

IoT based sensor enabled vehicle parking system

T. Abhishek Dheeven^{a,*}, P. Marish Kumar^b, V. Venkatesh^c, K.A. Indu Sailaja^b

^a Centre for Nanoscience and Technology, Anna University, Chennai, 600025, India

^b Department of Electrical and Electronics Engineering, Easwari Engineering College, Chennai, 600089, India

^c Department of Electrical and Electronics Engineering, Rajalakshmi Engineering College, Chennai, 602105, India

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ABSTRACT

Along with the development of society and the country, the development of cities also occurs. People use technology to facilitate the work of the community. Some of them are the Internet of Things (IoT). This technical concept solves some of the issues like traffic system, parking lots, and operating electronic devices at home when the user is away. The Internet of things provides wireless access to this system and allows users to maintain one-track parking space availability in the crowded area and on the busy lanes, with the increase in Vehicle population, road congestion in big cities is one of the major consequences. The system majorly focuses on the concept of a parking space detection mechanism that uses sensors in combination with the use of Internet of Things, i.e., it sends parking status to the internet web page. This allows users to see which parking spaces are free and where to park. This is achieved by sending the sensor's data to an IoT platform via the ESP8266 WiFi module, which displays data using HTTP. These types of systems make the user find parking slots easier than creating a mess this process saves the user time as well as improves the easy being by tracking the charges of the vehicle.

1. Introduction

Today's traffic congestion is rapidly increasing as the population grows. Vehicle usage has also increased concerning with the rate of population growth. As the use of increased vehicle in the cities, traffic jams began to occur on the roads, most people prefer private cars to public transport [1,2]. Finding parking spaces in most metropolitan and commercial areas can be very difficult and time-consuming, especially during peak hours. Finding a suitable and safe parking space is difficult based on the increasing population across the part of the globe. The concept of the Internet of Things, which would be helping to make our lives easier and faster, has enormous uses in the current age [3,4].

The Internet of Things system enables users to interface unique technologies to the cloud, and one of these services is the parking system. Unorganized parking causes numerous issues throughout that respective area. To acquire the necessary information regarding vacant parking spots in a specific location and procedures every day to allow vehicles to halt in open vacancies [5]. Most of the important circumstance that urban areas deal with is public parking and transportation planning systems [6]. The Internet of things allows the connection of adjoining environmental things to utilize those tools from any far-off area [7]. Not only this system decreases traffic congestion, it also

provides an authentication process, cost-effective monitoring system and aids in the reduction of carbon impact [8].

The vehicles are been detected in an autonomous process in a parking space using LIDAR integrated within the area. Data from various sensors are combined for further analyst, allowing vehicles to be tracked in a common parking space [9]. With the combination of useful methods are suggested and assessed to carry out real-time detection and tracking. In the context of the visualization, the system manages the position the vehicle precisely and accurate. Because the common parking service were not able to meet up with the growing demand for personal vehicles, a parking management guidance system based on the geomagnetic sensors was developed [10]. The liquid crystal display screens constrained by the focused server, on the other hand, can show data on accessible stopping places. The trial results show that the geomagnetic sensors distance location precision was within 0.4 m, and the most reduced bundle misfortune rate of the remote entity in the scope of 150 m is 0 %.

2. Hardware designing

The concept of smart urban communities is one of the booming trends with the integration of internet of things, the possibility of a city

* Corresponding author.

E-mail address: dheeven10@gmail.com (T.A. Dheeven).

is now easy to access remotely, with all its data [11]. Predictable efforts in the field of computation are being made to improve the efficiency and dependability of urban functionality. Computation system is been incorporated to reduce the traffic congestion, restrictions of vehicles halting careless causing congestion on road, and street well-being [12]. This system is an IoT-based cloud-coordinated system that allows the client to plan the vehicle in an organized halt manner. This system intimates the vacancy of the slot through IoT and automatically calculates the billing for the parking time which is directed to the user through an SMS [13–15]. This system minimizes the time for the client to search for the parking slot over a large area, and arranged vehicle in an organized manner with autonomous service mechanism.

