

Smart Parking: Innovative Vehicle Parking Idea Using IoT

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ABSTRACT:

One of the main contributors to traffic congestion, driver annoyance, and air pollution in large cities, especially megacities, is the issue of parking. Finding parking spots in busy areas can be extremely difficult, especially at peak times. The problem comes from not knowing where parking spots might be located at any given moment. Even if parking spots are known to be scarce, there may be a large number of cars vying for them, severely clogging the roads. The system proposed the tracking of the number of open parking spaces and directs the vehicle to the closest one. The system can also include the capability of pre-reserving parking spaces. The reservation-based parking policy of the system has the ability to improve parking system operations and reduce traffic congestion brought on by parking search. Additionally, it reduces the amount of time needed to check in and reserve parking spaces. The user receives parking information via notification, which reduces the waiting time for finding a parking spot. RFID technology is being used to avoid car theft.

Keywords: Smart Parking System; Parking Slots; Automation; Smart City; Firebase Real-time Database; IoT

INTRODUCTION:

India is the second-most populous country in the world. The growth and development of Indian cities lacks a suitable architectural design for parking spaces. If this continues for a while, the outcome would be that the number of automobiles increasing would be inversely proportionate to the number of parking spaces available. Vehicle parking is still an issue in India because of the inadequacy of roadside parking spaces and the unsuitability of walking on pavements. Due to the fact that so many people travel to different places for work, there is a good chance they won't be familiar with the neighbourhood. As a result, they might not be aware of where the parking spaces are. As a result, they might end up parking their cars in prohibited zones, which could result in fines and other repercussions at work. Furthermore, even if they are aware of the location, they must obtain an assurance that a slot will be available before traveling to the parking area to avoid wasting their precious time. These days, finding a parking spot in a big city during rush hour is the biggest issue [1].

As a result, the authors suggested an intelligent framework to locate the parking spot effectively (i.e., without wasting parking space and with less time spent seeking). The architecture that is suggested in this research aims to display the closest accessible parking spaces and slots to a user while tracking the available parking spaces in real-time. Their whereabouts are known. Due to a lack of local knowledge or a lack of time to go and reserve a parking space, many people simply park their cars. Additionally, once they arrive in the parking lot, a spot might not be available. They wind up receiving fines for leaving their cars in prohibited parking zones. The people will therefore greatly benefit from a system that shows the location of parking spaces and the number of available slots to visitors. Additionally, it enables people to reserve the time slot and even displays the path to the place to park. This system will save a ton of time in our hectic everyday lives, where everyone is focused on the next thing, and it will also be beneficial because it will spare the user from having to pay hefty fines. Along with the user, parking lot owners will also profit because their spaces won't be left empty in vain.



Figure-1, Three key parts of this system design

As a result, we put forth and created a prototype for a smart parking system that attempts to address the aforementioned issues. The application, cloud, and interface make up the three key parts of this system's design. Fig. 1 discusses the interior parts and a few other elements. The mobile app initially assists us in locating the closest parking spot; the spots are coloured red and green. Green denotes at least one open parking space, while red means that all available spaces are taken. The real-time cloud database from which this real-time data is retrieved provides accurate information to the user. The parking space marker enables us to learn information about the parking space, including the name, address, and number of free cars and bike slots.

The Internet of Things (IoT) can transfer data through a network without the need for human interaction. IoT allows users to utilize inexpensive wireless technologies and also benefits the data uploaded into the cloud by the user. IoT can help the user maintain transparency. The identification of things for connecting diverse devices was the origin of the Internet of Things concept. Through computers connected to the internet, these devices can be managed or observed. The phrases "Internet" and "Things" are significant components of the phrase "Internet of Things," where "Internet" refers to a wide network that links servers and devices [2]. The usage of smart parking may be a way to reduce user inefficiency, time spent searching for parking, and the overall cost of fuel used. In this, the output is obtained through analysis and processing of the data that was gathered from the sensor.

