Webology, Volume 18, Number 4, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I4/109

Interactive Parking System based on Mobile App and Azure IoT

Prakash Srivastava[1], Himanshu Sajwan[1], Rockey Chaudhary[2]

[1]Department of Computer Science & Engineering, Graphic Era (Deemed to be University), Dehradun
[2]Department of Physics, Graphic Era Hill University Dehradun, Uttrakhand,

ABSTRACT
As the number of car owners grows, so does the amount of parking. Users favour mobile phone-based solutions as the use of smartphones and associated applications increases. The e- Parking Management System (e-PMS), focused on an Android based application, is proposed in this study. The mobile application, which provides many appealing alternatives to users at no cost and allows them to check reservation details, recovers its area data from the cloud azure server via the IoT edge device. The smart parking system can be wirelessly connected with IoT technologies on Azure cloud to quickly find available locations.

Keywords: parking system, IoT, smart parking

INTRODUCTION
Due to a rise in the number of automobile owners, more parking spaces were required, and the Interest in smart cities has increased as a result of the Internet of Things. This is how IoT is used to problems like traffic congestion, backed-up automobiles leaving workplaces, and street security. In order to reduce these traffic problems and increase the comfort of vehicle drivers, a number of parking management systems have been developed. These systems incorporate smart phones, wireless algorithms, and mobile applications. Using information technology and the right sensors, smart parking is an electrical instrument that makes it possible to locate open parking places [7]. Automated Parking Management System is an effective method for managing the parking space allocated using IoT [8]. The e-parking management system generally composed of mechanical, electrical, and control equipment that ensures systematic, automatic, and directionally appropriate parking of numerous cars in a small area.

Finding a parking spot for your car is a constant issue anywhere in the world. When parking in malls, multistory parking structures, IT centres, and parking facilities where several hundred cars are parked, it becomes difficult to obtain a spot. On side streets and interior lanes, this task seems simple. The standard procedure for finding a parking space is to circle the block and drive aimlessly until a spot opens up. The typical method for obtaining a parking spot is to circle the block and drive aimlessly until a spot opens up. When there are numerous levels or broad acres of spread land, finding a parking space may be the easiest or the most difficult endeavour. Parking spots are typically found by driving around the block aimlessly until one becomes available. Finding a

Webology, Volume 18, Number 4, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I4/109

parking spot may be the easiest or the hardest task if there are huge spread-out areas on one or more floors. The journey uses needless time and fuel because the destination is unknown. The most straightforward tactic is to give a driving lesson tailored to the location inside the parking garage [9]. As the destination is unknown, unnecessary time and fuel are used. The simplest strategy is to provide a destination-specific driving route inside the parking garage.

RELATED WORK

The Android application [1] saves Information regarding vacant parking spaces is obtained from customer data such as location, state, vehicle identification number, user entry and exit times, and parking place selection. User data was stored in the MySQL database.

To reserve a parking space, the system [2] utilised Infrastructure to Vehicle (I2V) communication and Vehicle to Infrastructure (V2I) communication for communication with driver who submitted request for parking as well as to provide and inform the user of the status of the reservation's conformance. Webcam was used to read the QR code for safety reasons, and it was authorised to show the direction of the car parking area.

Wireless connectivity was used by the system [3] to sort the locations of the nearest parking spaces using GPS. The system tells users of available space every two minutes. If there are no parking spots available, no actions are seen; on the other hand, any user is willing to order a spot within two kilometres of where they are right now.

The system's [4] real-time delivery of parking facilities enables users to make reservations and payments before arriving at the parking lot.

The system in [5] suggested leveraging the cloud for both a database and a communication mechanism. a ground-based ultrasonic sensor linked through Ethernet.

A method that determines the best neighbourhood and parking spots given user-supported trajectory and time was presented in [6]. The method was dependent on the space's availability at the time and lacked a booking mechanism.

DESIGN OF EXPERIMENT/ MATERIAL METHODS

A three-step process is required to locate a parking space. The parking lot is the first place where the user and the parking lot may interact, thanks to sensors and Arduino devices. The second level includes the cloud services that act as a link between the user and the parking lot. The third step is the user side. The user is advised of the availability via mobile applications. The total number of parking spots, the number of empty spots, and the number of spaces that are reserved are detected by Arduino sensors that are placed for each parking region. The smartphone app and sensors communicate using a WIFI module.