The vehicle parking system is done autonomously with the incorporation of the computation analysis. The parking slot availability is displayed on the webpage, that the user can park the vehicle in the availability slot. The client can preview the availability of the slot before reaching the prescribed space. This system also follows the billing procedure, so the user can get the bill for the parking through SMS from the time of the vehicle is been parked in the slot till the vehicle is been taken out from the slot. The parking slot mechanism function by sensing the vehicle presence through the infrared object capturing process. The mechanism of the system is branched into four processing modules.

- Intimation of Parking slot.
- Parking Detection.
- Billing.
- Notification.

A. Intimation of Parking slot

Fig. 1 is the basic input architecture modules of the system in which the infrared sensor acts as the primary input to the system from the parking slot, and the radio frequency identification act as the substantial input to the system from the client side to the host. Display unit serves as the output unit for the entire system at the primary level, the database acts as the second output system.

B. Parking Detection

Fig. 2 explains the detection of the slot in the parking area. Is performed with the sensors, this phase is been considered the preliminary data capturing system. The unique identification number of the vehicle is scanned with the help of the reader and the specification of the vehicle is been transferred to the controlling unit to ensure the availability of the slots from the parking space. The LED indicated the availability of the slots in case the vehicle is been parked in that specific slot then the led indication is been turned red.

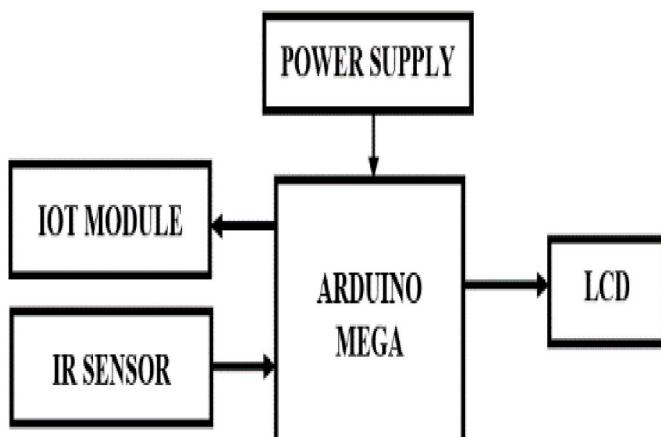


Fig. 1. The architecture of the data capturing unit.

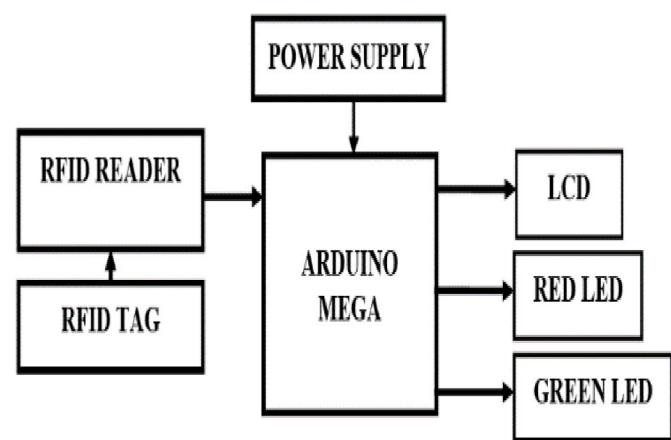


Fig. 2. Indication of the parking slots.

C. Billing

The billing process for the vehicle is been done based on the time duration for which the vehicle is been parked in a particular slot with slab approach. The duration is been captured from the real-time clock which is been interfaced with the Arduino which is indicated in **Fig. 3**.

D. Notification

The user is intimated through SMS regarding the parking information, the billing, the parking slot vacancy is updated simultaneously for the client through modules. The flow of this process is represented in the **Fig. 4**.

3. Working

The computation process has Arduino-Mega, Node MCU, and other modules. This system also requires a mobile network SIM which will be connected to GSM where the parking charges, duration of the halt are sent as a message to the client. The architecture of the system is mentioned in the **Fig. 5**.