Devices are used to communicate this data by separating the necessary information and delivering it to an Arduino device. The data is provided with command instructions to the necessary devices simultaneously. The servo motor receives the signal from the Arduino together with the cellular network module, which also notifies and instructs the user. The RFID card assigned to the registered user is scanned by the reader module when the user enters the parking area, assuring the security of the user identity. This enables the user to receive SMS notifications to their registered cell phone number and information about parking spaces that are available. It is divided into three sections, the first of which is the parking lot and contains IR Sensor and Arduino devices. These devices enable user interaction with the parking lot. The cloud web services that serve as a middleman between the user and the parking lot are covered in the second

half of the essay. The cloud is updated based on parking space availability. The user can view the cloud service to assess its availability in addition to the admin, who manages it. The user side is covered in the third section of the paper. Through the cellular network module, the user receives an SMS alerting them to the availability. The user can interact with both the parking lot and the cloud. The user is informed when there are no more parking spots available, saving them time.

LITERATURE REVIEW:

Providing residents with parking during the busiest times of the day is a serious challenge in many large cities. People as a result waste a lot of time looking for the ideal parking space or standing in queue to get one. Traffic jams are therefore caused as a result of this. Given the issues, numerous researchers have proposed various SPS methods and technologies to address this issue.

In this paper we are studying the clever parking system using android. Licence plate detection guarantees user safety. This strategy aims to reduce the amount of time spent seeking for available parking spaces and to provide hands-free payment options. This intelligent parking system can be implemented in parks, centres, and hospitals. This application allows users to reserve parking spaces in advance. For added assistance, navigation is also provided. IoT, or the Internet of Things, plays a crucial function in our daily lives. Using the application, parking assistance is provided to enable the user to locate their parked vehicle. On each parking lot, LED indicators allow for the identification of occupied and vacant spots. Online transactions and RFID technology allow users to make payments. The IR proximity sensor is utilised to determine if the parking lot is occupied or not (3)

This article describes the use of RFID and cloud-based technology in urban parking services. It provides a solution that utilises the RFID concept with the Internet of Things (IoT) connected to a cloud-based system. These features inform the user of the closest available parking space. In order to provide a user-friendly environment, a website providing information on the availability of parking spaces is being developed. In a densely populated area, searching for a parking location can result in time and gas being wasted, leading to the need for assistive technologies that could inform registered users of the availability of parking spaces. Using RFID, the reader module examines the object, and implementation then continues. The web page displays graphically the number of available and reserved parking spaces;

the WIFI module facilitates communication. This consists of host parking database management which collects and stores data about the driver's identify and parking location. When the parking reservation time is about to expire, a notification will be sent to the user via the web service that the administrator has provided. The primary disadvantage is that another user may occupy a reserved parking space; to prevent this, QR scanners are used to identify the user (7). It enables us to suggest a method by which a user can reserve a parking space by specifying the destination and vehicle type using mobile applications. The booking information will be stored in the cloud, which will determine the shortest route from the user to the parking space using GPS. Additionally, the location between the web page and the reader module. A tremendous amount of progress has been made in the establishment of smart cities over the past two years. The proposed system provides real-time information regarding parking space availability in a parking lot. Through our mobile app, distant users can reserve a parking space for themselves. The objectives of this document are to enhance the parking facilities of a city and, consequently, the quality of life of its residents (4).

With the increasing influx of people into urban areas that are industrially and technologically developed, the imperative need to make cities smart is becoming obsolete. Through data sharing, artificial intelligence, machine learning, analytics, and millions of RFID tags and sensors, cities are becoming sentient. Managing vehicles on the road and creating sufficient, well-managed parking spaces to prevent urban traffic congestion is one of the primary concerns of smart cities today. Autonomous system that directs the motorist to nearby parking spaces. In this article, a real-time prototype of the Internet of Things (IoT)-based intelligent parking system is described (5).

Using Internet of Things (IoT) technology for smart parking facilitates the design and development of a true smart parking system that provides information on vacant spaces and assists the user in locating the nearest availability. This paper employs computer vision to detect vehicle licence plates to improve security. Mobile payment allows the user to pay for the parking space prior to entering the vehicle. Thus, guaranteeing the parking reservation. The user is informed of the parking location, the number of available spaces, and any other pertinent information. The paper employs efficient algorithms and techniques for licence plate text extraction. An algorithm calculates the

minimal cost for the user based on the ultrasonic sensor detection of the vehicle entering the parking space (6).

Smart parking system based on reservation (SPSR) allows for the reservation of an available parking space. The management of the host parking database involves collecting and storing data about the driver's identification and parking location. The user will receive a notification via the web service provided by the administrator when the parking reservation time is about to expire. To prevent another user from occupying a reserved parking space, QR scanners are used to identify the user as the primary disadvantage (7).