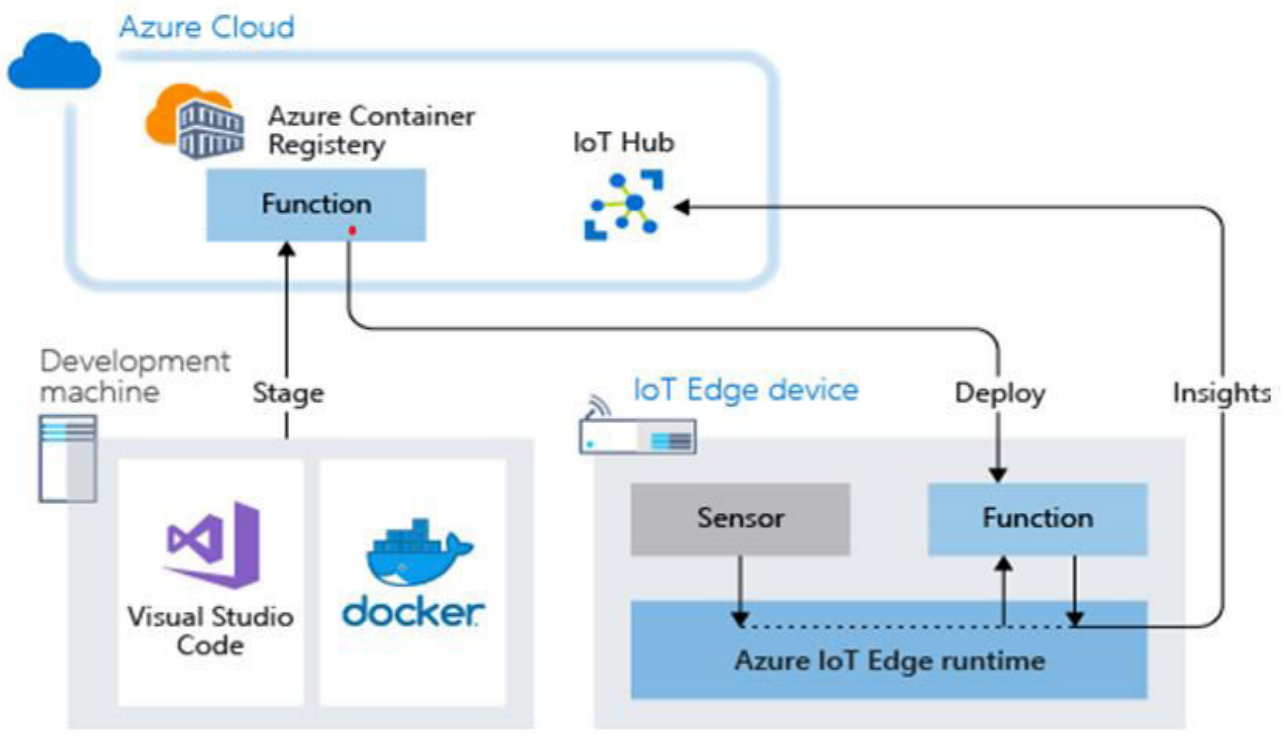
The e-parking management system proposed here consist of the various components: Parking metres, a laptop or workstation with WLAN or Wi-Fi built in known as a local parking management server hosted through Azure cloud, Wi-Fi access points installed inside each parking spaces, and an azure virtual machine server hosted on the cloud for addressing parking requests from car owners to

Webology, Volume 18, Number 4, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I4/109

reserve parking spaces as well as for disseminating information on parking availability across the city. Figure 1 depicts the network framework of e-parking management system described here. The proposed system calls for a IoT sensor to be installed in the centre of each parking lot. Fig. 1. Fig. 1 depicts the network architecture of the proposed E-parking system for the parking lot's back end based on Azure. Fig. 2 depicts the smart mobile phone management software that is running on the android platform. A wireless module that is IEEE 802.11 b/g/n compliant is used to connect to the local parking management system. The framework is made up of an Arduino MEGA 2560 microcontroller, an alarm IC module to generate a warning sound in case of incorrect parking, a camera module to take a picture of the vehicle's licence plate, and an ultrasonic sensor node to detect the presence of a vehicle inside the parking lot. The IoT sensor also includes two smaller solar cells, as shown in fig. 2, for recharging the batteries. The virtual machine server created on Azure is connected to a GSM module [5] via serial connection in order to send SMS messages to both the vehicle's driver and the site officer. The suggested e-parking system's software architecture and functional specification are shown below.

2.1 **TOOLS AND ENVIRONMENT**

1. Android Studio Chipmunk as code editor.
2. Google Pixel 2 as Android emulator.
3. Windows 11 as Operating System.
4. Java as Programming language.
5. XML to define the layout and UI for Android application.
6. Firebase as an online database.



Webology, Volume 18, Number 4, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I4/109

