VehiPark- Online Vehicle Parking Management System

HMIJ Herath[1], BM Kasthuriarachchi[2], PTC Sandamini[1], WCD Rathnasiri[1] and WPJ Pemarathne[2]

[1]*Department of Computer Engineering, Faculty of Computing, General Sir John Kothalawela University, Ratmalana, Sri Lanka.*
[2]*Department of Computer Science, Faculty of Computing, General Sir John Kothalawela University, Ratmalana, Sri Lanka.*

#37-ce-0006@kdu.ac.lk

Abstract:*Traffic congestion is exacerbated by the parking issue. The proposed vehicle parking system is built with Android (Mobile) and Web Applications. Android (Mobile) application for car owners to book their parking space and Web application for park owners to design their park and easily update park information. In addition, our project's goal will be outlined. The project's goals and constraints will be discussed at the conclusion of this chapter. Traditional methods of arranging a car slot do not appear to be more efficient. Many human resources are required to keep track of the details of the individual who reserved the parking space. The primary goal of this project is to create a new smart parking system that assists vehicles in identifying parking slots in a specific parking area. For this paper's data collection methods, document analysis and questionnaires were used. The current technique is time-consuming and generates gridlock when there is no proper and simple system in place to govern parking spaces. This proposed system would allow consumers to book a car slot before arriving at their selected location. This system results in functions such as displaying available parking spaces, accepting money for parking spaces, and legally accepting booking a slot.*

Keywords:*Android, Web development, Mobile computing, Vehicle parking*

1. Introduction

From the past, the matter is existing. The population is being increased day by day and the number of vehicles. Most of the time, there is no parking spot for the vehicle and there is no better way to have a parking spot when after arriving at a place. Most of the methods that are available nowadays, for booking a vehicle slot don't seem to be more efficient or user friendly. At the parking areas, vehicle owners must seem for a parking spot by drive their vehicle over the parking area. The problem with this traditional method is that it's more time consuming hence less efficient. The entire concept is hectic as vehicle drivers park their vehicle on the roadside. This leads to a traffic jam or congestion.

The current Silicon age world tends to change from manual and local Vehicle Parking Reservation System to computerized and Online Vehicle Parking Reservation system to make management, registration, and booking easier. This has helped to minimize paperwork, errors made by the reservation office like miss spelling the number plate, vehicle model, time wastage, delays, and congestion at the reservation office.

After a detailed significant study of the existing systems. It is found through a thorough study of the currents existing found from different parts of the world that these systems are composed of more hardware components which adds an extra budget to the system and requires high maintenance since these hardware components used are more likely to break down. Usage of many hardware components requires a considerable power supply therefore it is an evident need to make sure there is a continuous power supply, which adds to the budget.

Referred the existing systems and mentioned the issues with that. Then found a better practical solution with current technologies that we can establish. We can provide better and easy-to-use experience to the user and service providers by connecting them through our project. Therefore, it enables the best procedure to reserve a parking slot early rather than waiting in the queue. It is the newest experience with some new features to anyone using our system.

We have studied deeply on eight research papers on existing systems (two papers for each member) to get a clear understanding to improve our new system way better than those existing systems. We studied research papers not only international research papers but also local research papers.

2. Literature Review

The new system develops a Mobile application for vehicle users and the web application for the admin to establish possible solutions to improve the current Vehicle Parking Reservation problems and limitations as mentioned above in current systems. The new system is a combination of a mobile application and a web application the mobile application is specifically for vehicle users, and a web application is designed for park owners.

"Smart Car Parking Management System" This system proposed the following methods: Develop an intelligent car parking system to solve the chaos, perplexity and long queues at the entry and exit of a parking space located inside public buildings, including shopping malls and office spaces. Research problem or question: In recent years, a massive number of newly registered vehicles have been added to the congested cities of Bangladesh. This means registered vehicles are increasing, but car parking facilities are deemed inadequate to sustain the influx of vehicles on the road. Unplanned parking is one of the leading causes of traffic jams in a city. Thus, traffic congestion can be significantly attenuated by utilizing these confined parking spaces (Ball and Byahatti, 2016).