It enables us to propose a method for a user to reserve a parking space by specifying their destination and vehicle type using mobile applications. The cloud will store the booking information, which will determine the shortest route from the user to the parking space using GPS. Additionally, the location of the user will be routinely updated in the cloud. When the user arrives at the parking space, their RFID is verified and they are granted access. Cloud servers are responsible for invoicing. The smart parking system requires the registration of the parking space before it can be used, which is the primary drawback (8).

The implementation of wireless sensor networks (WSN) in a car parking system is discussed in this paper using a server that utilizes Xbee and Zigbee. The parking system is capable of identifying the vehicle stopped in the designated space, with the aim of making it economical and user-friendly. The accuracy of the data maintained by the car parking system is ninety percent (9).

A smart parking system offers a comprehensive parking solution for both the user and the parking area administrator. It provides allocated parking spaces and identifies reserved users. Depending on the size of the vehicle, the user can navigate to the adjacent parking lot. The user can reserve a parking space hourly, daily, weekly, or monthly. An algorithm has been developed to identify the closest parking spot based on its dimensions. The user's mobile application is used to reserve and pay for on-demand service (10).

SYSTEM ARCHITECTURE:

A. Proposed System

It is divided into three sections: the first is the parking area, which contains Arduino devices and an IR sensor. With the aid of these devices, the user interacts with the parking IoT, the

second section consists of cloud-based web services that function as an intermediary between the user and the parking area. Depending on the availability of the parking location, the cloud is updated. The administrator manages the cloud services, which the user can view to determine their availability. The user interface is the final section. The user is notified based on availability via SMS through the cellular network module.

Parking Details: We will divide the details of parking in two types of categories.

- i. **Infrastructure Details-** In this category we will store the details related to the infrastructure of parking like block division, floors in a block, size, number of parking slots etc.
 - Number of blocks are tracked in a parking lot.
 - Associated codes are stored with each block. which is usually given uniquely identifying codes, such as “X”, “Y”, “Z”, “A1”, “A2”, “A3”, and so on.
 - Digits indicate floors number in the block. The number “1” indicates that this is a ground-level block with no floors.
 - Floors are mentioned because in multi-level parking lots, a blocks may have more than one floor.
 - Number of slots that exist on a floor.
 - Identifies the floor to which a slot belongs.
- ii. **Reservation details-** Under this category we will store the reservation details of the parking slots.
 - Stores the pass purchased date.
 - Identification of customer who is making this reservation.
 - Storing the expected date and time of the customer’s arrival.

- Storing the duration for which the reservation was made.
- Storing the date on which the reservation was made.
- Internal column that assigns a parking slot to a customer once their request is captured and the payment has been made.

Customer: There is two type of customers.

- i. **Random Customer-** These are the customer not having regular pass.
 - Stores the plate number of a customer’s vehicle.
 - Stores the date and time when the vehicle was registered with the parking lot.
- ii. **Regular Customer-** These are the customer who have regular pass with them.
 - Indicates whether a customer has regular pass. If the column stores a value of true, then there must exist a valid entry in the regular table. Once a pass expires and the customer has not yet renewed it, the value in this column is updated to false.
 - Stores the date on which the pass was purchased.
 - Stores the date on which the pass will be considered valid, which may not necessarily be the date of purchase, as some customers purchase passes in advance.
 - Stores the number of days for which a pass is valid. A monthly pass usually remains valid for 30 days.
 - Stores the cost, in local currency, that a customer must pay to purchase a pass.

