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# Smart Parking to Reduce Vehicle Flood using IoT

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**Abstract:** Advanced level of services will be lent by IoT based technology in the forthcoming days and will completely change the lifestyle of people. Evolutions in the field of medicines, agriculture, gene therapies, smart homes and smart cities are just a very few of the categorical instances where IoT is strongly established. Smart cities concept is one of the biggest projects held by government. But the increasing population along with traffic congestion has slow down the project. Key solution for this is smart parking system. Reducing the vehicle traffic and finding the correct placement for parking the vehicle can solve many problems related to smart cities and also helps in maintaining environment by controlling air and noise pollution. This paper on parking system gives working flow of various existing system that provides parking slots information.

**Keywords:** IOT, LoRa, WSN, RFID, Image Processing, Cloud, Sensors, Mobile Application, Raspberry Pi, Cashier Machine

## I. INTRODUCTION

Internet of Things (IoT) is the networking of physical objects which are embedded in their architecture to interact and communicate with the environment. IoT has influenced our lifestyle in every aspect, from the way we react to the way we behave. It is a giant network with connected devices. These devices gather together and share information which is later processed and sent to the user to use it. The concept of smart system is all about how we utilize this IoT technology to solve our daily problem. This project shows how Internet of Things is used in smart parking. Searching for parking area in metro cities is very difficult task to perform. Dearth in the parking space, high parking tariffs, and traffic congestion due to visitors in search for a parking place are few examples of parking problems.

IoT mainly consist of hardware and software components. This paper shows the survey on IoT based parking system. Basically, parking system using IoT consist of three parts. First part is sensor modules, which collects the information from the parking area and uploads it to the cloud system. Next is the cloud system, which processes the data collected through hardware component. Lastly, user module, which consists of users who are in search of parking space and application which displays parking slots. This survey paper gives the insights on how parking system is implemented using different components and technology by different people.

## II. LITERATURE SURVEY

### A. An IoT based Smart Parking System using LoRa

Smart parking using LoRa uses LoRa transmitters and a receiver which transfers data into cloud using Wi-Fi protocol. Receiver needs internet to transfer data to cloud. Ultrasonic sensor is used to detect vehicle in the slot, LoRa (transmitter) boards are places at different lots in different places to transmit data. LoRa (receiver) receive data which is placed near lots and sends information to IoT platform. The availability of parking slots can be viewed in the phone.

The components required are

- 1) TTGO ESP32 LoRa can transfer the data up to 5km.
- 2) Ultrasonic sensors are connected to LoRa board. These are placed in each slot to measure distance of obstacle present.
- 3) Mobile phone is used to check slot information to determine which slot is free in parking lot.

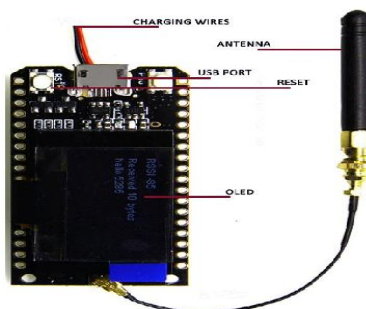


Fig1: TTGO ESP32 LoRa module

### B. Smart Parking with Computer Vision and IoT Technology

In this parking system the user checks on the phone which parking lot near his/her destination has a vacant parking spot. After user determines which parking lot, he wants to go presses navigate on the app and reach the entry point of lot. The user uses the app to determine which spot in parking lot is free. The user parks the vehicle in the parking spot and mark it in mobile application. As soon as the spot is marked the System Bollards activate. After attending his/her work, the user reaches back to his/her vehicle and unmark this parking spot. Deactivation of Security Bollards makes parked car to leave the spot. The driver leaves the lot.

It works with –

- 1) Ultrasonic sensors are able to withstand the harsh climate
- 2) MCU used as Wi-Fi module which will send data from sensor to cloud service
- 3) CCTV cameras are used to check if there is a vehicle at the parking spot or not

The user uses a mobile application that runs on Android operating system. This communicates with cloud database. Video feed of the CCTV cameras will be used to process the video to determine when the parking spot is occupied with vehicle. It will use YOLO on each frame of the video and keep on updating the database if there is a change in the state of existence of the vehicle in parking spot. Hardware has two main sets IoT device and cameras. IoT device use the ultrasonic sensor to determine if there is vehicle in front of system or not. It uploads the current state of sensor to cloud. Cameras which are deployed at lots for security purpose.