When the user enters the parking area, the unique identification tag is brought into contact with the reader to get the details and the specification of the vehicle. Infrared object capturing process is been introduced to differentiate the vehicle and other object in the slot, the parking slot is occupied or empty and detects the motion of the car. If the car is parked, the sensor detects and informs the user about the availability. RFID technology is used for parking payments. GSM is used to

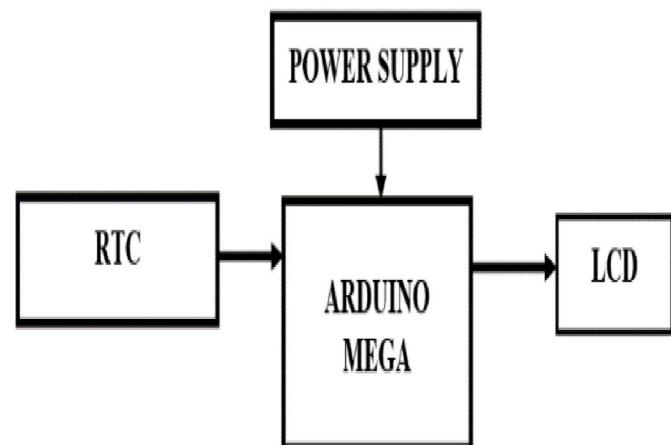


Fig. 3. Sequential block of the billing process.

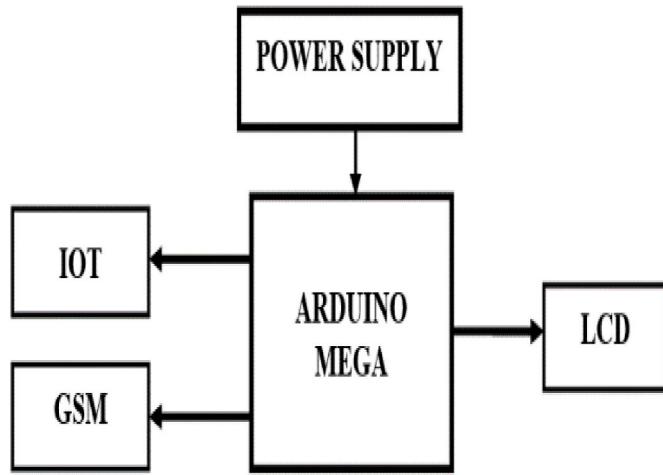


Fig. 4. Sequential diagram of the notification process.

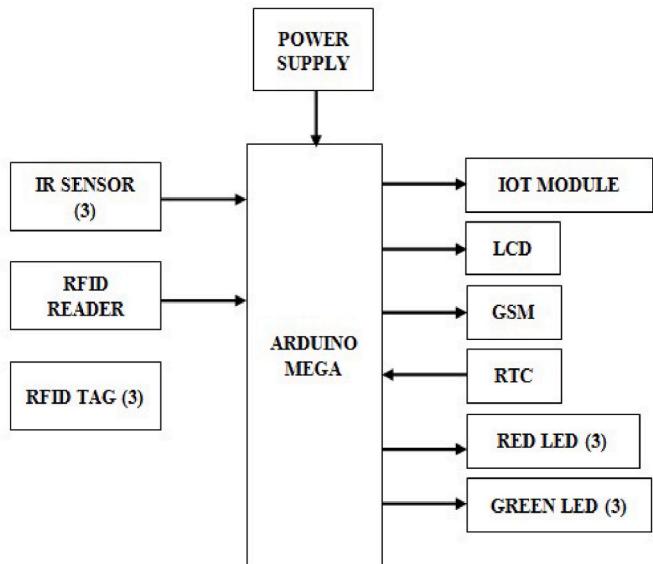


Fig. 5. Block diagrammatic representation.

send a message about the status and the duration of the parked vehicle in the slot. All the information about parking slots is known to the user before searching for the parking in IoT and displayed on the LCD. The system is inbuilt with internet of thing via node MCU.

