

## **IPS parking system**

**ZENG ZIHANG**

**Faizan Qamar**

*Fakulti Teknologi & Sains Maklumat, Universiti Kebangsaan Malaysia, 43600 UKM  
Bangi,, Selangor Darul Ehsan, Malaysia*

### **Abstract**

With the continuous economic development, car ownership in Malaysia has been steadily increasing. In 2019, the number of cars reached 31.2 million and continued to grow by 1 million annually. By 2021, the number of cars exceeded the population for the first time [1]. The rapid growth in car numbers has resulted in numerous traffic issues such as road congestion, rising accident rates, and a shortage of parking spaces. This research project focuses on addressing parking problems caused by traffic during peak hours. As business districts expand and attract more people, severe traffic congestion becomes increasingly common, leading to difficulties in finding available parking spaces. Insufficient parking facilities are also observed in public institutions like hospitals where inadequate space affects both patients' and staff's needs while impacting overall efficiency levels. Moreover, many drivers contribute to traffic

congestion when searching for parking spots—a problem that troubles countless individuals daily. Constructing or expanding parking lots requires significant resources and manpower investment. Therefore, the goal of developing an Intelligent Parking System (IPS) is to assist drivers in locating available parking spaces effectively while reducing overall pressure on existing facilities—enhancing operational efficiency and saving valuable time for drivers. The IPS parking system was developed based on Vue.js(a JavaScript framework for building user interfaces that is built on standard HTML, CSS, and JavaScript, and provides a declarative, componentized programming model to help developers develop user interfaces efficiently). Develop designs using a structured approach. Help users to obtain and book the parking space information of the target location.

**Keyword:** Assisted parking systems, parking problems, parking information acquisition and reservation.

## Introduction

With the economic growth and the gradual improvement of people's living standards, the number of private cars will also increase. This is also accompanied by many problems, such as traffic congestion, a large number of parking lots will be overloaded, parking will become a troublesome problem, and finding parking will waste a lot of time . At present, the popular parking system in the market has automatic license plate recognition, automatic timing, automatic payment and other

basic functions, which can reduce the queuing pressure and improve the operation efficiency of the parking lot, but it can not meet the current social needs. A practical and reliable parking system will solve this problem effectively.

How to let users quickly find the nearest parking lot to the destination, how to let users quickly find free parking Spaces, speed up the turnover of vehicles in the parking lot, improve the utilization rate of the parking lot and economic benefits. Practicality is the main development direction of this system, but it also limits the diversity of software functions. Users can know in advance the status of the parking lot near the destination, and directly display the free parking space.

Project development using structured method, is a software development activity that defines the necessary software structure to implement the requirements specification. Structured software design follows a data-flow oriented approach, with the goal of establishing the system's software model, architecture, and detailed processing algorithm. This method emphasizes both structural rationality in development and developed software, also known as the new life cycle method which combines structured program design thought with system engineering principles and user-centric top-down analysis and design. Structured analysis is used for demand analysis through top-down layer-by-layer decomposition to establish processing flow while utilizing data flow diagrams and dictionaries to create logical models.

This report consists of three parts: Development Methodology detailing methodology used in project development; Results and Discussion presenting current stage results

along with completed/unfinished content discussion; Conclusion summarizing obtained project results.

## **Methodology**

The structured method is a set of principles and techniques that help designers differentiate design quality at the module level. It takes the system as a series of data flow conversion, the input data is converted to the desired output value, through modularization to complete the top-down implementation of documentation, and as an evaluation standard in the software design plays a guiding role, usually connected with the structured analysis method, to obtain the software module structure based on the data flow chart.

### 1. Software design principles

#### (1) Abstraction

Extract the most basic characteristics and behaviors of things, ignoring non-basic details. Using hierarchical abstraction can control the complexity of software development process, which is conducive to the comprehensibility of software and the management of development process.

#### (2) Information hiding

Information hiding: encapsulation technology is used to hide the implementation details of the program module (process or data), which is inaccessible to other

modules that do not need this information, so that the module interface is as simple as possible.

According to the principle of information hiding, the module in the system should be designed as a "black box", and the external module can only use the information given in the module interface description, such as operation, data type, and so on.

### (3) Modularity

The program is composed of many logically independent modules. A module is a logically independent unit of a program; Module size should be moderate; High cohesion, low coupling.

