AITCS

Application of Iot Features in Parking System

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Abstract: Parking is an important aspect of determining the scale of functionalities of building in modern days. The parking facilities during modern days are implementing modern appliances technology such as the usage of Internet of Things (IOT) techniques to its usability. IOT techniques are implemented throughout the usage of electronic sensors that detects the physical substances to be sent to the process section of the model. There were problems that exists in the current system that are been implemented by the OrangeBeam SDN BHD. The problems that is currently exists is the guards are required to routinely checks the parking spaces to determine availability of the parking spaces. Next, the parking cannot determine the exact amount of time used by a vehicle in the parking spaces. The objectives of this project are to design an IOT parking model for by using structured approach. Next, to develop a functioning IOT parking model. Lastly, to evaluate the developed IOT parking model. The methodology that been used during this project is Prototyping Model. This model was implemented during the prototype creation and subsequently gathered feedback from user to check if the developed product is good enough. This model allows the product to be developed with customer's requirements and concerns. The project is expecting a functioning IOT model that will be paired with an application connected to it specifically. This project will hopefully able to influenced the public to use the IOT technologies to it fullest potential in order to improve each aspect our live exponentially.

Keywords: Parking Management System, Internet of Things (IOT) system

1. Introduction

Parking is an important issue that effect on strategic level planning and play major role in management of transportation in dense urban area [1]. The parking facilities had been extensively developed as technology advances. The parking system had applied many technologies inside it to further enhance its operational abilities. The step now is to implement an IOT concept to the parking in order for it to be functioning properly. The intended target for this project is OrangeBeam Construction sdn bhd. The importance of the parking system is to prevent the increase of shortage of parking spaces in a building [2].

The company had built a parking lot with operates solely on security guards and surveillance camera. The parking will be monitored by the guards that are assigned. The flow of usual parking that had been implement in the parking inside OrangeBeam Construction had its good and its bad. The parking will be monitored by the guards in order to known its availability of parking spaces inside the building. This required the guards to check it first in order to make sure if there is any available parking lot. The visiting clients are required to wait in order for the guards to confirm if there were any available parking spaces for the next clients to park their car.

There are few existing problems that allow this project to be proposed. The problems will stand as the main purposes of the project to be developed. The first problem that were available in this existing parking system is that the availability of a parking spaces is known only when a guard or security officer routinely checks the parking availability. The second problem is that the existing system cannot determine the exact amount of time for the parking spaces been used. Next is, the existing parking system can be monitored only by the guards to routinely patrolling around the parking in order to confirms the availability of parking space.

This report will provide the documentation of the project. The Report will consist of chapters which had been categorized properly. The report starts with introduction of the project. The report will be continued with literature review of the project. Next is the Methodology that will be used in the project. Then, the report continues analysis and design of the project. This report next will describe the implementation and testing of the project should. Lastly, the report will end with conclusion of project for the report.

2.   Literature Review

This part will discuss on the literature review of the project that had been done. The literature review will serve as the explanation to target of the project. This chapter will include the case study of the project, technology approach that will be used during the project development. Next, this chapter also will provide a comparison with existing application and system.

2.1   Parking System

A parking system is defined as a system that are specifically designed to maintains the parking spaces. The system is being used as facilities in most of the building in this times. A parking system hold many significances such as being able to safely place a vehicle under a supervised area and a good parking system can own lot of parking spaces and own an orderly car movement path [3]. The parking system that been used in current system are a traditional one where there is no proper detection module to allow the availability of parking spaces are not known.

2.2   Android Application

Android is a mobile operating system developed by Google. It is based on a modified version of Linux kernel and others open source software. Android is primarily designed for mobile devices that had implement touch screen usability such as smartphones and tablets [4].

Android technology provides features such as interface, application and memory management. These features allow the application can be build for the project as it provides it main functionalities through graphical user interface (GUI) for command input and informational display [5]. The GUI will be implemented in this application that will allows easier movement and control throughout using the application.

Android technology is used in this project to allows the development of application to finished. By using Android, the application will be able to be build for mobile phone usage as it will allow the user for this application to be able to use it. By having an application that will be paired to the IOT model that will be developed, it will allow the user to have an easier access to the capabilities through

application compared to using a web based system [6]. Having an application built by using Android technology, the users will be able to access this application from anyplacess.

2.3   Comparison of the Existing Systems

The developed project is compared with few existing systems that are involved on the same operational concept. The comparison was made to determine the features that were available in each application. Table 1 shows the comparison.

Table 1: Comparison of features in each application

Application\Features	Detection Module	Display module	Reservation Module	Payment Module
Kota Bharu Pacific Mall Parking System	Available	Available	Unavailable	Available (Through payment machine)
Park Mobile application	Available	Available	Available	Available
SMART Selangor Parking	Unavailable	Unavailable	Unavailable	Available
OrangeBeam Parking System	Available	Available	Unavailable	Unavailable

Based on the Table 1, the proposed system will be able to possess a Detection Module and a Display Module. The two modules will be important for the feature of the developed project application as it will help in the functionalities of the application. In the four system that are been compared, all of the systemswere not integrated to an application that allows remote viewing of the parking spaces which will make any visiting person to know any available parking spaces easier. The comparison allows the specific module for the developed project to be selected in order for it to be able functioning properly.