### C. Low-cost Parking System using Dynamic Resource Allocation

The features of this Guidance parking System are

- 1) To reduce the consumption of power and to decrease the usage of network cable.
- 2) To help users through mobile application.
- 3) Help user to reserve the parking space before reaching to that place.

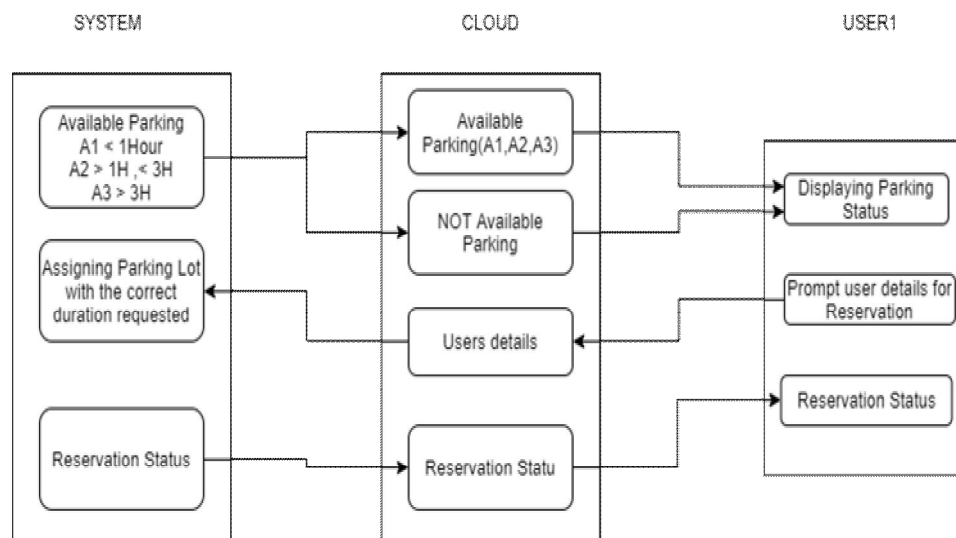


Fig 2: Working Flow diagram of Parking System

This system uses ZigBee and Arduino for low-cost parking system. Using python, they have interpreted the Serial COM Port of the Arduino which later acts as CCU (Central Control Unit). The information is later updated to the cloud system. When user sends request for parking slot with defined period, it fetches the information using another python script and according to the user's arrival time the parking slot is reserved for the user. To obtain the users arrival time this system uses Google Matrix Distance API. Thus, this system deploys scheduling and reservation system for low-cost parking.

### D. Smart Parking System using Google

This system consists of three sessions or modules

- 1) Sensor networks / Data Collection
- 2) Data processing part / Data processing
- 3) Mobile application / Data Display

Data Collection module consist of sensors nodes such as Power supply, Raspberry Pi, ultrasonic sensors and GPS modules. Presences of vehicles are detected using ultrasonic sensors. Ultrasonic waves reflect back whenever an object is detected which means when the car is present in the parking slot the sensor detects the car by sending the waves. The values obtained by the sensors are further updated to the cloud. In data processing module the values sent by the sensors are received and processed to show the available and non-available parking slots. Cloud collects the values of vacant places and sends this information to the mobile application. The values and information from last two modules are displayed in this module for the help of user. Mobile application is used to find the vacant parking slots by users. Cloud is immediately updated when the availability of parking slot changes. This information is also provided for the users. They can obtain this information anywhere through internet.

#### E. Smart Parking System using IOT

IoT technology can allocates an efficient parking space. Due to increase in the population of vehicles in metropolitan cities that causes a road congestion this is the major problem that being faced nowadays. They can provide parking information via notification for user. RFID sensor can use to avoid the car theft. In this model they provide a real-time information for deducting a parking space for reservation & e-payment to migrate a traffic congestion. To solve this problem, they used a SPS (smart passive sensors) as be suggest & implemented. using a RFID sensor in parking gates once the vehicle reaches the gate the RFID sensor senses the RFID tag on the vehicle & record the information of the vehicle & updated to the system & they provide a parking space & bill. The charges to the paid according to the time. This model includes a reservation system using a GPS. They get an efficient parking slot.