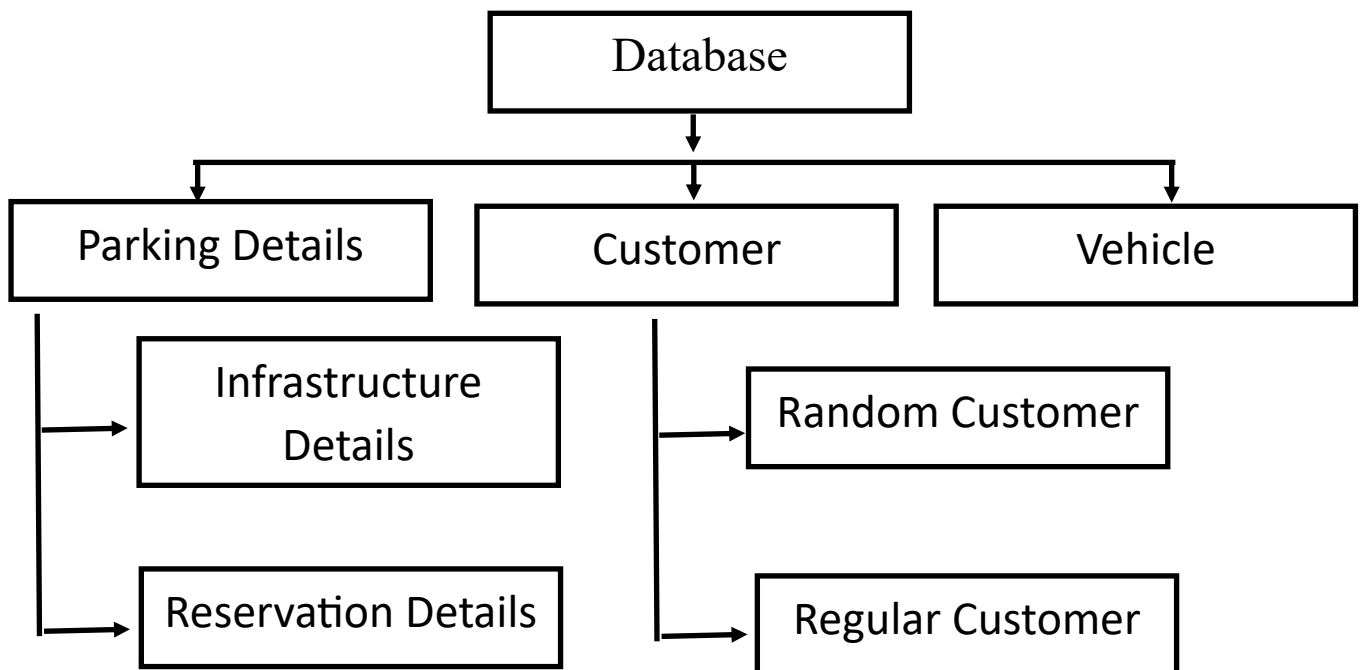
Vehicle- This will be divided on the basis of size (length & Width) of the vehicle.

Table 1 Type of Vehicle in India

Car segment	Length of the car	Classification	Car model belonging to the segment
A1	Up to 3,400 mm	Ultracompact cars	<u>Suzuki Alto, Tata Nano, Mahindra e2o</u>
A2	3,401 to 4,000 mm	Sub-four meter	<u>Maruti Suzuki Wagon R, Hyundai i10, Suzuki Swift, Suzuki Baleno (subcompact), Hyundai Xcent, Honda Amaze, Maruti Suzuki Dzire, Ford Aspire, Mahindra Verito, Hyundai i20, Tata Zest</u>

A3	4,001 to 4,500 mm	Entry-level mid-size sedans	<u>Hyundai Verna, Honda City, Suzuki Ciaz</u>
A4	4,501 to 4,700 mm	Small family cars	<u>Toyota Corolla, Škoda Octavia, Chevrolet Cruze</u>
A5	4,701 to 5,000 mm	Mid-size Executive cars	D-segment: <u>Toyota Camry, Škoda Superb</u> E-segment: <u>Mercedes-Benz E-Class, BMW 5 series</u>
A6	More than 5,000 mm	Grand saloons	<u>Mercedes-Benz S-Class, Audi A8, BMW 7 series, Jaguar XJ</u>
B1	<4,001 mm	Small vans	<u>Maruti Omni, Tata Venture</u>
B2	>4,000 mm	Mid-size MPVs/minivans	<u>Toyota Innova, Suzuki Ertiga, Mahindra Marazzo, Kia Carnival</u>
SUV	Any	SUVs	<u>Renault Duster, Honda CR-V, Ford Endeavour, Hyundai Creta, Audi Q7, Toyota Land Cruiser</u>

Basic details to create database for parking system



Details of the module:

A. Cellular Network Module

The cellular network module is a circuit used to establish communication between cellular phones and microcontrollers. It is used to transmit SMS, MMS, and voice communications via mobile network. The cellular network extension GPRS enables high data transmission rates. The

transmission method for cellular network is time division multiple access.



Figure 2. cellular network Module

B. IR Sensor

Infrared sensors are essentially electronic devices that detect the presence of objects. This device emits infrared radiation. If this device does not detect any reflected IR light, there is no object in the vicinity. The presence of an object is indicated if the light is detected by the sensor.



