

Smart E-Parking System

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Abstract -- Now a days the concept of smart cities have gained great popularity. The reason behind this is the evolution of Internet of things (IOT) with the help of which the concept of smart town now appears to be exist. Steady efforts are being made inside the field of IoT so that it will maximize the productivity and reliability of city infrastructure. The growing wide variety of cars on the road along with the mismanagement of existing parking system leads to several issues which include, traffic congestion, constrained car parking facilities and avenue safety. For this reason it is enormously required to increase an automated clever parking control system that could assist the driver to discover a few suitable parking space for his/her vehicle very quickly. Although adequate amount of studies working for the improvement of clever parking system exist in literature, but maximum of them have not addressed the trouble of actual-time detection of mistaken parking and automatic series of parking prices. It is quite a difficult and tedious job to look for a free or vacant parking space while traveling. So, smart parking system allows reserving the parking spot in advance, which helps in reduction of time in searching the parking spot, reduction in traffic congestion, reduction in pollution, reduction in frustration of drivers etc.

Keywords— Internet of Things; Cloud Computing; Smart Parking; Smart City; Cloud of Things

I. INTRODUCTION

The idea of Internet of Things (IoT) began with things with personality specialized gadgets. The gadgets could be followed, controlled or observed utilizing remote PCs associated through Internet. IoT expands the utilization of Internet giving the correspondence, and subsequently between system of the gadgets and physical items, or 'Things'. The two noticeable words in IoT are "web" and "things". Web implies a tremendous worldwide system of associated servers, PCs, tablets and mobiles utilizing the universally utilized conventions and interfacing frameworks. Web empowers sending, accepting, or imparting of data. Thing in English has number of employments and

implications. Lexicon importance of 'Thing' is a term used to reference to a physical protest, an activity or thought, circumstance or action, on the off chance that when we don't wish to be exact. IoT, when all is said in done comprises of between system of the gadgets and physical articles, number of items can assemble the information at remote areas and convey to units overseeing, obtaining, sorting out and investigating the information in the procedures and administrations. It gives a dream where things (wearable, watch, wake up timer, home gadgets, encompassing items with) wind up shrewd and act alive through detecting, registering and imparting by inserted little gadgets which communicate with remote articles or people through network. The versatile and vigorous nature of Cloud figuring is permitting engineers to make and host their applications on it. Cloud goes about as an ideal accomplice for IoT as it goes about as a stage where all the sensor information can be put away and got to from remote locations [11]. These elements offered ascend to the amalgamation of the two advancements in this manner prompting the arrangement of another innovation called Cloud of Things (CoT). In CoT the things (nodes) could be gotten to, checked and controlled from any remote area through the cloud. Because of high versatility in cloud any number of hub could be included or expelled from the IoT framework consistently. In basic terms IoT can be clarified in type of a condition expressing:

Physical Object + Controller, Sensor and Actuators + Internet = Internet of Things

The perfect of making a Smart City is presently getting to be conceivable with the rise of the Internet of Things. One of the key issues that shrewd urban areas identify with are auto stopping offices and activity administration systems. In introduce day urban areas finding an accessible parking space is constantly troublesome for drivers, and it has a tendency to end up harder with consistently expanding number of private auto clients. This circumstance can be viewed

as an open door for shrewd urban areas to attempt activities all together upgrade the proficiency their stopping assets in this manner prompting decrease in seeking times, movement clog and street mischances. Issues relating to stopping and activity clog can be unraveled if the drivers can be educated ahead of time about the accessibility of parking spots at and around their planned goal. Late advances in making minimal effort, low-control inserted frameworks are helping engineers to manufacture new applications for Internet of Things. Taken after by the advancements in sensor innovation, numerous cutting edge urban areas have picked sending different IoT based frameworks in and around the urban areas to monitor. A current review performed by the International Parking Institute mirrors an expansion in number of creative thoughts identified with stopping frameworks. At exhibit there are sure stopping systems that claim to subjects of conveying constant data about accessible parking spots. Such frameworks require effective sensors to be sent in the stopping territories for observing the inhabitation and also speedy information preparing units keeping in mind the end goal to increase viable bits of knowledge from information gathered over different sources.