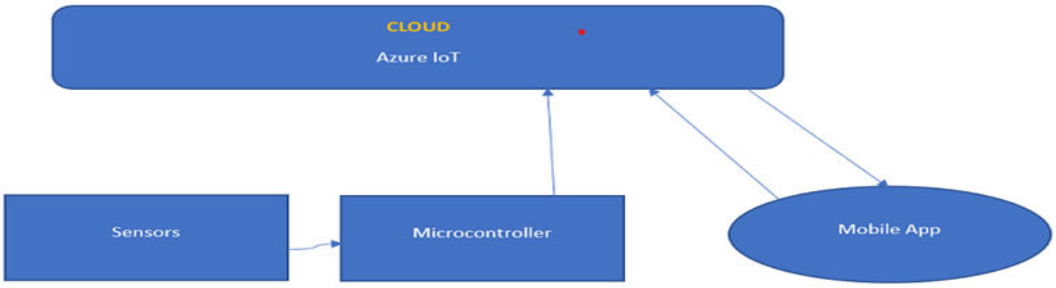
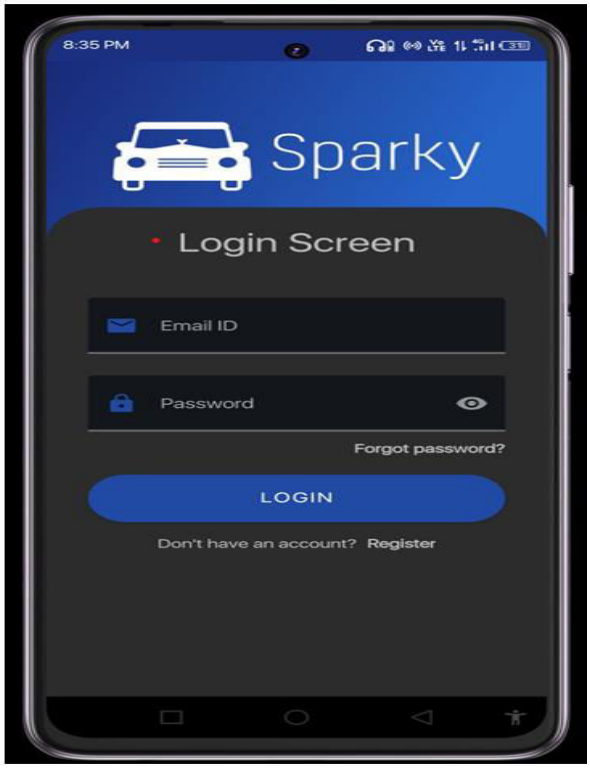


FIG. 1 Proposed E-parking management system framework

3.1 Registration:

For a new user to register in this mobile management system he has to do the following task for registering his vehicle in the smart parking hosted though Azure cloud server via mobile API.

- A normal user will firstly register and verify their account.
- A normal user can view, edit their profile, can search for parking lots, book and cancel their booking of slots.
- A normal user then can apply to become a parking lot manager.
- A parking lot manager has the same features as a normal user and some more such as adding new slots in a parking lot, removing slots in a parking lot.



Webology, Volume 18, Number 4, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I4/109

A database is used, called Firebase Realtime Database.
Real-time means that the application will receive notifications from the database each time some data is added, modified, or deleted from the database.
The "User" node inside the root node will be used to store user information (name, email, phone, etc.) with a special key.

The "Parking" node inside the root node will include information on parking lots, with Latitude:Longitude serving as the special key. Data about booking will be stored in “Booking” node inside the “User” node with Latitude:Longitude:SlotID as unique key.

CONCLUSIONS

Finding a parking spot for your car is a constant issue anywhere in the world. When parking in malls, multistory parking structures, IT centres, and parking facilities where several hundred cars are parked, it becomes difficult to obtain a spot. On side streets and interior lanes, this task seems simple. In order to find a parking spot, the usual procedure is to circle the block and drive aimlessly until a spot opens up. Finding a parking spot may be the easiest or the hardest task if there are huge spread-out areas on one or more floors. The journey uses needless time and fuel because the destination is unknown. The most straightforward tactic is to give a driving lesson tailored to the location inside the parking garage.

REFERENCES

1. Dhumal, Y. R., Waghmare, H. A., Tole, A. S., & Shilimkar, S. R. (2016). Android based smart car parking system. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 5(3), 1371-1374.
2. Shaikh, F. I., Jadhav, P. N., Bandarkar, S. P., Kulkarni, O. P., & Shardoor, N. B. (2016). Smart parking system based on embedded system and sensor network. International Journal of Computer Applications, 140(12).
3. Garra, R., Martínez, S., & Sebé, F. (2016). A privacy-preserving pay-by-phone parking system. IEEE Transactions on vehicular technology, 66(7), 5697-5706.
4. Khanna, A., & Anand, R. (2016, January). IoT based smart parking system. In 2016 international conference on internet of things and applications (IOTA) (pp. 266-270). IEEE.
5. Karthi, M., & Harris, P. (2016, October). Smart parking with reservation in cloud based environment. In 2016 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM) (pp. 164-167). IEEE.
6. Hsu, C. W., Shih, M. H., Huang, H. Y., Shiue, Y. C., & Huang, S. C. (2012, November). Verification of smart guiding system to search for parking space via DSRC communication. In 2012 12th International Conference on ITS Telecommunications (pp. 77-81). IEEE.
7. Orrie, O., Silva, B., & Hancke, G. P. (2015, November). A wireless smart parking system. In IECON 2015-41st Annual Conference of the IEEE Industrial Electronics Society (pp. 004110-004114). IEEE.
8. Khanna, A., & Anand, R. (2016, January). IoT based smart parking system. In 2016 international conference on internet of things and applications (IOTA) (pp. 266-270). IEEE.
9. Elsonbaty, A., & Shams, M. (2020). The smart parking management system. arXiv preprint arXiv:2009.13443.