Figure 3. IR Sensor

C. RFID Card

An integrated circuit (IC), an antenna, and a substrate make up RFID devices. It could be a identification of distinguishing proof or credit card that passes on data approximately an question to a per user module. RFID labels transmit data almost a question through radio waves. When RFID labels are attached to objects, they can be utilized for following purposes as well.



Figure 4. RFID Card

D. READER Module

This module is a device which examines and gathers the information from the RFID Card. This card can be used for object tracking. The user scans the RFID card as the car pulls into the parking lot, sending all the data on the card to the administrator via this module.



Figure 5. Reader Module

E. Servo Motor

It is a rotator device that permits both angular and linear motion control. A servo motor is utilised to open and close the gate. Servo drive transmits electrical signals to the servo motor in order to generate movement



Figure 6. Servo Motor

F. Arduino Nano

It is a compact module with a wide range of applications. There are a total of 22 input/output pins, 14 of which are digital pins. It has approximately 32 kb of flash memory. These pins have the ability to control both digital and analogue pins. This module is a board that is compatible with breadboards and can be used anywhere.

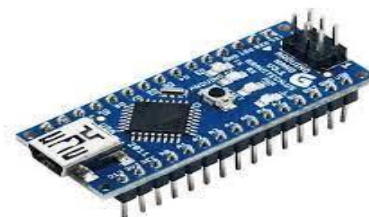


Figure 7. Arduino

G. WIFI Module

TCP/IP and the HTTP POST method are used to communicate data from an embedded system to the Internet. It is a product of espressif system. A 32-bit microcontroller containing 80kb of user data. It has sixteen gpio ports.