The shrewd stopping framework that we propose is actualized utilizing a portable application that is associated with the cloud. The framework enables a client to know the accessibility of parking spots on an ongoing premise. Whatever is left of the paper is composed as takes after: Section II discusses the components dependable of Cloud-IoT incorporation. Area III displays the cutting edge in shrewd stopping framework. Area IV portrays the usage and working of the framework. Area V finishes up the paper.

II. NEED FOR IOT-CLOUD INTEGRATION

Distributed computing and IoT have seen vast advancement. Both the advancements have their favorable circumstances, however a few common points of interest can be anticipated from their reconciliation. On one hand, IoT can address its innovative imperatives, for example, stockpiling, handling and vitality by utilizing the boundless abilities and assets of Cloud. Then again, Cloud can likewise stretch out its compass to manage true

elements in a more disseminated and dynamic mold by the utilization of IoT. Essentially, the Cloud goes about as a middle amongst things and applications, keeping in mind the end goal to shroud every one of the complexities and functionalities vital for running the application. The following are a portion of the components that prompted the amalgamation of Cloud and IoT.

Storage limit: IoT involves a substantial number of data sources (things), which deliver colossal measures of non-organized or semi-organized information. Thus IoT requires gathering, getting to, handling, envisioning and sharing a lot of data. Cloud gives boundless, minimal effort, and on-request stockpiling limit, therefore making it the best and most financially savvy answer for manage information produced by IoT. The information put away on the Cloud can be gotten to and envisioned from anyplace through standard APIs.

Computation control: The gadgets being utilized under IoT have restricted handling abilities. Information gathered from different sensors is normally transmitted to all the more intense hubs where its total and preparing can be done. The calculation needs of IoT can be tended to by the utilization of boundless preparing abilities and on-request model of Cloud. With the assistance of distributed computing, IoT frameworks could perform constant handling of information hence encouraging exceedingly responsive applications.

Communication assets. The essential usefulness of IoT is to make IP-empowered gadgets speak with each other through devoted arrangement of equipment. Distributed computing offers shoddy and powerful methods for associating, following, and overseeing gadgets from anyplace finished the internet. By the utilization of implicit applications IoT frameworks could screen and control things on an ongoing premise through remote areas.

Scalability: Cloud gives a versatile approach towards IoT. It permits increment or abatement in assets in a dynamic design. Any number of "things" could be included or subtracted from the framework when cloud mix is provided. The cloud apportions assets as per the prerequisites of things and applications.

Availability: Any time anyplace accessibility of assets turns out to be simple with cloud combination. A significant number of the cloud suppliers guarantee 5 nine accessibility. With cloud, the applications are dependably up and running and consistent administrations are being given to the end clients.

Interoperability: IoT includes the utilization of gadgets that are heterogeneous in nature. These gadgets may have diverse equipment or programming designs therefore causing similarity issues. It turns out to be extremely troublesome in an IoT situation to guarantee interoperability among these devices. Cloud helps in tending to this issue as it gives a typical stage where different gadgets can associate and interface. Gadgets are permitted to share and trade information in an organization that is worthy to them.

III. SYSTEM ARCHITECTURE

This area portrays the abnormal state engineering for the brilliant stopping framework alongside a scientific model. The stopping framework that we propose includes different on-screen characters that work in a state of harmony with each other. The following is the numerical model that characterizes our savvy stopping framework.

Table 1: Nomenclature Table

| SYMBOL | MEANING |
|--------|----------------------|
| T | Parking time |
| C | Driver's car number |
| P | Amount paid |
| U | User ID |
| S | Parking slot |
| M_i | Driver |
| O | Occupancy rate |
| X() | Input function |
| Y() | Output function |
| F() | Computation function |
| I() | Identity function |

$M_i \text{ } \acute{X} (T,C,P,U,S)$ // Driver provides input to the input function

$X() \acute{F}(S,T)$ // Input function notifies the computation function

$X() \acute{I}(P,C,U)$ // Input function notifies the identity function

$O_i = F(S,T) \acute{Y}()$ // Computation function notifies the output function and the resultant is stored in form of the occupancy rate.

