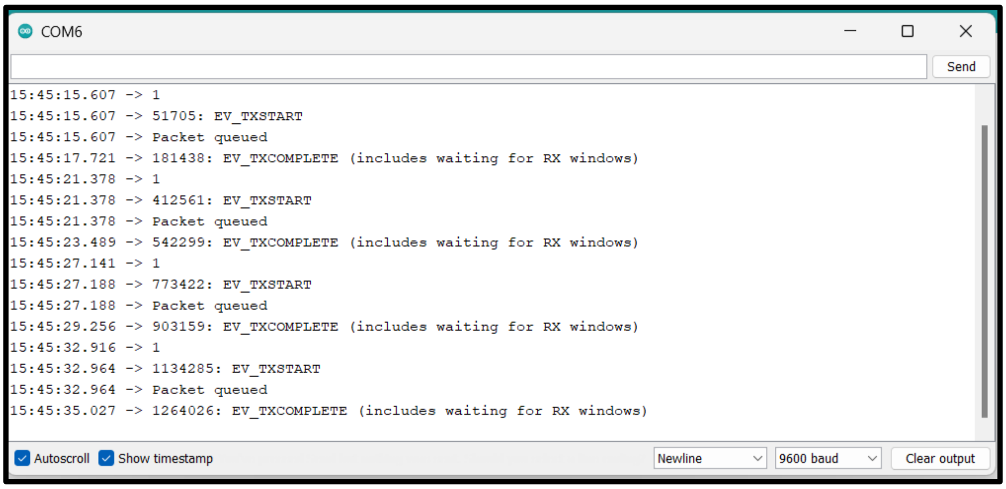

Figure 8. Arduino IDE Serial Monitor Output

4.2 Qubitro Dashboard

Qubitro is one of the fastest ways to integrate LoRaWAN gateway with its database.The TTN has webhooks integration for Qubitro where the project key and webhook signing key from TTN will be automatically synchronised with its dashboard. Further dashboard can be created for devices connected with the LoRa gateway by its EUI. The data can be represented in the form of gauge or in a histogram. In Fig 9 and Fig 10 the dashboard data for two parking slots are represented in the form of gauge and histogram which shows whether the slot is occupied or vacant.