### (4) Consistency

Consistent concepts should be used throughout the software system (including documentation and programs) in all modules; System specifications and system behavior should be consistent; Achieving consistency requires the support of good software design tools (such as data dictionaries, databases, automatic document generation and consistency checking tools, etc.), design methods, and coding styles.

## 2. Merits and demerits

### Advantages:

The overall idea is clear and the goal is clear.

The stages in the design work are very strong, which is conducive to the overall management and control of the system development.

During system analysis, the existing problems and structural defects in the original system can be diagnosed.

shortcoming:

User requirements are difficult to accurately define during the system analysis phase, resulting in many problems when the system is delivered.

Using the results of each stage of system development to control, can not adapt to the changing requirements of things.

The development cycle of the system is long.

### 3. Model design

#### 3.1 Project Phase Methodology

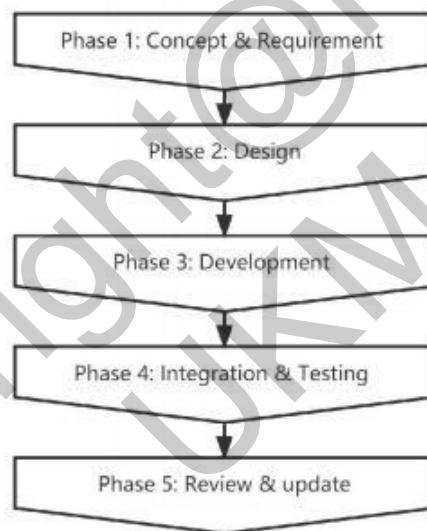


Figure 1. 1. Project Phase Methodology

#### 3.2 Context diagram

Context diagram shows how the system will receive and send information to external entities. Data transfer process among users, systems, and administrators.