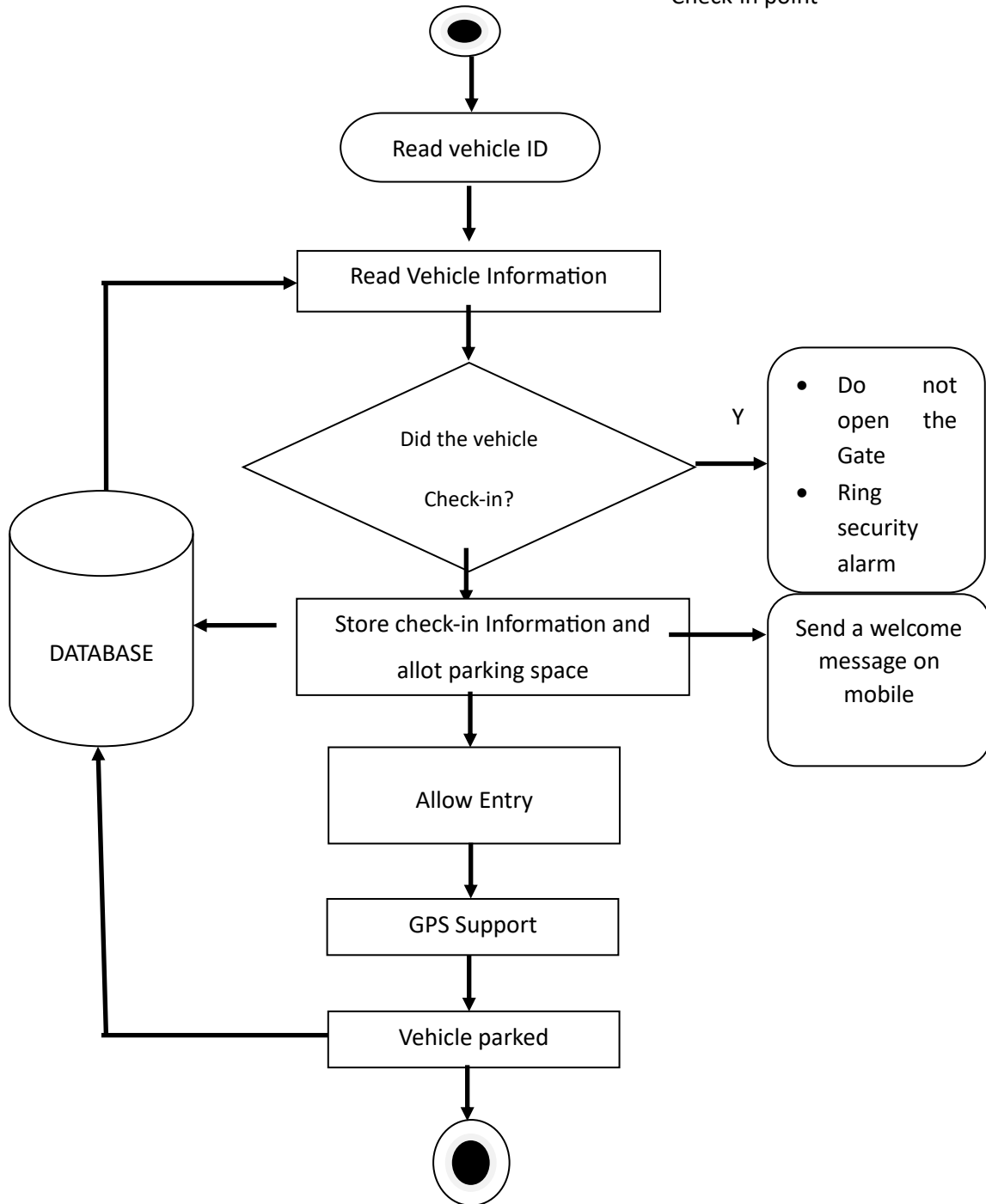


Figure 8. WiFi Module

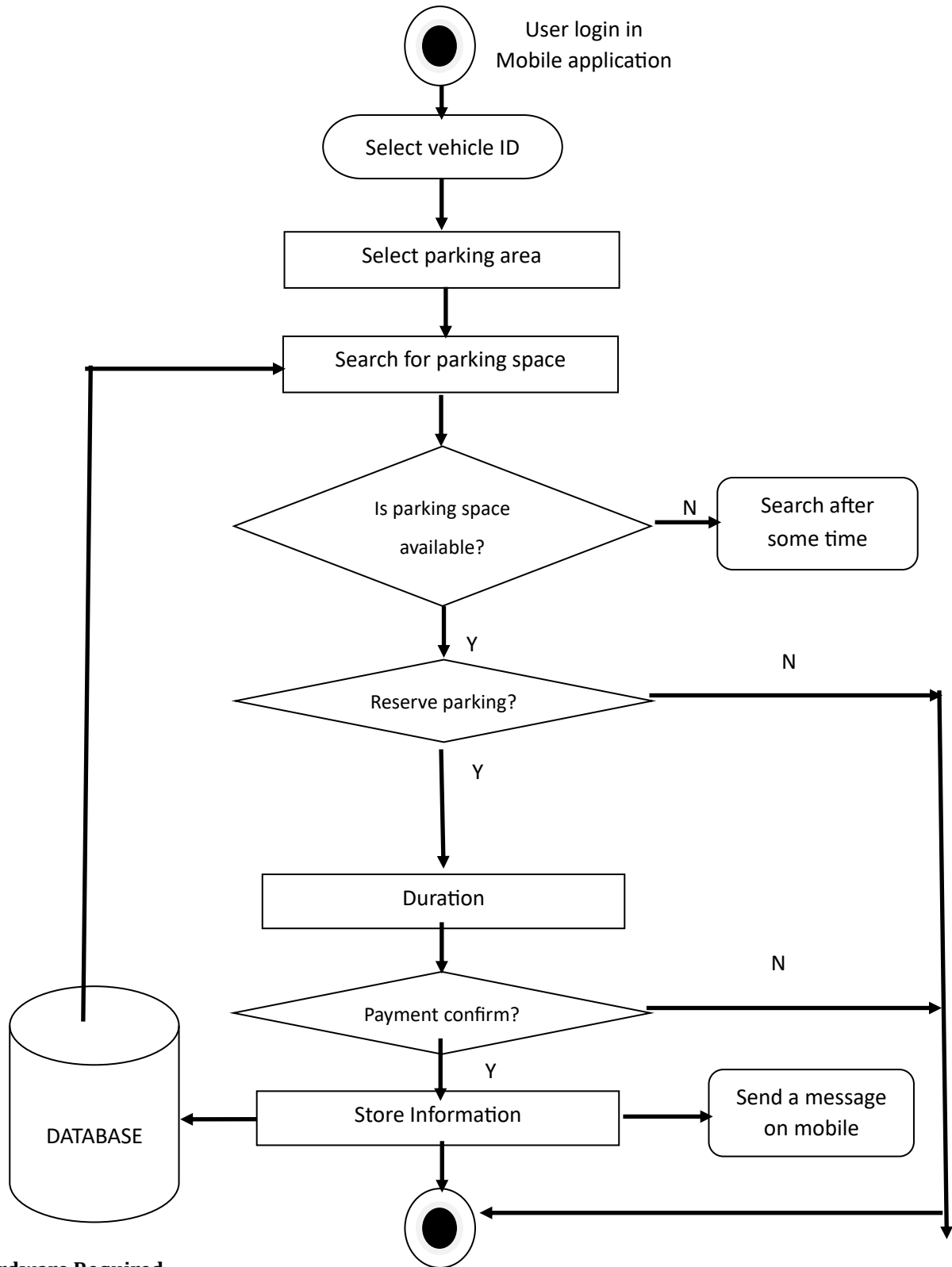
The proposed model will work in two parts

