Park Smart and Ride

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***Abstract*—The traffic congestion in metropolitan areas is exacerbated by the recent increase in vehicles. Parking has also become a major problem in metropolitan cities. Traffic congestion was a big issue in the suburbs around Colombo in Sri Lanka. vehicles coming from the south to Colombo via the expressway exit through Makumbura and use public transport to avoid the Capital traffic crisis. This smart parking system helps them to park their vehicles safely and efficiently. This further reduces the time it takes for the user to park the vehicle and allows him to know if there is space in the parking lot. Here solutions have been developed for these with the help of IoT and cloud technology. IoT allows you to connect through the network and access it remotely. In this paper, we propose an IoT solution for this. Park Smart and Ride in real-time, accurately forecast and sense spot/vehicle occupancy, and direct vehicles to available parking. Allows for more accurate and real-time monitoring and management of vehicles in a parking lot. Use Parking Spaces More Efficiently. Relevant solutions are explored in this Paper.**

Keywords—Smart Parking, Internet of Things, Cloud Computing, RFID

I. INTRODUCTION

In today's hectic age, people use their own vehicles for transportation mostly. They often find it difficult to park vehicles despite the traffic crisis. Although there are many parking lots, the crisis there does not diminish unless it increases the time and fuel cost for drivers, such as lack of space. The need for massive parking is essential in urban development. Thus, the parking crisis can be overcome. Leaving vehicles on the side of the road causes traffic congestion, theft of vehicle parts due to lack of adequate security, and fines for parking vehicles in the wrong places. Highly well- planned smart cities can provide sustainable infrastructure economically, ecologically, and socially to the citizens. This will also help control traffic congestion. Today, many cities are launching smart parking systems and taking them successfully. This allows for safer parking, minimizes environmental pollution, and lowers fuel consumption. It will also improve public transport and generate revenue for the government. The smart parking system is the best way to avoid this. To overcome these concerns, a smart parking system was developed. Drivers can easily locate and obtain an empty parking lot at a location that is convenient for them. The adoption of a hassle-free payment mechanism also makes the parking system more convenient.

The Internet of Things (IoT) allows data to be transferred over a network without the need for human contact. IoT enables users to employ low-cost wireless technologies while also assisting them in transferring data to the cloud. The Internet of Things (IoT) assists the user in maintaining transparency. Kevin Ashton was the first to use the Internet of Things, which was originally launched in 1999 [1]. The Internet of Things (IoT) is embedded in electronics, software, sensors, and Internet access. Such devices not only simplify the work of the users but also play an important role in energy saving. This provides an opportunity for direct integration between the world of science and computer systems. This will lead to skill development, accuracy, and economic evidence. There will be an embedded electronics system that will identify each object individually; These will be streamlined with the web framework currently in operation.

This study aims to aid users in finding a parking spot near their work using IoT devices and using the Android platform, by using real-time data transmission techniques. The study adopts the same concept as Uber Taxi Service and applies that concept to the problem. The study proposes a simple yet effective methodology for vehicle parking space management using real-time data transmission and geo-positioning systems. The proposed system aims to use sentiment analysis to analyze user feedback and aid in providing a better parking space according to each user, by using their feedback, rating, and behavior. The proposed system acts as a single network of parking spaces so, the user can find a parking space near to his work. The main features are finding a parking space close to their workplace without creating a lot of traffic congestion, and without wasting time and fuel. The system identifies available and allocated parking spaces using IoT devices and uses that data to display nearby available parking spaces, notifying the users of the availability of the parking spaces and where he/she can park their vehicles. The system also utilizes user feedback and behavior to recommend suitable parking spaces. This

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approach does not stop at a single parking lot/structure, it creates a network connecting with other parking lots/structures available throughout the city and uses all the data as a huge pool to manage the parking infrastructure. Retrieving real-time data, Processing the data, transmitting the processed information throughout the parking space network, and transmitting information back to users.

II. LITERATURE REVIEW

Several methods and strategies have been employed to develop the system, according to earlier similar publications. To ensure a better upgrade of the suggested system in this project, it is critical to know about the systems that have been built. Over the past few years, several smart parking systems based on radio frequency detection (RFID), Auto Transient Network (VANET), Wireless Sensor Network (WSN), Bluetooth, Wi-Fi, ZigBee, and other technologies have been proposed with image processing techniques. This suggests an e-parking system. This includes parking meters, a Wi-Fi integrated workspace known as the local parking management server, as well as a central server to distribute parking information throughout the city to obtain driver requests for certain Wi-Fi access points (APs) in each parking facility [2].