$O_i = 0 \acute{N} 1$ // Occupancy rate can either be 0 or 1. Where 0 specifies occupied and 1 means vacant.

The following figure gives an outlined view of the complete system.



Figure 1: Smart Parking System

Talking of the above mentioned figure, it depicts a parking area where our parking system is implementation along with the way in which communication happens between various actors. The primary actors that constitute the parking system are:

Parking Sensors: For our stopping framework we have made utilization of sensors like Infrared, Passive Infrared (PIR) and Ultrasonic Sensors. Crafted by these sensors is the same i.e. to detect the stopping region and decide if a stopping space is empty or not. For this situation we are utilizing ultrasonic sensors to identify the nearness of an auto. The ultrasonic sensors are remotely associated with raspberry pi utilizing the ESP8266 chip. An ESP8266 WiFi chip includes an independent SOC with incorporated TCP/IP convention stack that permits any microcontroller to get to a WiFi arrange. The sensors are associated with

a 5V supply either from raspberry pi or an outside source. Outside source being more ideal.

Processing Unit: It contains Raspberry pi which is a processor on chip. The handling unit acts like a middle of the road between the sensors and cloud. Every one of the sensors are remotely associated with the preparing unit. A solitary raspberry pi unit includes 26 GPIO pins i.e. 26 distinct sensors can be associated with it. Notwithstanding we can expand this number by joining a multiplexer (MUX) to it. It is fundamental that the ground of raspberry pi and sensors must be associated keeping in mind the end goal to exchange information utilizing the GPIO pins. There is a python content running on the chip that checks the status of different GPIO sticks and updates this data onto the cloud. Information gathered from different sensors is sent to the raspberry pi through the esp8266 chip. The raspberry pi at that point transmits this information to the IBM MQTT Server through MQTT convention over a channel. MQTT[15] (Message Queue Telemetry Transport) Protocol is a distribute buy in based "light weight" informing convention that is utilized over the TCP/IP convention. It is intended to set up associations crosswise over remote areas where constrained measure of information should be moved or in instances of low transmission capacity accessibility.

Mobile application: The portable application acts like an interface for the end clients to cooperate with the framework. The application is produced in Apache Cordova and Angular Js system utilizing JavaScript as a programming dialect. The reason for utilizing Apache Cordova is to make applications that can keep running on both android and iOS stage with a similar source code. The application is associated with the IBM MQTT server through a protected channel and a 2 factor approval. The motivation behind this portable application is to give data with respect to accessibility of parking spots and enabling the end client to book a space as needs be. Exchange of information happens in JSON arrange between IBM MQTT server and the portable application. With a specific end goal to guarantee appropriate correspondence both the Raspberry pi and portable application must be bought in to a specific channel on IBM MQTT server.

The Cloud: The IBM MQTT server is facilitated on cloud. Cloud goes about as an information base to store every one of the records identified with stopping zones and end clients that approach the framework. It monitors each client associated with the framework and keeps up data, for example, time at which the auto was stopped, time span for stopping an auto, sum paid by the client and method of installment. It is because of the adaptable idea of cloud which allows the framework to include any number of clients whenever of the day. Nonstop reinforcement is made of the information put away cloud with a specific end goal to guarantee simple and brisk recuperation of information in the event of any sort of framework disappointment.

On firmly taking a gander at the figure one gets the opportunity to see that unfilled parking spots are shown by red light in Lane A while green light in Lane B. This is because of the way that in the event of Lane An in spite of the fact that there is no auto as of now stopped yet there still is a red light in light of the fact that the opening has just been reserved by some client. Then again, the stopping opening in Lane B demonstrates green light since it neither has a booking nor an auto stopped in it.

IV. IMPLEMENTATION & WORKING

In the past area we examined about the engineering and specialized stack identified with the brilliant stopping framework. In this area we discuss the implantation and working of the framework in a certifiable situation. The entire procedure of booking a stopping opening, stopping an auto in that space and leaving the stopping region is clarified with the assistance of the accompanying stream graph.