1. Identification and check-in process

Check-in point



2. End user support
 - i. User registration
 - ii. Automated parking system details



Hardware Required

GMS module, RFID card, and IR sensors are the three primary pieces of hardware used. An RFID is required for a user to enter a parking place. The

RFID card carries data about the registered user. The RFID badge of the registered user is scanned by a reader module as the car pulls into the parking space. The user is simultaneously

advised by SMS of the parking area's status as the data is provided to the Arduino to confirm the parking area's availability. Depending on its availability, the cellular network module sends the message. In reaction to the presence of a vehicle, an IR sensor sends out signals.

RFID Reader: - Reader is used to read the vehicle's information at the time of check-in or check-out.

Vehicle RFID Tag: - This contains vehicle's information. Specifics of the module: 1. cellular network Module the cellular network module is a circuit that establishes communication between.

Software Required

The server in the cloud functions as a mediator between the modules. Wi-Fi module is associated with the cloud server. The user receives text messages via the SMS module as the car using an RFID card enters and departs the parking lot. The cloud manages the SMS module's message transmissions. As soon as the IR sensor detects the car, the cloud's status is updated from 0 to 1, and when the car departs the parking area, the car's status is updated from 1 to 0.

Platform: - Windows 32 bit

Language: - JAVA jdk1.7

Database: - My SQL

IMPLEMENTATION:

The implementation of the proposed system is described in this section. Each user who accesses the parking space carries an RFID card containing his or her personal information. The user's information is sent to the module when the RFID tag is scanned by it. The IR sensor now detects whether the parking space is available. If no parking spot is available, the parking barrier gate won't open. When a parking space is available or unavailable, a registered message is transmitted via a cellular network module and relayed to the user. The WIFI module aids the system by storing all information in the cloud. It links the devices to the cloud server.

WELCOME GUEST <NAME>:-)

THANKS <NAME> FOR USING PARKING:-)

SORRY <NAME> NO FREE SPACE: - (

Figure 9. Message will be Received by User

Here, the user scans the RFID card that has been provided. If space is available, the user receives

the message "Welcome, username" and the barrier gate opens, allowing them to position their vehicle. When the user leaves the parking place, they must once more scan the RFID in order to receive the message "thanks for using smart parking username." The cloud will house the database of the user's actions in the parking space.

The user will be informed by the cloud status whether a specific storage space is accessible. When the automobile is parked, the IR sensor detects an item and changes the cloud status from 0 to 1, and when the car is driven away, the status is changed from 1 to 0. If the cloud status is 0, the user may therefore park his car. Updates are made to the cloud's status every two minutes.

RESULT & DISCUSSION

The need for sophisticated parking management solutions is growing. Users can access the real-time availability of parking spaces thanks to this. The current system in the modern era lacks the capacity to check parking slot availability and make reservations. The previous technology was a vision-based monitoring system that estimated parking spaces by counting the number of vehicles entering and leaving an area, which takes a lot of time and work. The second method currently in use is a sensor-based one that detects the presence of vehicles using ultrasonic sound waves, and it is followed by two-tier parking, which leverages the idea of parking cars one on top of the other. The result of this article is a parking lot that is cost-effective for the user, saves time, and is connected to the outside world. This paper results in a decrease in auto theft. The amount of petrol used by a vehicle in its quest for this paper is decreased.

CONCLUSION & FUTURE WORK

In the past few years, significant strides have been made to make the smart city a reality. The development of internet of things and cloud technologies has created new opportunities for smart cities. Intelligent parking facilities have always been central to the development of smart cities. The system delivers parking slot information and real-time processing. This paper improves the efficiency of locating an appropriate parking space by sparing user's time. It contributes to the resolution of the expanding issue of traffic congestion. As for future work, users will be able to reserve parking spaces remotely. In the future, GPS, reservation capabilities, and licence plate readers can be incorporated.