"Eco QR Car Park System" This system proposed the following methods:

To minimize the parking system cost, reduce the environment's pollution, and improve the customer's overall satisfaction. Limitations of this system can be listed as follows, With the use of QR codes following disadvantages can be obtained, Lack of Familiarity, Slower, Security issues (Jogada and Warad, 2016). With the use of bar codes following disadvantages can be obtained, slightly more difficult to read or scan, needs to be near the scanner, can't add additional information, not very secure, vulnerable. With the use of RFID following disadvantages can be obtained, more expensive, picking up information problem, tag collision problem (Siew et al., 2016).

"Smart Car Parking Slot Reservation Using Mobile Application" Research problem or question: the problem of inessential time consumption in finding parking space in college campus car park areas. This system proposed the following methods:

- Mobile Application Development.
- Interfacing GSM with Microcontroller.
- Interfacing RFID Module with Microcontroller.
- Interfacing LCD with Microcontroller (Wang & Long, 2018).

Limitations of this system can be listed as follows,

- The use of redundant systems will result in a more significant cost.
- It may be confusing for unfamiliar users.
- It is not recommended for high peak-hour volume facilities (Chowdhury et al., 2019).

"A Smart Vehicle Parking Management Solution" Research problem or question: The proposed model has been analysed through financial, technical, and operational perspectives. Difficulties in finding vacant spaces, improper parking, and poor management are some parking lot problems (Rahman, 2020).
This system proposed the following methods:

- RFID-Based Automatic Vehicle Parking System.
- Street Parking System (SPS) based on wireless sensor networks.
- Ultrasonic Sensor Detection Area.
- Vehicle number plate recognition (James & Abraham, 2018).

Limitations of this system can be listed as follows,
Infrared sensors: It supports lower data rate transmission compared to wired transmission. It can control only one device at one time (Ggyu, Gunasekara and Kathriarachchi, 2015).

3. Design and Implementation

It is presumed that the reader has read the proposal since this document also defines the implementation details of the expected behavior given the requirements within it. In the Overall system architecture, it is described about the presentation layer, application layer and the data link layer of the developing system with the aid of diagram.

A. Overall System Architecture

Architectural design defines the overall structure of the system. This forms a solution before moving on to the detail design. The architectural design is given according to the three-tier-architecture where overall design is split in to three layers of presentation tier, application tier and data tier.

B. Software Architecture

Software architecture was based on modularized approach where the software is divided into parts. Each module is assigned to execute one or more tasks of the overall system to achieve the ultimate objectives expected. This section will describe about the organization of the modules it consists of. The overall software system has been divided into several modules.

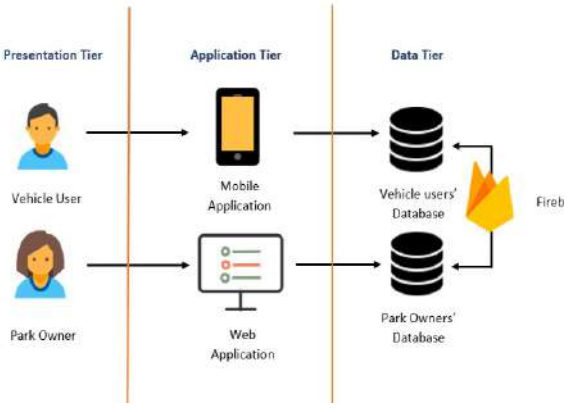


Figure 1: Software Architecture

C. Procedural Design

The objective of procedural design is to transform structural components into a procedural description of the software. The step comes after the data and program structures have been established. Procedural details can be represented in the following ways:

- Graphical Design Notation
- Tabular Design Notation
- Program Design Language

Graphical Design Notation is the most widely used notation. This can be done with flowcharts. In tabular Design Notation, Decision tables provide a notation that translates actions and conditions into a tabular form.

In our project VehiPark, there are two applications for two types of users.

1) The vehicle owners: Regarding vehicle owners, there is a mobile application. The vehicle owners can register to the mobile app and book a parking spot as their preference by selecting a slot from VehiPark.

2) The vehicle park owner: Regarding vehicle park owners, there is a web application. The vehicle park owners can register to the web application and design their park as they want. There, they have to enter the details like numbers of floors, number of bike slots and number of car slots.