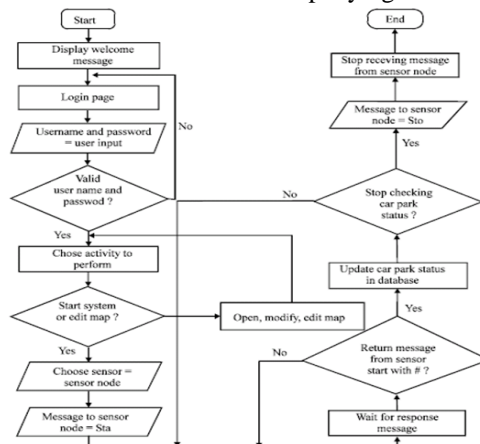


Figure 2: Flow chart of the system

We directed an investigation with a specific end goal to delineate the working of our framework at each phase from checking the accessibility of parking spot to really stop an auto in an empty stopping space. This is finished by actualizing the keen stopping framework in the stopping region of a shopping center. The following are the means that a driver needs to follow so as to stop its auto utilizing our stopping framework.

Step 1: Install the keen stopping application on your cell phone.

Step 2: With the assistance of the versatile application look for a stopping territory nearby your goal.

Step 3: Select a specific stopping region.

Step 4: Browse through the different stopping openings accessible in that stopping zone.

Step 5: Select a specific stopping opening.

Step 6: Select the measure of time (in hours) for which you might want to stop your auto for.

Step 7: Pay the stopping accuses both of your e-wallet or your MasterCard.

Step 8: Once you have effectively stopped your auto in the chose stopping opening, affirm your inhabitation utilizing the versatile application.

The above mentioned procedure for booking a slot and parking a car in that very slot is explained with the help of the following screenshots.

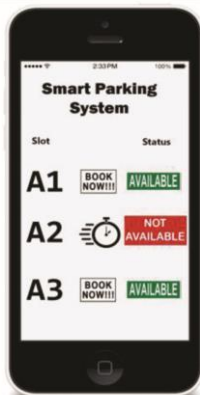


Figure 3: Booking a parking slot

The above figure depicts the presence of vacant and occupied parking slots. In this case parking slots named A1 and A3 are vacant whereas slot A2 is occupied. The driver chooses the A1 parking slot.

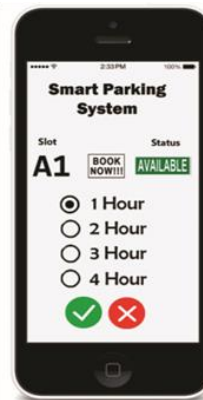


Figure 4: Selecting the amount of time

The above figure depicts the scenario when a driver needs to specify the amount of time for which it needs the selected parking slot. In this case the driver selects the 1 hour option.



Figure 5: Occupancy check

Once the driver has stopped its auto in the chose opening it needs to affirm its inhabitation. Figure 5 delineates this very situation in which the driver needs to indicate its quality. This component is included with the goal that exclusive a honest to goodness driver can stop its auto in a specific stopping opening. On the off chance that a driver neglects to affirm his inhabitation in the following 30 seconds of stopping its auto, an alert would begin ringing making the experts realize

that an auto has been stopped in the wrong place. In the event that by any possibility a honest to goodness driver comes up short do as such he can stop the caution whenever by affirming his inhabitance.

On the off chance that the driver over shoots its stopping time, a notice expressing this situation would be sent to the driver and additionally to the stopping specialist. The driver would then have an alternative of broadening its stopping time and pay appropriately for the additional time. On the off chance that the driver neglects to do as such, the stopping specialist would make a note of this and charge cash for the additional time in type of a fine. This fine would be gathered from the driver when the auto would leave from the stopping zone.

V. CONCLUSION

The idea of Smart Cities have dependably been a fantasy for mankind. Since the recent years huge progressions have been made in making shrewd urban communities a reality. The development of Internet of Things and Cloud advances have offer ascent to new potential outcomes as far as savvy urban communities. Brilliant stopping offices and activity administration frameworks have dependably been at the center of developing keen urban areas. In this paper, we address the issue of stopping and present an IoT based Cloud coordinated brilliant stopping framework. The framework that we propose gives ongoing data with respect to accessibility of stopping openings in a stopping territory. Clients from remote areas could book a stopping opening for them by the utilization of our portable application.

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