The IR sensor which is fixed at the slot detects the vehicle in the slot and this information is updated on the webpage through the module. When the user is aware of the parking slot he can directly reach it and park his/her vehicle. Once the vehicle is parked the parking slot information is to be updated in the IoT. The LEDs attached to the parking slot glow depending on the parking status which is mentioned in the below Fig. 6.

The unique identification tag fixed in the car is used to count the number of vehicle passed in and out of the parking area with their parking time this reduced manual function for detection of the vehicle and entering its details. When the vehicle is detected the time of the entry of the car is noted through an RTC module which is used to calculate the billing of the car till the time of exit. All this information and timings is displayed through LCD for the supervision process. The intimation about the slot is sent to the user based on the request via the application access. The user receives a notification SMS with the parking information about the billing, the parking slot vacancy is updated

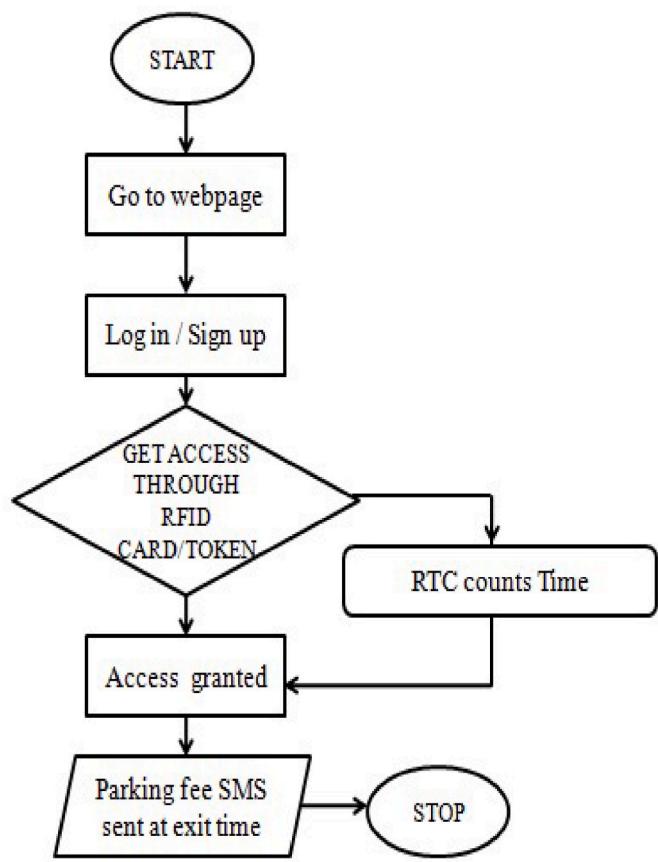


Fig. 6. Schema representation.

simultaneously. This computation procedure creates a user-friendly approach towards the system user before searching for the parking slot. The hardware setup is been shown in below Fig. 7.

4. Results and discussion

A. Intimation of Parking Slot

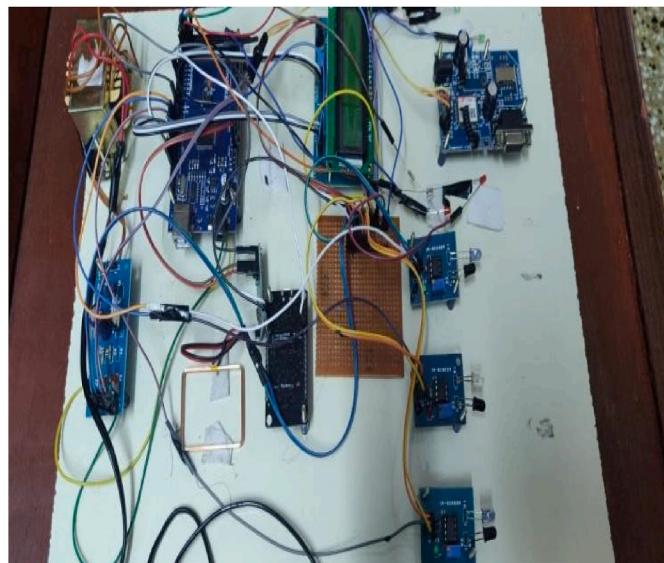


Fig. 7. Hardware representation.