#### F. Smart Parking System with Automated Cashier Machine Utilize the IoT Technology

For data input process this system contains more than one device. Mainly there are 3 data Imputations devices are present namely - Automatic machine, smart sensor device and Mobile Application. Car driver is used to give data for mobile application. Data is automatically inputted by system for automatic cashier Machine depending upon the transactions.

There are 2 different ways for allotting parking spot.

In 1st way, the user should reserve the parking slot before arriving mobile application is used for reservations. Here the user must input the data and he should check for availability, if there any empty slot is present then the user can choose that free space and he can book that slot. Then the user will get a QR code after booking. In automated machine the QR code is stored.

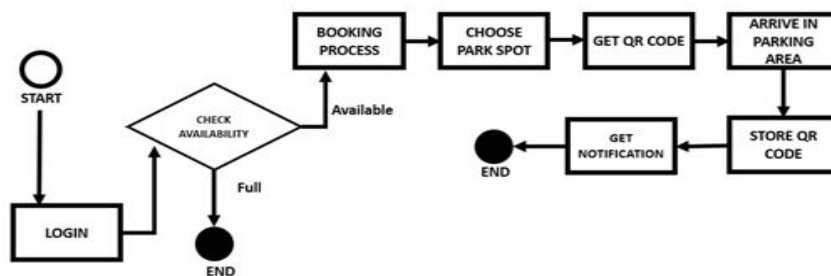


Fig 3: With reservation of Parking Process

In another way user should not do Pre reservation before they arrive. User can directly come to parking area and the automated machine gives the information about availability of free spots. If any free spot is available then the allocation of spot process is done. Automated machine gives a QR code for user and user should do a scan process via mobile application.

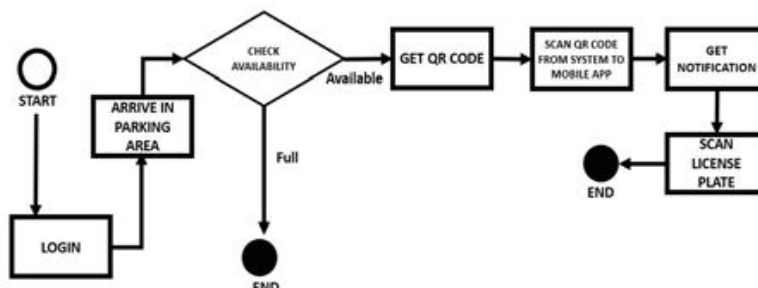


Fig 4: Without reservation of Parking Process



### G. Navigation Based -Intelligent Parking Management System using Queuing theory and IOT

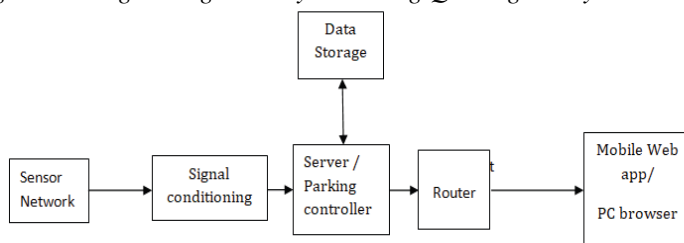


Fig 5: Basic Block diagram of system.

The Basic Block diagram of the system consists of web app, sensor network, router, data storage, signal conditioning and a PC browser/web app. Each and every parking slot is monitored with IR based occupancy sensor, which gives the exact number of vehicles in the queue. All these data will be available for user on Internet. In short, the parking lots are converted to IoT node. To do this we use a web server. On controller the sensor data will be stored into a memory space. We implement a web server architecture on server so the user can able to access the data on Internet.