We carry out the analysis, design, development, and testing portions one at a time, going back to the earlier ones and implementing adjustments as necessary, to finish our project in thirty weeks. We need the qualities of the Agile paradigm. Agile project management, in contrast to traditional managing projects, is a non-linear approach that prioritizes cooperation, collaboration, and adaptability beyond a specific sequence of events.

In the web application,

1. The user (vehicle park owner) has to log in or sign up to the web page. If the user has already signed up before, then he can use the login button and log in to the website. Otherwise, the user can sign up first by entering park details.

2. In the sign up the user must enter the owner's name, park name, address, email, contact number and set a password for their VehiPark account. Then the user can sign up to VehiPark.

If the user hasn't registered to 'VehiPark' before, after signing up he has to design their park.

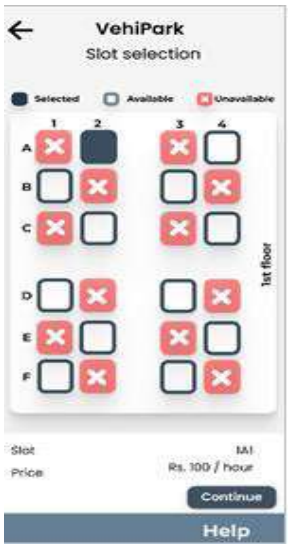
3. After the sign-up, the user will have an interface based on their account. There, they have to enter the location of their vehicle park and parking dates like 7 days, weekdays or weekends.
4. Then next the user has to enter the opening and closing time and payment options they provide to customers to pay for the tickets.
5. Then they have to select the type of their vehicle park whether it is an outdoor vehicle park or an indoor vehicle park and give the number of parking slots they have in their vehicle park. Those parking slots are divided into car slots, bike slots and disable parking slots.

In the mobile application,

1. The user (the vehicle owner) has to log in or sign up to the mobile app.
2. If the user has already signed up before, then he can use the login button and log in to the mobile app after entering the email and password. Otherwise, the user has to sign up first by entering his details.
3. In the signup, the user has to enter the name, address, email, contact number and set a password for their VehiPark account. Then the user can sign up to VehiPark.
4. After the sign-up, the user will have an interface based on his account. There he must enter the destination where he wants to go and park his vehicle, the time period he would like to book the slot and his vehicle type either car or bike. Then the user directs to select the parking slots.
5. In the interface where the user has to select a slot, he can select a slot with his preference. He must select a slot and enter the number of that slot. There the user can identify the available and unavailable slots separately (Omae, Shimizu and Fujioka, 2004).

D. Interface Design

Interfaces are design using two different platforms. Android application is design for the vehicle owners and Web application is design for vehicle park owners. Both vehicle user and vehicle park owner can login to the system using their registered username and password. The functions are available according to their category. User can get the specific services thought mobile application.