REFERENCES:

1. Said, A.M., Kamal, A.E. and Afifi, H., 2021. An intelligent parking sharing system for green and smart cities based IoT. *Computer Communications*, 172, pp.10-18.
2. Khanna, A. and Anand, R., 2016, January. IoT based smart parking system. In *2016 international conference on internet of things and applications (IOTA)* (pp. 266-270). IEEE.
3. shna Viji Alex, Amina Abdul Rasheed, Shaun Thomas, Salmanil Farisi, Ansia S, (Android Application for Smart Parking using IoT, 2021).
4. Nisha, S.R., Shyamala, C., Pooja, S., Abarnia, A.P. and Shajeetha, M.S., 2020. RFID based smart car parking system using IoT and cloud. *Studia Rosenthaliana (Journal for the Study of Research)*, 12(5), pp.60-66.
5. Dhabliya, D., Soundararajan, R., Selvarasu, P., Balasubramaniam, M.S., Rajawat, A.S., Goyal, S.B., Terms and conditions Privacy policy Copyright © 2023 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V. Raboaca, M.S., Mihaltan, T.C., Verma, C., Suci, G. Energy-Efficient Network Protocols and Resilient Data Transmission Schemes for Wireless Sensor Networks—An Experimental Survey (2022) *Energies*, 15 (23), art. no. 8883, .
6. Gupta, A., Srivastava, A., Anand, R. and Chawla, P., 2019. Smart vehicle parking monitoring system using RFID. *Int. J. Innov. Technol. Explor. Eng*, 8(9S).
7. Lookmuang, R., Nambut, K. and Usanavasin, S., 2018, May. Smart parking using IoT technology. In *2018 5th International Conference on Business and Industrial research (ICBIR)* (pp. 1-6). IEEE.
8. Sai Pandraju, T.K., Samal, S., Saravanakumar, R., Yaseen, S.M., Nandal, R., Dhabliya, D. Advanced metering infrastructure for low voltage distribution system in smart grid based monitoring applications (2022) *Sustainable Computing: Informatics and Systems*, 35, art. no. 100691, .
9. Molla, J.P., Dhabliya, D., Jondhale, S.R., Arumugam, S.S., Rajawat, A.S., Goyal, S.B., Raboaca, M.S., Mihaltan, T.C., Verma, C., Suci, G. Energy Efficient Received Signal Strength-Based Target Localization and Tracking Using Support Vector Regression (2023) *Energies*, 16 (1), art. no. 555, .
10. Patil, M. and Sakore, R., 2014. Smart parking system based on reservation. *International Journal of Scientific Engineering and Research (IJSER)*, 2(6), pp.21-26.
11. Vishwanath, Y., Kuchalli, A.D. and Rakshit, D., 2016. Survey paper on smart parking system based on Internet of Things. *International Journal of Recent Trends in Engineering & Research (IJRTER)*, 2(03), pp.2455-1457.
12. Kepuska, D.V., HA (2016). Smart Car Parking System. *International Journal of Science and Technology*, 7.
13. Kumbhkar, M., Shukla, P., Singh, Y., Sangia, R.A., Dhabliya, D. Dimensional Reduction Method based on Big Data Techniques for Large Scale Data (2023) 2023 IEEE International Conference on Integrated Circuits and Communication Systems, ICICACS 2023,.
14. Cynthia, J., Priya, C.B. and Gopinath, P.A., 2018. IOT based smart parking management system. *International Journal of Recent Technology and Engineering (IJRTE)*, 7(4S), pp.374-379.
15. Kathole, A.B., Katti, J., Dhabliya, D., Deshpande, V., Rajawat, A.S., Goyal, S.B., Raboaca, M.S., Mihaltan, T.C., Verma, C., Suci, G. Energy-Aware UAV Based on Blockchain Model Using IoE Application in 6G Network-Driven Cybertwin (2022) *Energies*, 15 (21), art. no. 8304, .
16. Anupong, W., Azhagumurugan, R., Sahay, K.B., Dhabliya, D., Kumar, R., Vijendra Babu, D. Towards a high precision in AMI-based smart meters and new technologies in the smart grid (2022) *Sustainable Computing: Informatics and Systems*, 35, art. no. 100690, .