3   System Methodology

The prototyping model is the process contained in the System Development Method (SDM) in which the prototype is built, tested and reworked until an acceptable prototype is created. There are many types of Prototyping Models that can be used during development. The chosen model is the Prototyping Throwaway Model. The Throwaway Prototyping Model was implemented during the prototype creation and subsequently gathered feedback from users to check if they were good enough [7]. This model was chosen because the nature of the system to be developed is vague and unclear. This model will allow the system to be developed with the customer's concern and hope to meet the customer's requirements. Figure 1 shows the Throwaway prototype diagram.
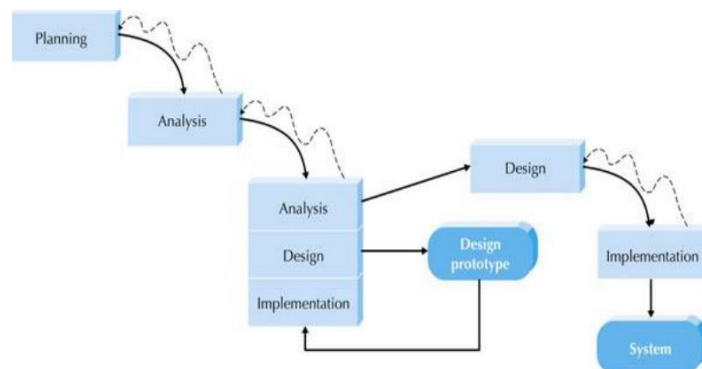
Figure 1: Throwaway Prototyping Model Pathway

3.1   Workflow of System Development

The project development is divided into five phases that are dependable to each other. The first phases of this project is Planning where the development is being planned. The next phase is Analysis phase where in this phases information regarding the project were collected to be analyzed. Next, in Design Phase the design of the project will be designed according to the requirements. Then, in Implementation phases, the coding process will be implemented for each of the process that will be available in the final product. Lastly, Design Prototype phase is where the prototype will be designed and developed at this phase. Table 2 shows the phase in Prototyping model

Table 2: Phases of selected model

| Phase	Task	Output
Planning	• Determine project scope • Produce proposal • submit proposal	• Project Proposal
Analysis	• Conduct an Interview • Made an Observation • Analyse the obtained information	• System Requirements • DFD • ERD
Design	• Develop functional requirements • Design Database • Design User Interface	• Functional requirements • Database design • User Interface design
Implementation	• Develop Code • Develop Database • Develop User Interface	• Project code • Database • User Interface
Design Prototype	• Finish the development • Detects faults in Prototype • Improve Prototype	• Prototype

4   System Analysis

This chapter explain on the analysis of the developed project. This chapter consists of four subchapters that explains on the system design, Data Flow Diagram, Entity Relationship Diagram and design interface of the developed project.

4.1   System Design

The developed project has a flowchart which are different for each user type. The project which consists two users, that are Visitor and Officer. Both of the users will have different usage of flow in the application. Figure 2 and Figure 3 shows the flowchart for both Visitor and Officer.