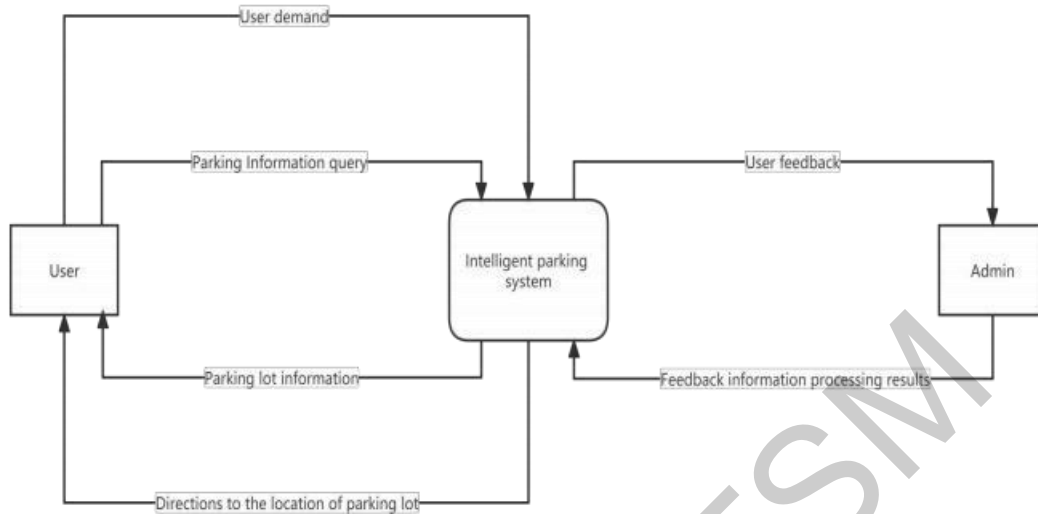


Figure 3.2. Context diagram

### 3.3 Activity Diagrams

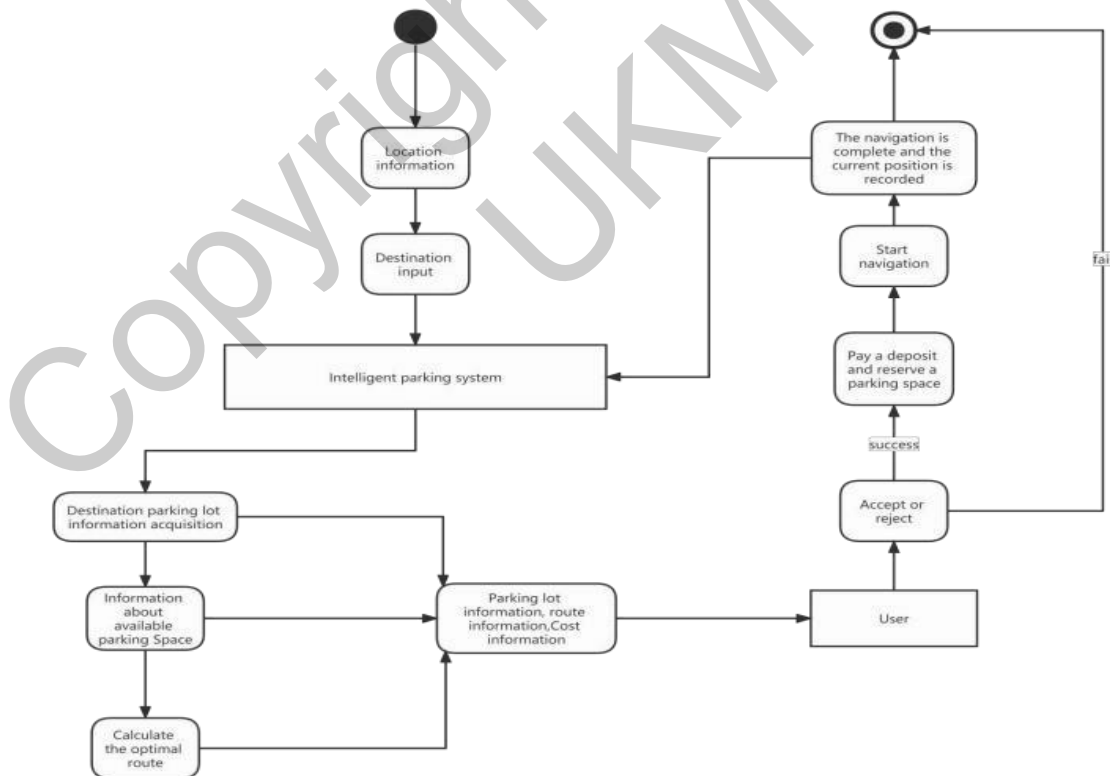


Figure 3.3. Activity Diagrams

### 3.4 Client-Server Mode

In this section, the client-server model (Client-Server Model) and hierarchical model (Hierarchical Model) of the Intelligent parking system will be discussed.

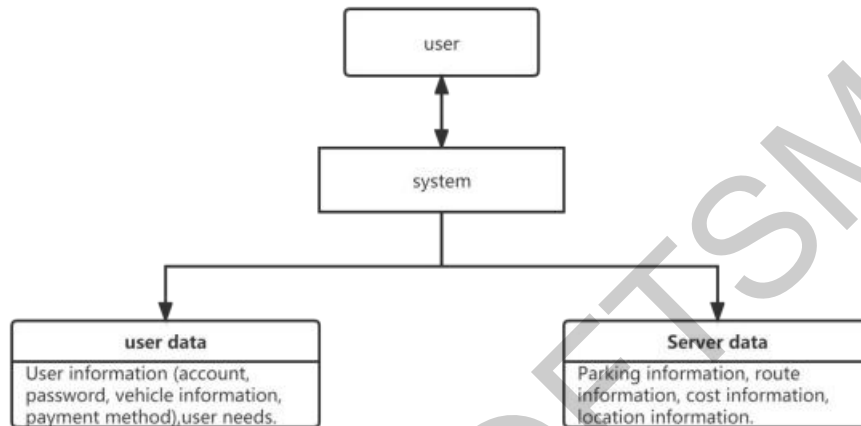


Figure 3.4. Client-Server Model

shows the client-server model, users send information requests from the mobile terminal to the server, and the server transmits the information back to the mobile terminal through feedback. The user logs in his personal account from the mobile terminal. After the server accepts the login, the user can choose to send the demand (destination input). After obtaining the location information, the server searches the target area and feeds the free parking information to the mobile terminal. The server takes the next step (start navigation or end service) based on user requirements.