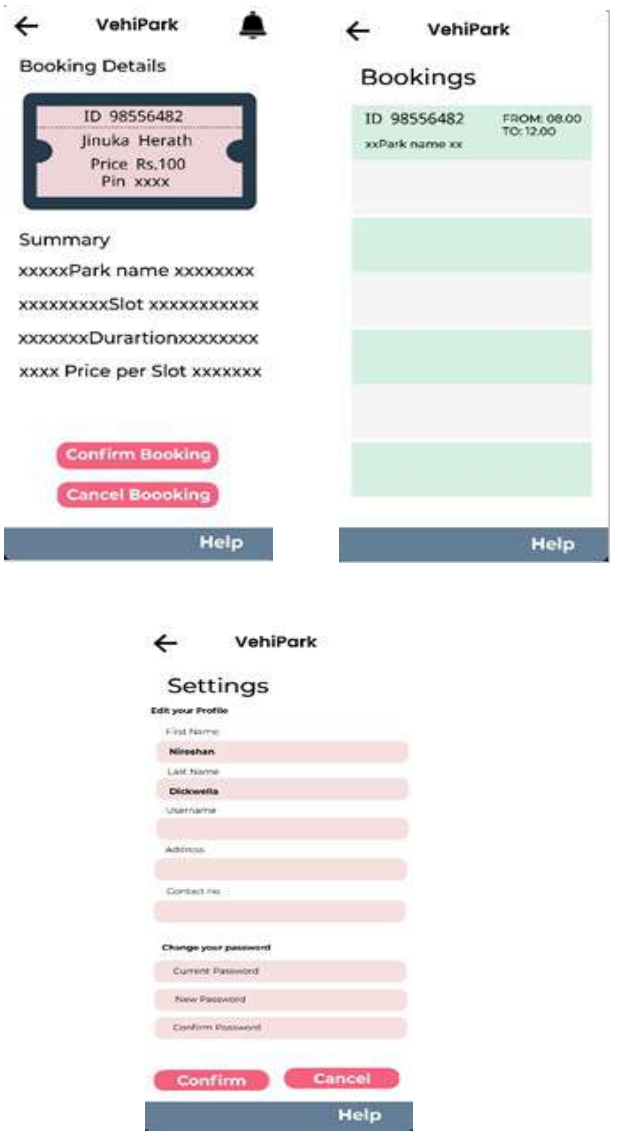


Figure 2: Interfaces of Mobile Application

4. Technology Adopted

A. Android Studio

Android Studio as the Integrated Development Environment (IDE) to create our mobile application. In this project, developers created mobile app using Android Studio. The method of creating apps for smartphones and digital assistants, most notably for Android and iOS, is known as mobile application creation. The apps can include preinstalled, be downloaded from a smartphone app store, or be viewed through a mobile web browser. Android Studio decreases the workload of designing mobile applications for android environment.

B. Firebase Database

Firebse databases to store all data create through the app and added by admins to the system.

C. Java

Java is the main language used for programming android apps. So, we use java to implement the system.

D. Github

Coordinating work among programmers collaboratively and fast performance. In here I should elaborate we implemented the mobile app for android environment while most of other systems were run by using 32- or 64-bit valued windows versions. This will enable everyone to deal with the app in a smart way rather than login to websites. Not only for android users this is eligible run on IOS platforms and can be used in open resources such as Linux.

E. Visual Studio Code

VS Code to implement the web app. There, we used HTML, CSS, and JavaScript. Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger.

5. Results and Discussion

The software was introduced as a solution to the problems caused by lack of parking space, high parking fees and traffic congestion caused by people looking for a place to park. VehiPark is a software application made to manage vehicle parking. VehiPark consisting of a mobile application and a web application. With the web application, park owners can customize their park and with the mobile application, vehicle owners can reserve a space in parks that have registered with the application through the web application. These apps are enhanced with many features for both vehicle owners and park owners.

Apart from the park owner, the individual who will be configuring and registering their park into our online program, the vehicle owner will be able to book their parking place at any time. As a result, testing should be performed from every user's perspective. Several tests must be done to discover faults in the system. Flaws of various forms can arise because of code errors, database connection issues, network issues, and system compatibility issues. Because there are several testing methodologies, it is critical to select testing techniques that are appropriate for the created system, as the objective is to generate a functional mobile application with as few mistakes or problems as possible. The testing methodologies allowed

us to concentrate on one or more elements to reach the desired result.

6. Conclusion and Further Work

The accomplishment of accomplishing the aim depends on the achievement of accomplishing the objectives of the system. So, our project helps vehicle park owners to customize their park and, with the mobile application vehicle owners can reserve a space in parks, which have registered with the application through the web application.

Identifying recommendations is the main phase to provide a user-friendly and user satisfied system in future enhancements. The system called "Vehi Park" which helps the drivers to identify where the vehicle parks are located is already identified, following recommendations about to implement in future development phases.

The existing implemented system will be more productive and efficient with the following implementation.

- Vehicle owners Being able to easily choose the right parking place.
- Park owners can easily customize their vehicle park.
- The ability of one park owner to include more than one park (Phudinawala, Malusare and Mahadik, 2022).

A. Future Enhancement

Identifying major phases will help to implement on future development to provide better experience and expand the achieved scope of the "Vehi Park" vehicle park management system. List of identified major future enhancement phases as follows.

- Taking the vehicle number from the user and detecting the vehicle number to the park and access to enter the park.
- Adding a payment method.
- Allowing park owners to get the statistics of the park.

References

Balol, L.A. and Byahatti, K.M. (2016). Smart Car Parking Monitoring System with Android Application. Bonfring International Journal of Software Engineering and Soft Computing, 6(Special Issue), pp.160–162. doi:10.9756/bijsesc.8266.