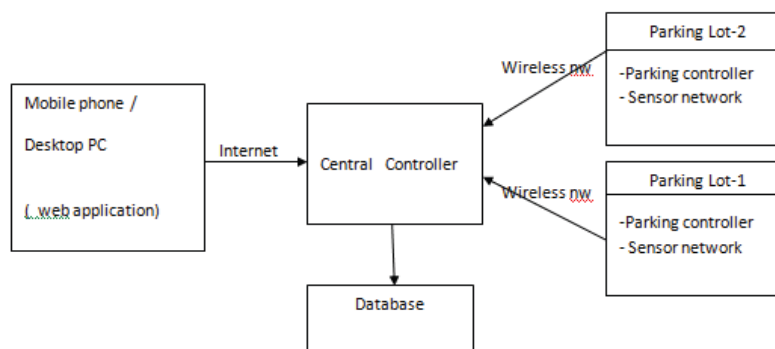


Fig 6: Block diagram of proposed system.

The Block diagram of the proposed system consists of:

- 1) *Web Application*: User can login to the app through their mobile internet browser to fill the required user credentials.
- 2) *Central Controller*: It is IoT enabled controller board which is enabled to process user data, sensor data and it communicates with the segments of physical layer.
- 3) *Database*: It acts as user data to identify between the categories of user.
- 4) *Parking Lots*: There are some parking controllers with central controller with real-time status of Occupancy. Data is communicated with central controller via wireless network.

To achieve this process in a better way we use queuing theory approach which is integrated with IoT optimize the system in a way better user experience. Priority based allotment will be activated depending upon the peak hours or non-peak hours.

Queuing Theory:

This theory deals with the problems like queuing. When there is a limited amount of resource then the queues are formed, while designing the queuing system we need to focus on the balance between service for consumer and economic consideration. For classifying queuing system there are 4 standard notations namely A/B/C/D/E. Probability distribution for the arrival process is represented by A, probability distribution for the service process is represented by B, number of channels (servers) is represented by C, maximum number of customers allowed in the queuing system is represented by D, maximum number of customers in total is represented by E.

#### H. Machine Vision Smart Parking Using Internet of Things (IoT) In A Smart University.

College campus is one of the places where high traffic congestion and parking problems are faced. The authors of this paper implemented smart parking system at Christopher Newport University (CNU), a midsize university.

iOS application called ParkFast was developed. The app consists of four level navigation. One is landing screen and other is login screen. Both of which are not available for user after they login to the application. This screen is opened only once. They are first time user the login screen is ask you're a faculty, staff or student because they have provided certain parking slots for a particular user. Third screen is main screen which shows all the parking slots of campus. And the last screen is Help screen which gives information on usage of application.

Cameras are used to monitor small and medium parking lots. This system uses Haar Feature-based Cascade classifier for processing and detecting the vehicles. Cameras are charged using solar power.

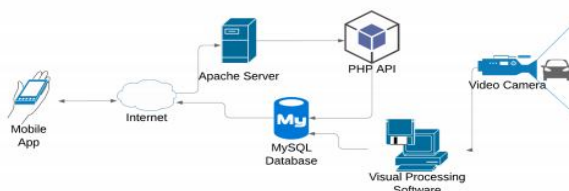


Fig 7: Map of campus parking lots

#### I. Smart Transportation System Using IoT

Mobile application is used to search the available parking slots. Suitable route to reach a particular parking slot is also provided in this application. This application is embedded with RF model & connected with a battery which will help us to show the availability of the parking place. In the LCD display different routes and weather condition of the routes will be provided. Raspberry pi and Wi-Fi module are used to manage and monitor traffic situations and also display the information. Once the user requests for parking slot. The availability of slots is checked and then this information about parking slot for parking and also suggestion of best route to reach a parking area is provided to the users.