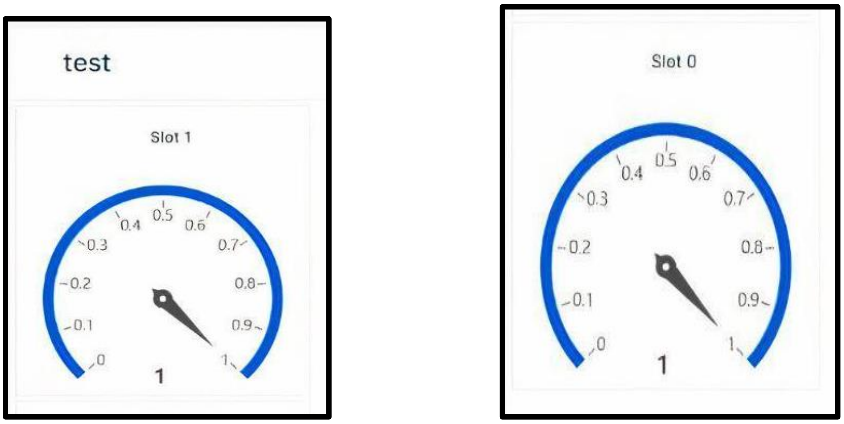

Figure 9. Qubitro Dashboard-Gauge

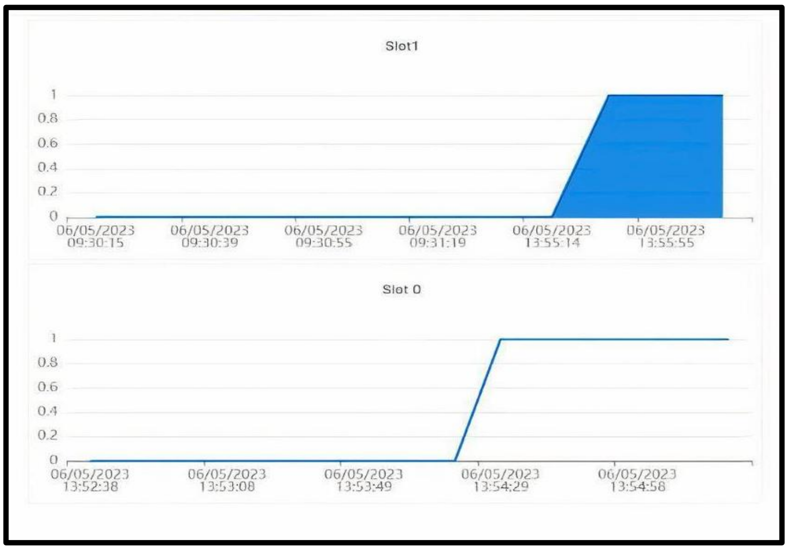

Figure 10. Qubitro Dashboard-Graph

The gauge depicted in Fig 9 accurately displays a value of 1, indicating that the parking space is taken. The histogram depicted in Fig 10 accurately displays a value raised to 1, indicating that the parking space is taken.

In the context of the LoRa-based parking slot monitoring, the sequence commences as sensors detect alterations in occupancy status. These modifications are subsequently encoded into LoRa messages by the LoRa transceivers, which transmit the encoded data through gateways to The Things Network (TTN). TTN effectively processes and archives the data. To seamlessly incorporate this data flow into Qubitro's dashboard interface, an API linkage is established between TTN and Qubitro. This integration facilitates automated data transmission at scheduled intervals. Upon reception, Qubitro undertakes data processing, extracting the occupancy changes and correlating them with specific parking slots. The refined data is then stored and showcased through a personalized dashboard, empowering users to instantaneously oversee parking slot occupancy, dissect historical trends, and obtain alerts.

5. Conclusion

The proposed system has been tested and implemented by using ultrasonic sensors, Dragino LoRa LG01N, Lora Shield and TTN IoT platform. The system provides faculty members, students, and visitors with a way to easily check the vacant slots in parking area in real-time. This helps to save time and lessens the frustration of probing for a parking space. The inclusion of an automatic car plate recognition system enhances security by automatically identifying and recording the licence plates of vehicles entering the parking area. This feature can help track the movement of authorised vehicles and prevent unauthorised access. The proposed system in future could be designed to incorporate multiple sensors and LoRa (Long Range) modules that allows for scalability, making it suitable for covering larger areas such as very big campuses.

References

[1] A. Khanna, R. Anand, “IoT based smart parking system”, in: 2016 International Conference on Internet of Things and Applications (IOTA), IEEE, 2016.

[2] Hardik Tanti et.al (2020), “Smart Parking System based IoT”, International Journal of Engineering and Technical Research, Volume 9, Issue 05,ISSN:2778-0181.

[3] B. Mahendra, S. Sonoli, N. Bhat, T. Raghu, “IoT based sensor enabled smart car parking for advanced driver assistance system”, in: 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), IEEE, 2017, pp. 2188–2193.

[4] A. Kianpisheh, N. Mustaffa, P. Limtrairut, P. Keikhosrokiani, “Smart parking system (SPS) architecture using ultrasonic detector”, Int. J. Softw. Eng. Appl. 6 (3) (2012) 55–58.

[5] Yee, O. C., N. Yaakob, M. Elshaikh, and F. Azahar. “A cloud-based automated parking system for smart campus”,In *IOP Conference Series: Materials Science and Engineering*, vol. 767, no. 1, p. 012049. IOP Publishing, 2020.

[6] Jabbar, Waheb A., Chong Wen Wei, Nur Atiqah Ainaa M. Azmi, and Nur Aiman Haironnazli. “An IoT Raspberry Pi-based parking management system for smart campus”, *Internet of Things* 14 (2021): 100387.