### 3.5 Hierarchy Model

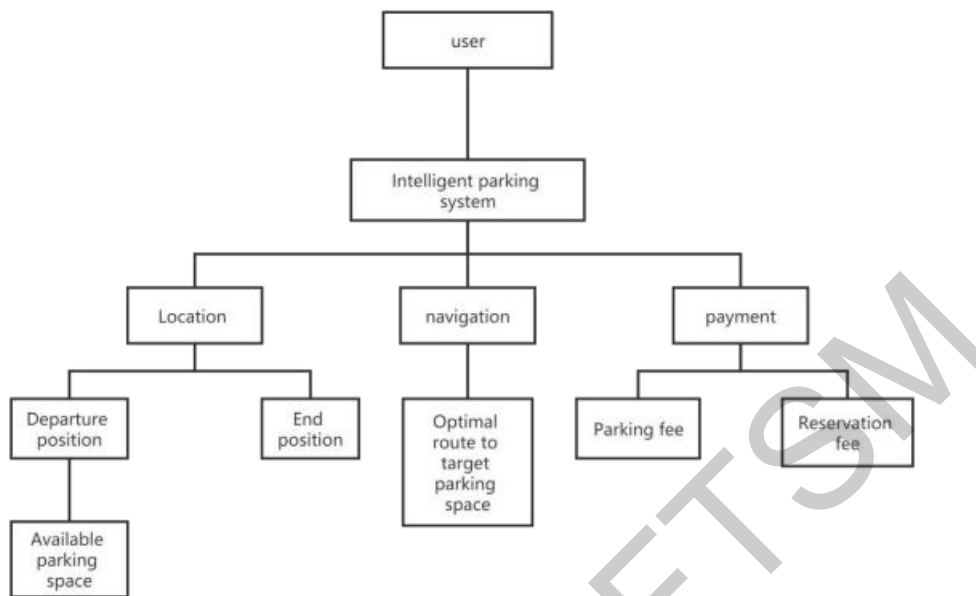


Figure 3.5.Hierarchy Model

shows the hierarchical model of an intelligent parking system. It mainly includes three main modules.

Location module: Obtain the user's location information, free parking information, and the vehicle's parking position at the end of the service.

Navigation module: The optimal route guide from the user's starting position to the parking space.

Payment mode module: Users can pay parking fees and reservation fees by binding payment mode.