Chowdhury, L.H., Mahmud, Z.N.M.Z., Islam, I.-U., Jahan, I. and Islam, S. (2019). Smart Car Parking Management System. 2019 IEEE International Conference on Robotics, Automation, Artificial-intelligence and Internet-of-Things (RAAICON). [online] doi:10.1109/raaicon48939.2019.49.

Ggyu, G., Gunasekara, A. and Kathriarachchi, R. (2015). A Smart Vehicle Parking Management Solution. [online] Available at: http://ir.kdu.ac.lk/bitstream/handle/345/1048/com-054.pdf?sequence=1&isAllowed=y.

James, A. and Abraham, P. (2018). Smart Car Parking With Reservation System Using QR Generator. IOP Conference Series: Materials Science and Engineering, 396, p.012019. doi:10.1088/1757-899x/396/1/012019.

Jogada, P. and Warad, V. (2016). Effective Car Parking Reservation System Based on Internet of things Technologies. Bonfring International Journal of Software Engineering and Soft Computing, 6(Special Issue), pp.140–142. doi:10.9756/bijsesc.8261.

Omae, M., Shimizu, H. and Fujioka, T. (2004). GPS-based Automatic Driving Control in Local Area with Course of Large Curvature and Parking Space. Vehicle System Dynamics, 42(1-2), pp.59–73. doi:10.1080/00423110412331291544.

Phudinawala, H., Malusare, O. and Mahadik, R. (2022). Vehicle Parking Management System. International Journal of Advanced Research in Science, Communication and Technology, 1(1), pp.556–559. doi:10.48175/ijarsct-2995.

Rahman, A. (2020). Multilevel Automated Car Parking System. Journal of Advanced Research in Dynamical and Control Systems, 12(SP7), pp.1273–1281. doi:10.5373/jardcs/v12sp7/20202227.

Siew, J., Ng, C., Foo, X.C., Cheong, L.E. and Lee, J.J. (2016). ECO QR Car Park System. International Journal of Scientific Engineering and Technology, 6(5), p.176. doi:10.5958/2277-1581.2017.00013.4.

Wang, Z.-X. and Long, L. (2018). Design of Intelligent Reservation Parking Platform System Based on Microcontrollers. DEStech Transactions on Engineering and Technology Research, (ecame). doi:10.12783/dtetr/ecame2017/18373.

Abbreviations and Specific Symbols

- HTML- HyperText Markup Language
- CSS- Cascade Style Sheet
- IDE- Integrated Development Environment
- API- Application Programming Interface
- QR- Quick Response
- GSM- Global System for Mobile Communication
- RFID- Radio-Frequency IDentification
- LCD- Liquid Crystal Display
- SPS – Street Parking System

Acknowledgment

We would like to express our deepest gratitude to the instructors who supported us throughout this research with useful guidance, insightful comments, and encouragement to complete this project. Without their unwavering immense support, this research would have remained merely an idea.

Author Biography

Mast. HMIJ Herath is currently BSc. Computer Engineering undergraduate at the Department of Computer Engineering, Faculty of Computing, in the University of General Sir John Kotelawala Defense University.

Miss. BM Kasthuriarachchi is currently BSc. Computer Science undergraduate at the Department of Computer Science, Faculty of Computing, in the University of General Sir John Kotelawala Defense University.

Miss. PTC Sandamini is currently BSc. Computer Engineering undergraduate at the Department of Computer Engineering, Faculty of Computing, in the University of General Sir John Kotelawala Defense University.

Mast. WCD Rathnasiri is currently BSc. Computer Engineering undergraduate at the Department of Computer Engineering, Faculty of Computing, in the University of General Sir John Kotelawala Defense University.

Mrs. WPJ Pemarathne the supervisor of this project is a Senior Lecturer Grade II of the Faculty of Computing, General Sir John Kotelawala Defense University. She holds a Master of Philosophy in University of Sri Jayewardenepura and Master of Science in Computer and Network Engineering- Sheffield Hallam University (UK) and Bachelor of Science Degree in Information Technology (Computer Systems and Networks) in Sheffield Hallam University (UK) Her main research interests include Applications of Swarm Robotics, Artificial Intelligence and Robotics, Mobile and Wireless Communications, Network Security, Evolutionary Computing, and Internet of Things.