The infrared object capturing, fixed in the parking slot detects the vehicle in the slot and this information is updated on the webpage via the module.

Fig. 8. Represents the login pages where the individuals log in to check their slots and the charges for the duration as well as for the availability of the parking slots and to lock the slot in advance.

B. Parking Detection

When the user is aware of the parking slot, he can directly reach it and park his/her vehicle. When the vehicle is parked in the lot, the information is updated in the database. The LEDs attached to the parking slot glow depending on the parking status. The RFID tag fixed with the car is used to count the billing time when it reaches the reader fixed in the parking slot.

Figs. 9 and 10 refer to the displaying unit of the system where the individual can review and ensure the vacancy in the lot to follow a systematic procedure.

C. Billing

The RFID detects the car in the lot during the time of the entry the car is noted through an RTC module which is used to calculate the billing of the car till the exit. All this information and timings can be monitored through LCD **Fig. 11**.

D. Notification

The notification about the parking is sent to the user and it is also updated in the IoT.

The client-side representation where the individual receive the message or the notification from the data end which is noted as the vendor side for the individual based on the duration of the vehicle is been parked in the lot the tariff is been laid based on the slab scheme where the individual gets the minimal cost for 1 h based on the time extended the individual is been charged shown in the **Fig. 12**.

5. Conclusion

Internet of the things-based parking system can even more likely track the accessibility of parking spaces on a given area, making it simpler to find an accessible parking space. For instance, some utilize QR

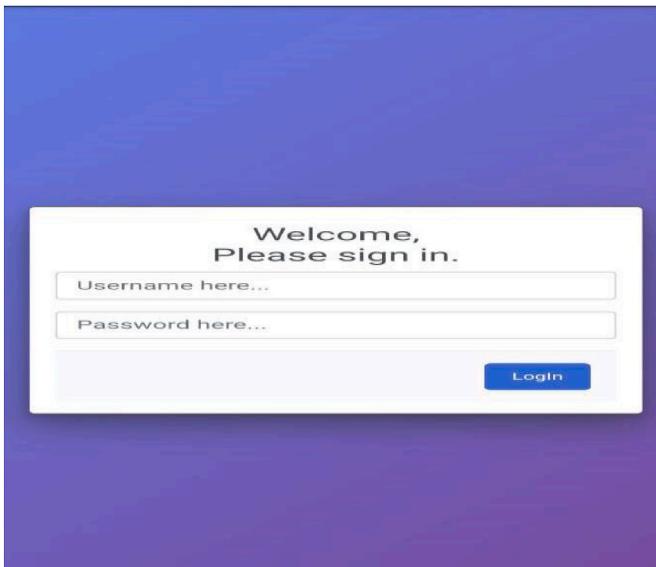


Fig. 8. Login page for the user credentials.



Fig. 9. Empty slot display in LCD.



Fig. 10. Full slot display on LCD.

Wifi-IoTLogs			
DataLogs			
Click Here To Delete Logs: CLEARLOG			
Show:	10	entries	Search:
LogID	DATA	Logdate	LogTime
1	Slot_1:0_Slot_2:1_Slot_3:0	05/24/2022	15:41:25
4	Slot_1:0_Slot_2:1_Slot_3:0	05/24/2022	15:41:50
6	Slot_1:0_Slot_2:1_Slot_3:0	05/24/2022	15:42:07
11	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	15:45:24
12	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:05:56
14	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:04:19
16	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:04:44
18	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:05:05
20	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:05:25
22	Slot_1:0_Slot_2:0_Slot_3:0	05/24/2022	23:05:47

Fig. 11. Data-log on the website.

codes to distinguish accessible parking spaces, while others use sensors to recognize when a vehicle leaves a parking space. The advantages of an IoT-based smart parking system are that it is more innovative, productive, and helpful for the two drivers and proprietors of the parking area. This system can be implemented in crowded places so the user can easily locate the parking slots with the help of IoT. This can also reduce