## 3.6 Flowchart

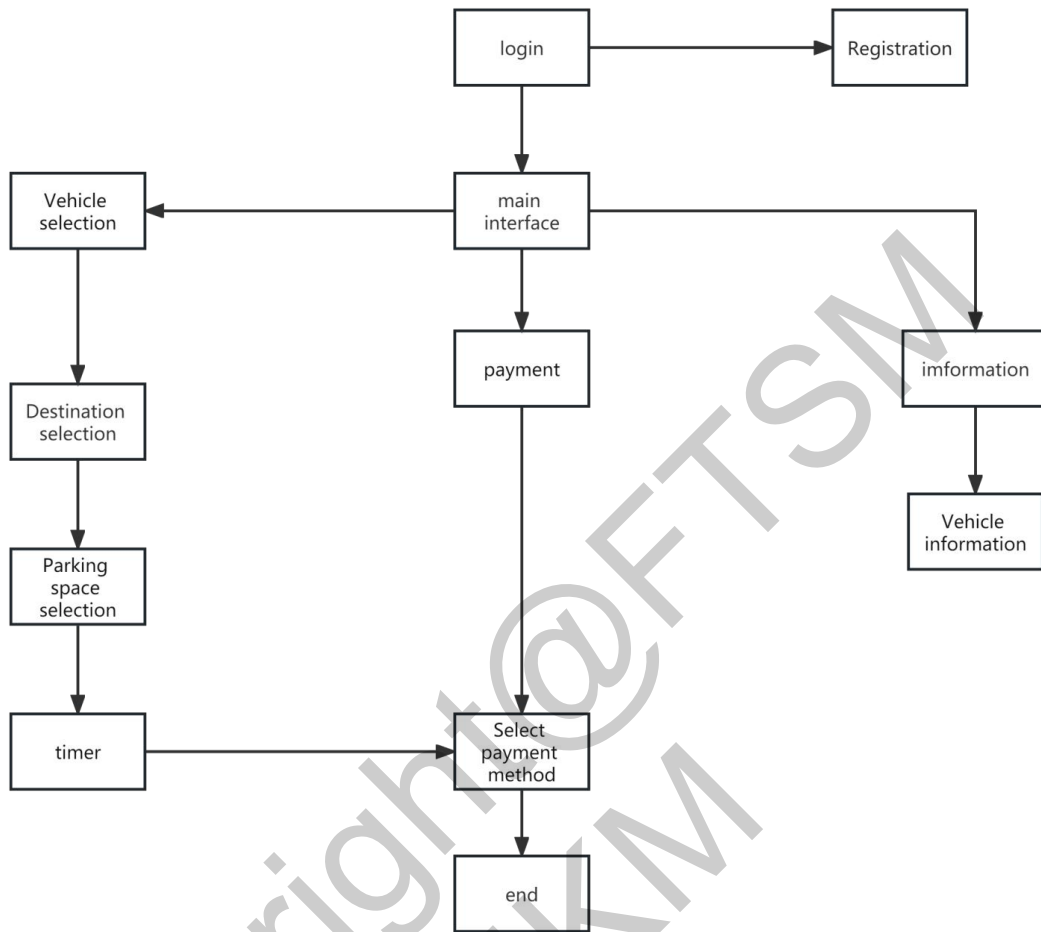


Figure 3.6. System Flowchart

## Results and discussion

### 1. Results

#### 1.1 Database

Ali Cloud database is used in the current project development. The advantage is easy to develop, with a certain stability, the disadvantage is that it can not bear a large number of users at the same time.

#### 1.2 User interface

UI style: The page is simple, the function is clear.

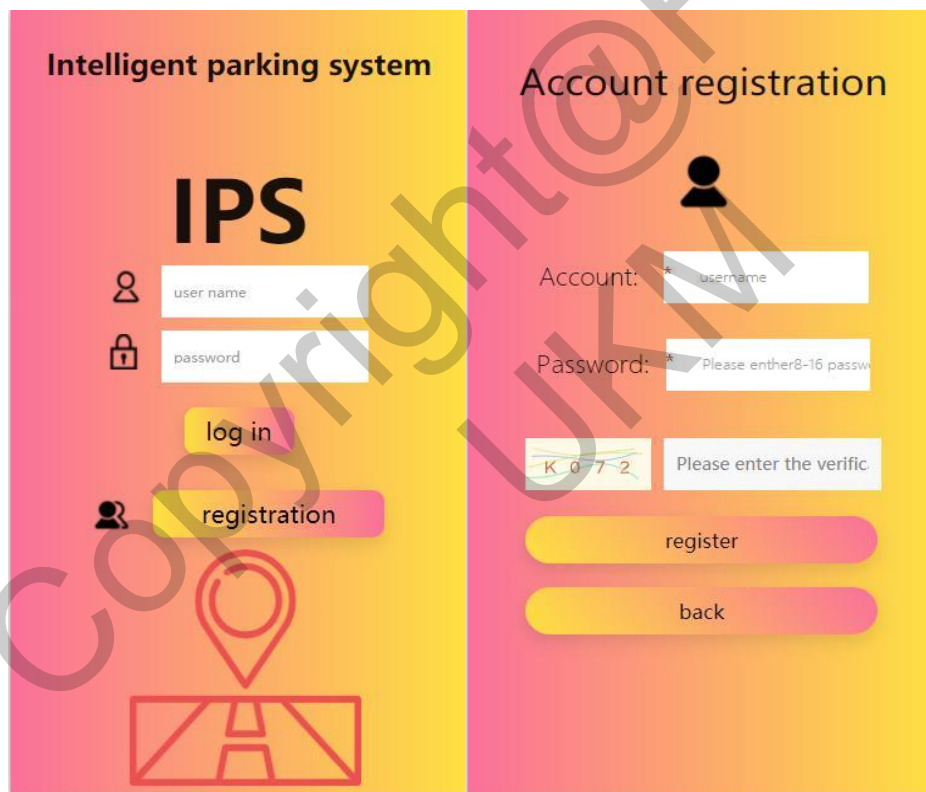


Figure 1.2.1 login page and Register page

In the design stage, the registration page was bound by the mobile phone number, but in the actual development process, I found that I could not obtain the permission of

the local operator, so I deleted the mobile phone number binding module and added the random verification code module.