A system that uses image processing. The image of the vehicle was sent to the ALPR (Automatic License Plate Recognition) cloud for number plate verification. The parking number is assigned to a specific number, reducing the number of free parking spaces. ALPR Cloud will issue the number plate of the image provided [3]. On the other hand, the RFID reader tags, and other components are used in the system, which makes it very simple and practical. Users are advised of available free parking places in the parking area using this method. It makes easier the process to customers to reach straight to the free slots without wasting time looking for them. As a result, if the system is implemented in shopping malls, consumers will be able to spend more time in the mall rather than in the parking lot [4].

The database stores and retrieves all the data generated by the system. The tracking system combines several cutting-edge embedded and communication technologies. Global Positioning System (GPS) is a space-based global navigation satellite system that provides status and time-related data to users anywhere in the world. Google Earth technology can be used to display location data provided by our GPS units. Various parameters about safety, emergency services, and engine stalls can be monitored using the implemented tracking system [5].

Developing low-cost, low-power embedded devices has given developers the ability to develop new Internet of Things applications. As a result of the development of sensor technology, many modern cities have chosen to implement various IoT-based systems in and around their cities for surveillance purposes. By leveraging the Cloud's unlimited capabilities and resources, IoT can transcend technological restrictions such as storage, computation, and energy consumption [6]. The cloud service provider provides cloud storage for parking information in the parking area within the cloud based IoT configuration for the smart parking system. The centralized server that stores all smart parking system data, including the number of available spaces, car availability, and so on. This data will be accessed via the network through some secured gateways [1].

The suggested system notifies users when parking spaces become available. Instead of waiting in the parking lot, a user can select a parking slot in advance using their smartphones, which display parking availability. For vacancy detection, IR sensors will be installed in each slot [7]. The parking area contains Arduino devices as well as an IR sensor. These devices allow the user to interact with the parking lot. Without the usage of an RFID card, the user is unable to enter the parking space. The cloud-based web services in the second segment operate as a mediator between the user and the parking lot. The cloud is updated based on the parking space's availability. The administrator manages the cloud services, which can also be inspected by users to check for availability. Finally, the user receives an SMS notification based on the availability via the GSM module [8].

III. METHODOLOGY

Methodology demonstrates a systematical approach to work. It is a typical method of explaining a process in the simplest possible way. Design is the process of using scientific principles, technological data, and imagination to create a new system that performs a specific function in parking.

A smart parking system based on high-level architecture is required. Here RFID, IR sensors, Servo motor, LCD, Node MCU Board, Arduino Board, and Raspberry Pi 4 are used. Users can interact with the parking slot using these gadgets. When the RFID read is successful, the main gate of the parking area is opened. Then the available parking slot number ahead of his/her vehicle number is displayed on the digital board in the main gate premises. That parking available parking slot number and his/her vehicle number are displayed on the digital board which is in the parking slot for easier finding the parking slot.

The block diagram of the smart parking system using the Raspberry Pi and other components used in the proposed system is shown below.

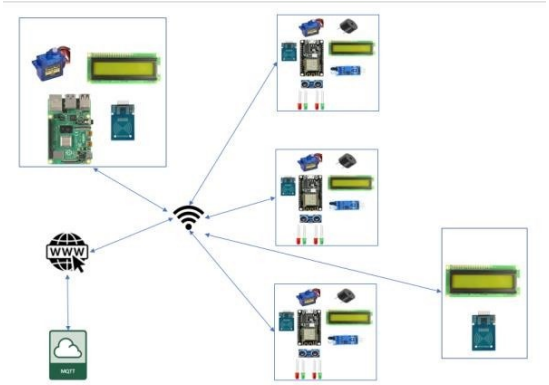

Fig. 1. Block Diagram

This part describes the high-level design for the Park Smart and Ride system. The system we suggest is made up of several devices. The above block diagram clearly illustrates this. There are three sensors used here. The IR sensor, the RFID sensor, and the ultrasonic sensor. These sensors are being used in the main entrance, ticketing counter, and parking slot. All these sensors have two common pins denoted

by VCC and GND. The VCC pin can be connected to a power source either 3V or 5V while the GND pin must be connected to the GND PIN in Raspberry Pi. It is advisable to use an external source.

Apart from the sensors we are using actuators, servo motors, buzzers, LEDs, and an LCD. The servo motor acts as the main gate and the slot gates while the buzzers, LEDs, and display are used to provide parking assistance. As is shown in the diagram, the system consists of three main components. The main entrance, parking slots, and the ticketing counter. These three components will be connected to a local area network over Wi-Fi. Using a wireless network helps to reduce the investment and maintenance cost and effort. An MQTT broker is used to communicate between the system components.