### III. DISCUSSION

| PARKING SCHEME  | FEATURES  | ADVANTAGES   | DISADVANTAGES   |
|---|---|--|---|
| An IoT based Smart Parking System using LoRa              | <ul style="list-style-type: none"> <li>LoRa is installed in parking lots to transmit the data of parking availability</li> </ul>  | <ul style="list-style-type: none"> <li>LoRa can transfer data up to 3-5 km so the data can be received by LoRa receiver within that range</li> </ul> | <ul style="list-style-type: none"> <li>LoRa is only suited for short and periodical communications</li> </ul>                     |
| Smart Parking with Computer Vision and IoT Technology     | <ul style="list-style-type: none"> <li>Image of the vehicle parked is obtained by the CCTV cameras and able to guarantee security of vehicle using security bollards</li> </ul>     | <ul style="list-style-type: none"> <li>CCTV cameras can capture more vehicles at a time so it makes identification more efficient.</li> </ul>        | <ul style="list-style-type: none"> <li>It can only monitor the area which cameras can cover</li> </ul>                            |
| Low-cost parking system using Dynamic resource allocation | <ul style="list-style-type: none"> <li>To help users through mobile application. Helps user to reserve the parking space before reaching to that place</li> </ul>                   | <ul style="list-style-type: none"> <li>Low cost</li> <li>Dynamic slot allocation</li> </ul>  | <ul style="list-style-type: none"> <li>Does not support higher data rate</li> </ul>   |
| Smart Parking System using Google                         | <ul style="list-style-type: none"> <li>Sensors sends information to cloud and this information is processed and displayed to users through mobile application</li> </ul>            | <ul style="list-style-type: none"> <li>Easy maintenance</li> <li>Usage of google map helps to find routes easier</li> </ul>                          | <ul style="list-style-type: none"> <li>High cost</li> <li>Extra hardware is required to convert from analog to digital</li> </ul> |
| Smart Parking System using IOT                            | <ul style="list-style-type: none"> <li>Wireless sensors detect the vacant parking spaces and transmit the data to get an idea about the vacant spaces for parking spaces</li> </ul> | <ul style="list-style-type: none"> <li>Less time consumption</li> </ul>  | <ul style="list-style-type: none"> <li>No application is developed for remote monitoring</li> </ul>                               |

|   |  |   |  |
|---|--|---|--|
| Smart Parking System with Automated Cashier Machine Utilize the IoT Technology        | <ul style="list-style-type: none"> <li>Real time monitoring, check in and check out of cars, it generates parking spot for a new car automatically</li> </ul>                                  | <ul style="list-style-type: none"> <li>It easily tracks transactions and it speeds the customer's check-in and checkout time</li> </ul>   | <ul style="list-style-type: none"> <li>The data get lost when there is any fault in the machine.</li> </ul>            |
| Navigation based - Intelligent Parking Management System using Queuing theory and IOT | <ul style="list-style-type: none"> <li>Infrared sensors and wireless sensor node are used during peak hours to avoid wait time and also it provides real time status of parking lot</li> </ul> | <ul style="list-style-type: none"> <li>IR sensors gives exact count of vehicles in a queue based on the Priority allotments are activated, depending on non-peak and peak hours.</li> </ul> | <ul style="list-style-type: none"> <li>The waiting space might be limited. Arrival rate is state dependent.</li> </ul> |
| Machine Vision Smart Parking Using Internet of Things (IoTs) In A Smart University    | <ul style="list-style-type: none"> <li>Parking id of reserved slot is provided to user.</li> </ul>   | <ul style="list-style-type: none"> <li>Flexible and easy to implemented.</li> <li>System is private with the spaces reservation using GSM</li> </ul>  | <ul style="list-style-type: none"> <li>No guidance and navigation system are used.</li> </ul>                          |
| Smart transportation system using IoT   | <ul style="list-style-type: none"> <li>The smart parking system is expected to be significantly influenced by arrival vehicles and helps a reservation.</li> </ul>                             | <ul style="list-style-type: none"> <li>reduce cost reliability</li> <li>more comfort to travelers</li> </ul>  | <ul style="list-style-type: none"> <li>Difficult to use in mixed traffic</li> </ul>                                    |

#### IV. CONCLUSION

Smart parking system concentrates on safe and secure easy parking of vehicles. Many parking systems already exists. In this paper, survey on different system and their pros and cons are discussed. This survey was very much helpful in finding out new ideas on parking system which would overcome the problems in existing system. As for the future work it is possible for us to enhance existing system using image processing and cloud technology. By implementing and enhancing the smart parking system the problems such as traffic congestion, air pollution etc. Are reduced and helps in betterment of lifestyle of peoples.

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