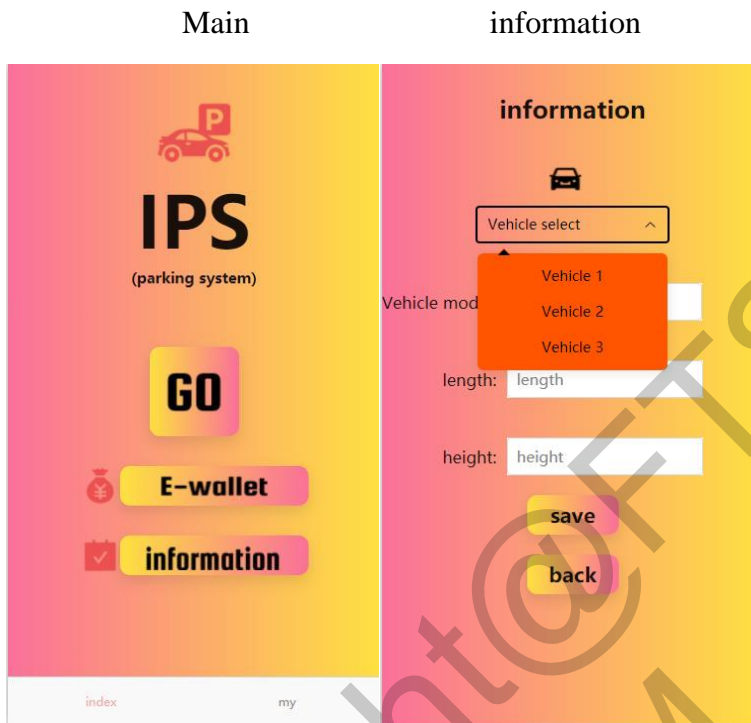
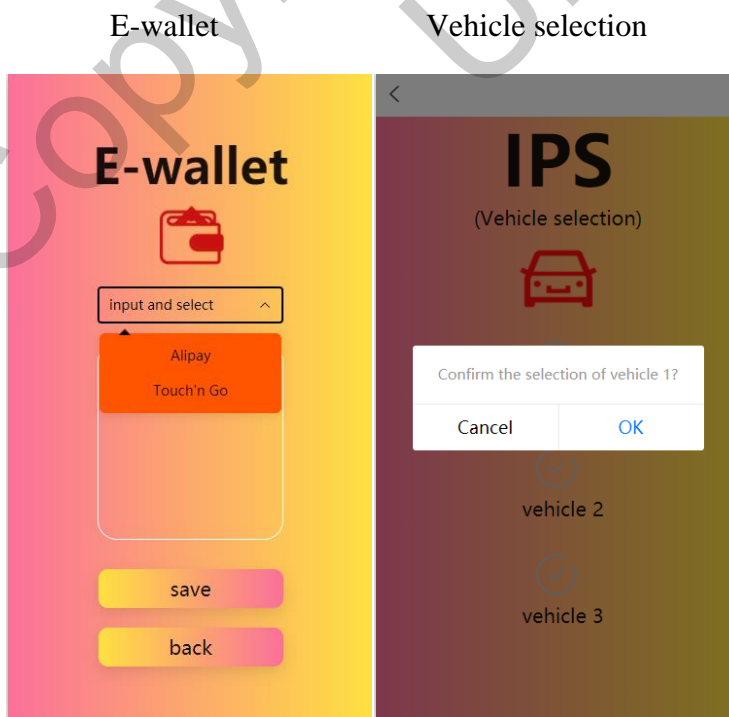