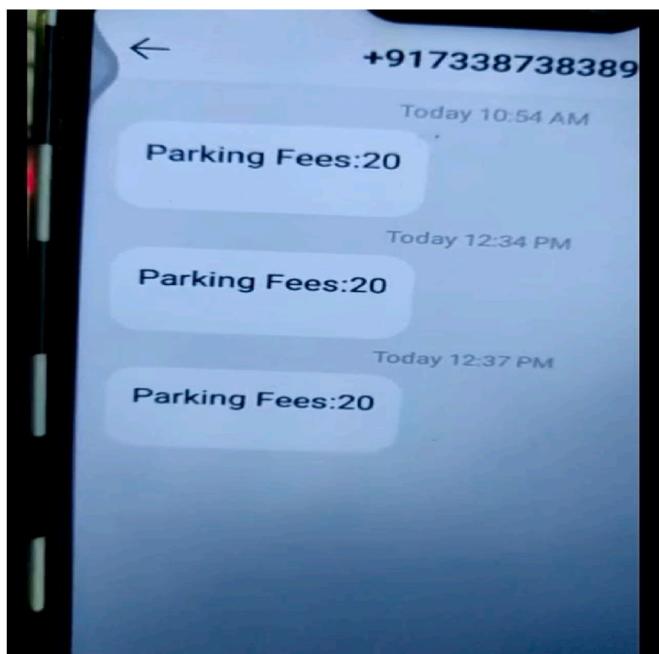


Fig. 12. Parking charges through SMS.

pollution as the user can directly reach their parking location. The automatic billing system attached to the parking slot makes it more convenient for the user [14]. Using these technologies can be implemented in large cities and can be monitored from a single source and they can be implemented by governments in main shopping areas.

Source of support

Nil.

Compliance with ethical standards.

Ethical statement

Ethical approval and consent to participate are not applicable to this article as no data were generated or analyzed during the current study.

CRediT authorship contribution statement

T. Abhishek Dheeven: Methodology, Software, Validation, Data curation, Writing – original draft, Writing – review & editing. **P. Marish Kumar:** Conceptualization, Supervision. **V. Venkatesh:** Resources. **K.A. Indu Sailaja:** Formal analysis, Resources.

Declaration of competing interest

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors are unable or have chosen not to specify which data has been used.

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Abhishek Dheeven T, He is currently pursuing his Master's Degree (M. Tech.) in Nanoscience and Technology at the Centre for Nanoscience and Technology, Anna University, Chennai, Tamil Nadu, India. He has completed his Bachelor's Degree (B.E.) in Electrical and Electronics Engineering from Easwari Engineering College, Chennai, Tamil Nadu, India in 2022. Currently, he is working in Bioactive glass, the Brain-Computer Interfacing technique for Human Interfacing, the health care system, and Internet of Things. He was an IEEE Student Branch Chair of STB61311, Chennai, Tamil Nadu, India. His researches include brain computer-interfacing, health care system, bio regeneration, electric vehicle, and renewable energy. He holds 14 IEEE professional development certification issued from the Power Electronics Society and Transportation Electrification Community.



P. Marish Kumar, He received the B. E Degree in Electrical and Electronics Engineering from the Madurai Kamarajar University, Tamil Nadu, India, in 2003, and the M.Tech degree in the specialization of Power Electronics and Drives from S.R.M University, Chennai, Tamil Nadu in 2005 and a Ph.D. in Electrical Engineering from Anna University, Chennai, Tamil Nadu, India, in 2020. He has more than 17+ years of Experience in Teaching. At present, he holds the post of Associate Professor in the Department of Electrical and Electronics Engineering, at Easwari Engineering College, Chennai, India. His research area includes photovoltaic systems, Renewable Energy systems, Control systems, and Power converters. He has authored the books titled “Power Electronics” and “Electric circuits and Electron Devices”. He has published more than 25 journal articles and holds two patents.