The main gate component contains RFID scanning, a gate created with a servo motor, and an LCD. At the point of a user entry, RFID will read the user's tag and will transmit the tag details to the Raspberry Pi where it will be checked against a database and be authenticated. Once authenticated the raspberry pi will run the function to open the main gate with a timeout. After the time out the gate will be automatically closed as the Raspberry Pi runs the function to close the gate. In parallel, Raspberry Pi will check the database for available parking slots and will assign the user's vehicle to an available parking slot. The parking slot information (Slot number) will be displayed in the LCD for the user's reference. After the gate is closed Raspberry Pi will publish a message containing the slot ID and the assigned user information via MQTT to all the parking slots. The LCD will then be cleared, and the main entrance will go to the initial state for the next user.

The parking slot will use a NodeMCU microcontroller and will have the RFID scanner, servo motor gate LCD, ultrasonic sensor, IR sensors, LED in red and green, and buzzers as shown in the diagram.

The NodeMCU is used as it is There can be any number of parking slots within a station. The message published by the main gate via MQTT will receive the MQTT clients in all the parking slots. The slots will read the received message and if the slot ID in the message matches the ID assigned to the slot the program in the slot will proceed and if not, it will ignore the message. If the slot ID matches the slot ID mentioned in the message the slot will read the data in the message. The message will contain the RFID details of the user, the vehicle number, vehicle details, user details, etc. All the slots will be keeping a variable to store the RFID tag details which will be a null value if a vehicle is not allocated. After reading the message, the slot will assign the RFID details of the user to the variable which will make the slot now respond only to the authenticated user. The LCD of the slot will also display the user's vehicle number in the slot where the user will be able to easily identify the parking slot. Once the user is at the parking slot, he will need to provide the RFUID for authentication. If authenticated, the gate will open. The user will have the ultrasonic sensor facing his vehicle which is used to calculate the minimum safe distance to avoid the vehicle crashing into the slot wall. The safety distance reach will be indicated with red LEDs which are also placed facing the vehicle. These LEDs will be lit in green initially once the gate is opened. There is a background function running in the system to calculate the safe distance and light the correct LED according to the ultrasonic sensor readings. The same function will also sound the buzzers once the minimum safe distance is reached. At this point the gate will be closed automatically and the system will publish a MQTT message saying that the parking slot is occupied. The IR sensors are used to monitor the motions while the vehicle is parked, and the user is away. If anyone tries to move the vehicle by passing the system these sensors will pick it up and alert the system.

The ticketing counter I the third and final component of the system which will also be using an RFID scanner to identify the user and an LCD. The user can have a pre-defined destination which can be entered upon ticket purchasing. The display will finally show the terminal number that he should proceed to take the shuttle to his destination. After all, he can reach the parking slot and re-scan the RFID to drive his vehicle away.

An RFID reader module is a device that scans and collects data from an RFID card. This card is useful for keeping track of stuff. RFID scans the details of users and uses it to gather information. Here RFID is used in two stages. In the first stage, the details of the vehicle and its owner are obtained and stored in the database and the RFID containing these details is given to the user. With this, the user can enter the parking lot. In the next step, the user will be able to get the fare for his trip from the database. After parking the vehicle, the user exits and executes his / her RFID to specify the destination. Based on the availability and user's preference user will be directed to a bus or the train. The user who returns to the parking lot after finishing his work will rescan his RFID again, open the gate, and take his vehicle out, his account will be calculated, and his amount will be sent to the user via the mobile app.

Fig.2. Travel Ticket

The Raspberry Pi is a small, low-cost computer that can be paired with a computer monitor or LCD and uses a standard keyboard and mouse. Here devices like IR sensors, Servo motors, and LCDs are connected to the Raspberry Pi and the MQTT server is connected through the Raspbian platform. The NodeMCU (Node Micro Controller Unit) is an open-source software and hardware development environment board specially targeted for IoT-based Applications [9]. It incorporates all the essential components of a modern computer. NodeMCU is connected to IR sensors, servo motors, and buzzers in parking slots.

An infrared sensor is a type of electronic gadget that detects the presence of objects. The free slot detection that is available in the parking space is done using infrared sensors. The IR is used near the barrier gate. If the vehicle is

scanned and registered, the gate will open with the help of a Servo motor, while the green signal light will illuminate and the red signal light will illuminate for a few minutes after entering the vehicle. This process is performed when the vehicle exits, and the vehicle is parked in the parking lot allotted to it. A servomotor is a rotating or linear drive that can precisely control angular or linear position, speed, and acceleration. In both cases, the servo motor was used at the entrance of the parking lot and then in the designated parking lot.