Figure 1.2.2 Main interface

Figure 1.2.3 information interface



E-wallet

Vehicle selection

Figure 1.2.4 E-wallet

Figure 1.2.5 Vehicle selection

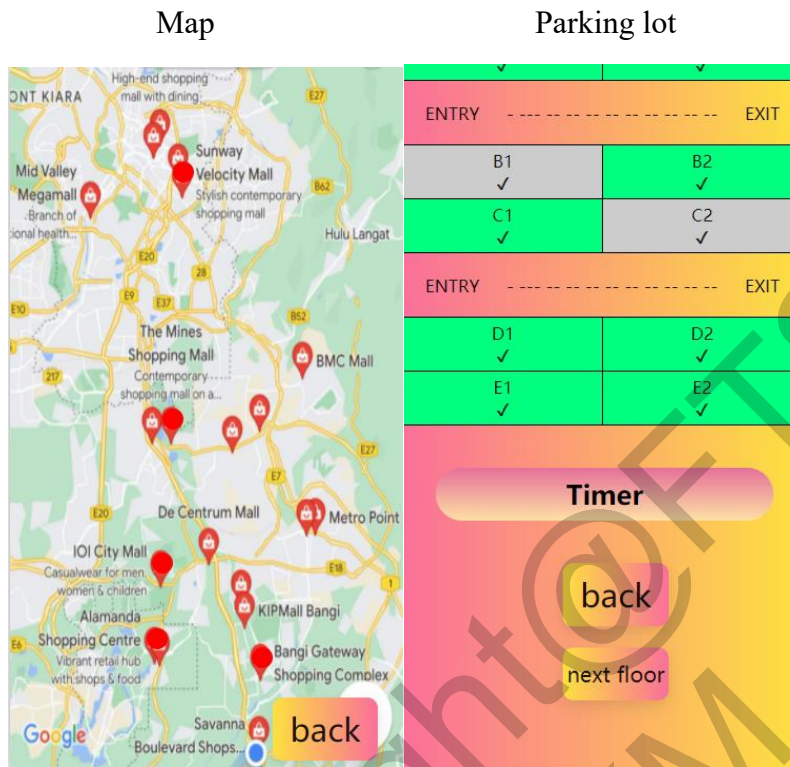


Figure 1.2.6 Map

Figure 1.2.7 Parking lot



Figure 1.2.7 timer and pay

## 2. Discuss

Personally, the current development of the project is still a long way from the expected results. I will briefly elaborate on the following points:

### 1. User interface

I am satisfied with the overall design of the user interface, the hopping logic between pages is reasonable and practical, and the layout of buttons is also easy to operate.

However, I think the content of some pages needs to be further enriched, and the style is too monotonous.

### 2. Map

The design phase was intended to embed Google Maps apis for destination selection, but the actual development process found that the Google developer platform required a set of qualifications (which I currently do not have). Destination information cannot be tied to the parking lot.

### 3. Parking Lot

After the visit, no parking lot is willing to give me the real parking space information at present, which makes the project once entered the stage of stagnation. In the subsequent development process, we will continue to try to communicate with some parking lots, try to build a new database, and make the software have certain practicability.

## Conclusion

1. This technical report introduces the development of IPS parking system. We have practiced the following goals and achievements in the current development stage:

### 1.1 Software architecture

The overall operation of the software has been tested, and the performance of most models on the market has been tested by the test platform.

### 1.2 Series interfaces

The jump between each interface conforms to the expected design and meets certain practicability.

### 1.3 Functionality

Although the functionality at this stage has not reached the expected design standards, the operation mode has met the demand for the design concept, and the parking space is selected by directly selecting the destination. This will solve the problem of drivers trapped in finding parking Spaces and avoid the appearance of redundant vehicles in the parking lot. The timing and payment modules are also designed to improve the throughput efficiency of the parking lot.

## 2. Goal

The map and parking modules at this stage do not meet the requirements of the design stage. At this stage, I have completed the coding of Google API embedding, but I

have not yet obtained the qualification of Google Developer platform. The acquisition of parking lot data is difficult, and it is also necessary to communicate with relevant departments.

### 3. Influence

The research direction of this project is to solve the parking problem, and the practicability of the project is visible. Allow users to book the target parking space before departure, effectively avoiding the problem of finding parking Spaces, and to a certain extent, it can also alleviate the congestion problem.

### 4. Shortcomings and suggestions

The project development did not meet the expected standards. Judging from the result, it reflects my immaturity in the project design stage, and the choice of development model is not wise. However, this development process has also allowed me to gain a lot of experience, and I hope I can effectively avoid these problems in the future development process:

Choose the development model reasonably, conceive important modules in advance, design alternatives, enrich personal programming ability, and improve development efficiency.

The actual development process and the design stage are not consistent, and too much pursuit of design will greatly improve the difficulty of implementation.



## Appreciation

I would like to thank my Supervisor Dr. FAIZAN QAMAR for his guidance and advice in the process of project development and the college for educating me on my professional skills.

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ZENG ZIHANG(A172812)  
Fakulti Teknologi & Sains Maklumat,  
Universiti Kebangsaan Malaysia

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