[7] Suthir S, Pon Harshavardhanan, Kavitha Subramani, Senthil P, Veena T, and Nivethitha V.(2022), “Conceptual approach on smart car parking system for industry 4.0 internet of things assisted networks”,Measurement: Sensors, Vol.24, pp.100474.

[8] Lee, Cheng Pin, Fabian Tee Jee Leng, Riyaz Ahamed Ariyaluran Habeeb, Mohamed Ahzam Amanullah, and Muhammad Habib ur Rehman (2022), “Edge computing-enabled secure and energy-efficient smart parking: A review” Microprocessors and Microsystems, Vol.93, Issue No. 104612, pp.0141-0152

[9] Jawale M. A., William P , Pawar A. B., and Nikhil Marriwala (2022), “Implementation of number plate detection system for vehicle registration using IoT and recognition using CNN”, Measurement: Sensors, Vol. 27, pp.100761-100774.

[10] Rodić, L.D., Perković, T., Škiljo, M. and Šolić, P., (2023), “Privacy leakage of LoRaWAN smart parking occupancy sensors”, Future Generation Computer Systems”, Vol. 138, pp.142-159.

[11] Mohit Patel, Rahul Sakore (2014), “Smart Parking System Based on Reservation”, International Journal of Scientific Engineering and Research, Volume 2, Issue 6, ISSN:2347-3878.

[12] Dipali Balmiki et.al i, “A Research on Smart Vehicle Parking System”, International Journal of Scientific Research and Management Studies (IJSRMS),Volume 4, Issue 7 Pg:124-127.

[13] Mahi, Vaibhav sadhana et al (2018), "Reservation Based Smart Parking System", International Journal of Creative Research Thoughts(IJCRT),Volume 6, Issue 2 ISSN:2320-2882.

[14] R.Subhash, et.al (2018), "IoT Based Smart Parking System", International Journal of Pure and Applied Mathematics, Volume 119 No. 14, ISSN :1314-3395.

[15] Amara Aditya, Shahina Anwarul, Rohit Tanwar, Sri Krishna Vamsi Koneru, "An IoT assisted Intelligent Parking System (IPS) for Smart Cities", Procedia Computer Science, Volume 218, 2023, Pages 1045-1054, ISSN 1877-0509.

Website References

[1] https://www.aida-eng.co.jp/en/parking/park/

[2] https://www.advantech.com/en/iretail-hospitality/solutions/detail/parking-service-system

[3] https://www.intel.com/content/dam/www/public/us/en/documents/solution-briefs/iot-siemens-smart-parking-brief.pdf

[4] https://www.smartparking.com/asset/801.pdf

[5] https://www.theparkingspot.com/

[6] https://www.exportersindia.com/shin-woo-ubicos/automated-car-parking-system-3997880.html

[7] http://www.cloudparc.com/

Author's biography

Dr.M.Poongothai is currently working as a Professor in the Department of Electronics and Communication Engineering, Coimbatore Institute of Technology, Coimbatore, India. Her research areas include scheduling in Real-time Systems, Energy Efficient Computing Systems, Low Power Design, Power Management of Energy Harvesting Real-time Embedded Systems and Internet of Things.

Chinmaya Mahadev.M.N is currently doing his Final year B.E in the Department of Electronics and Communication Engineering, Coimbatore Institute of Technology, Coimbatore, India. His areas of interest include Java programming, Embedded Systems and Circuits Designs.

Shivananth.A is currently doing his Final year B.E in the Department of Electronics and Communication Engineering, Coimbatore Institute of Technology, Coimbatore, India. His areas of interest include Computer Networks, Embedded Systems and Wireless Communication.

Vamsi Krishna.D is currently doing his Final year B.E in the Department of Electronics and Communication Engineering, Coimbatore Institute of Technology, Coimbatore, India. His areas of interest include Embedded systems, Digital Electronics.

Vinesh.S.R is currently doing his B.E in the Department of Electronics and Communication Engineering, Coimbatore Institute of Technology, Coimbatore, India. His areas of interest include computer networks and web development.