IV. Results and Discussion

Demand for this specialty has grown significantly because of recent technologies. This allows you to use real-time access to parking slots. The existing system is a manual tracking system that estimates the parking space in the area by counting the number of vehicles that took a long time and effort and the number of vehicles entering and leaving. The next method was a sensor-based system that used ultrasonic waves to detect the presence of vehicles. This system does not have features such as parking reservations and slot availability.

In a large parking facility, our approach reduces the time spent waiting for a parking spot. It also aids parking facility owners in maximizing their venue generation. It would also help to reduce the amount of manpower required at the parking facility, lowering costs and reducing errors. This strategy would also reduce the use of paper, resulting in a more environmentally friendly system. This work can be expanded to include the pre-booking of parking lots over some time. Other operating systems, such as iOS, Windows, and Android, can be used to enhance the mobile application.

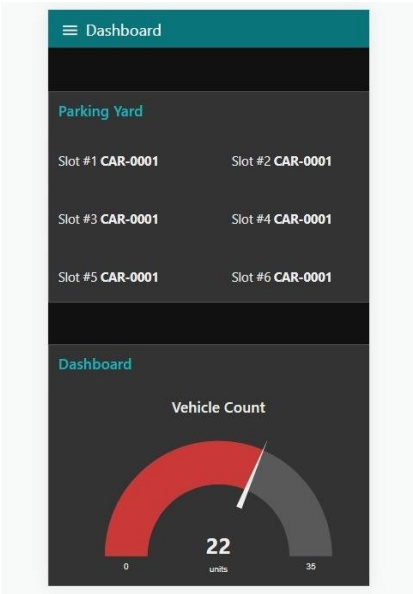

Fig. 3. Dashboard

V. Conclusion

Implement Park Smart and Ride system to face parking challenges present and in the future. Also, ensuring that IoT-enabled technologies are at the forefront of Park Smart and Ride system design should be a top priority. As a result, there are many options for technology to upgrade the Park Smart and Ride system and implement smart functionality. Some systems can be installed quickly and others are difficult to install. However, drivers should be allowed to get real-time information about online parking and existing parking slot. The Park Smart and Ride system needs to be redesigned in a detailed, real-time and cost-effective way.

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References

[1] B. S. R, "Automatic Smart Parking System using Internet of Things (IOT)," International Journal of Scientific and Research Publications, vol. 5, no. 12, pp. 629 - 632, 2015.

[2] P. Sadhukhan, "An IoT-based E-Parking System for Smart Cities,," in Sixth International Conference on Advances in Computing, Communications and Informatics, 2017.

[3] Vemula Krishna Chaitanya, Mamidi Sri Harsha, Lanka Maneesh Kumar, Vankadari Rahul, Palem Goutham Kumar Reddy, Abhishek Kumar, "Smart Parking Management System," Community Based Research and Innovations in Civil Engineering , no. 796, pp. 1 - 7, 2021.

[4] M. Prasanth, K.S. Roshini, T. Pujitha, C. Sai Thanusha,C.Sai Mahesh, M. Purushotham Rao,P. Rajesh, "Design and Implementation of Smart Parking System Based on Raspberry Pi Advanced Microcontroller System," Journal of Interdisciplinary Cycle Research, vol. 12, no. 6, pp. 960 - 965, 2020.

[5] Prof.S.S.Thorat, Ashwini M , Akanksha Kelshikar , Sneha Londhe ,Mamta Choudhary , "IoT Based Smart Parking System Using RFID," International Journal of Computer Engineering in Research Trends, vol. 4, no. 1, pp. 9-12, 2017.

[6] Abhirup Khanna, Rishi Anand, "IoT based Smart Parking System," International Conference on Internet of Things and Applications , pp. 266 -270, 2016.

[7] Mehala Chandran, Nur Fadila Mahrom, Thennarasan Sabapathy, Muzammil,Jusoh, Mohd Nasrun Osman, Mohd Najib Yasin,

N.A.M Hambali ,,R.Jamaluddin , N.Ali, Yasmin Abdul Wahab, "An IoT Based Smart Parking System," International Conference Computer Science and Engineering, vol. 1339, pp. 1 -8, 2019.

[8] ElakyaR,Juhi Seth, Pola Ashritha, R Namitha, "Smart Parking System using IoT," International Journal of Engineering and Advanced Technology, vol. 9, no. 1, pp. 6091 -6095, 2019.

[9] L Anjari ,A H S Budi, "The Development of Smart Parking System based on NodeMCU 1.0 using the Internet of Things," in International Symposium on Materials and Electrical Engineering, 2017.