4.2   Data Flow Diagram

This subchapter will discuss on the contents of Context Diagram, Data Flow Diagram 0 and Data Flow Diagram 1. This chapter also explains on the processes that were available and the data flow for each of the available process.
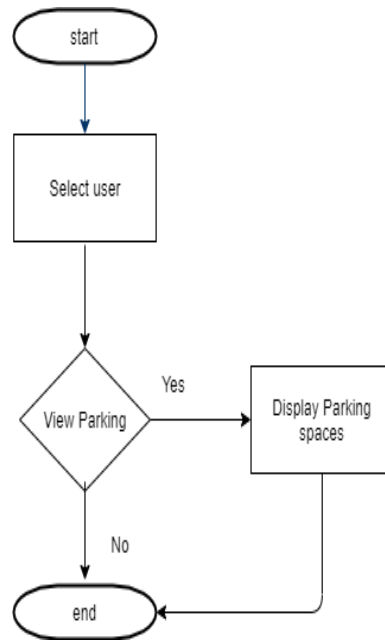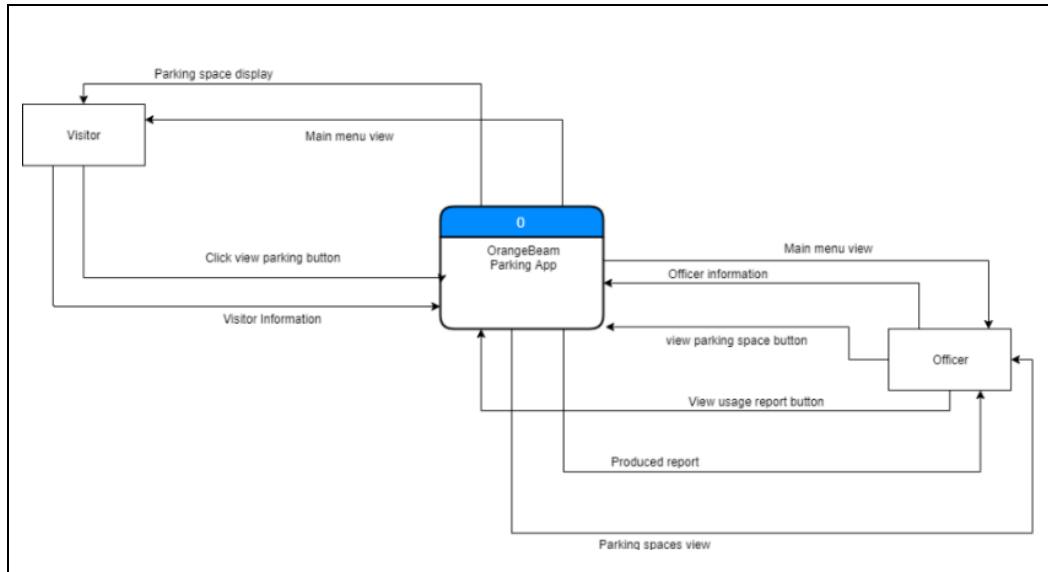
Figure 2: Flowchart for Visitor
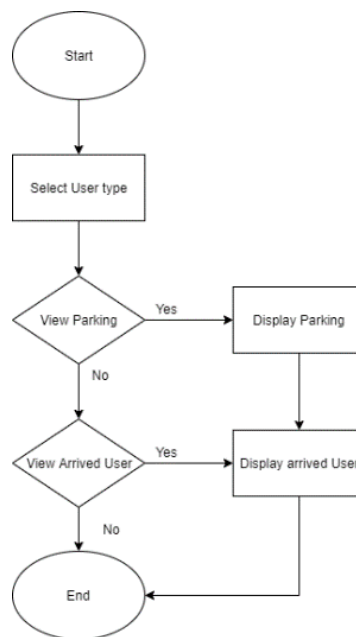
Figure 3: Flowchart for officer

4.2.1 Context Diagram

The context diagram of the application will show the flow of data from both users which are Visitor and Officer. Figure 4 shows the context diagram of OrangeBeam Parking App

Figure 4: Context diagram

4.2.2   Data Flow Diagram level 0

The data flow of the user of the OrangeBeam Parking App will be directed into each of the process that were available in the application. The process will be using the data inserted by the users. Figure 5 shows the Level 0 of the developed application
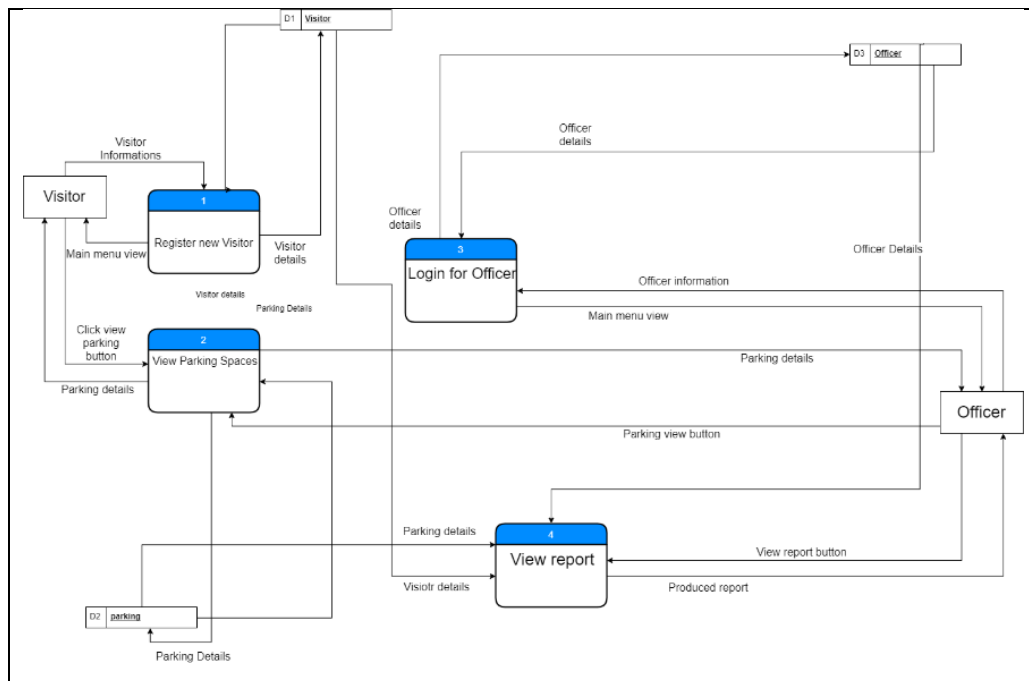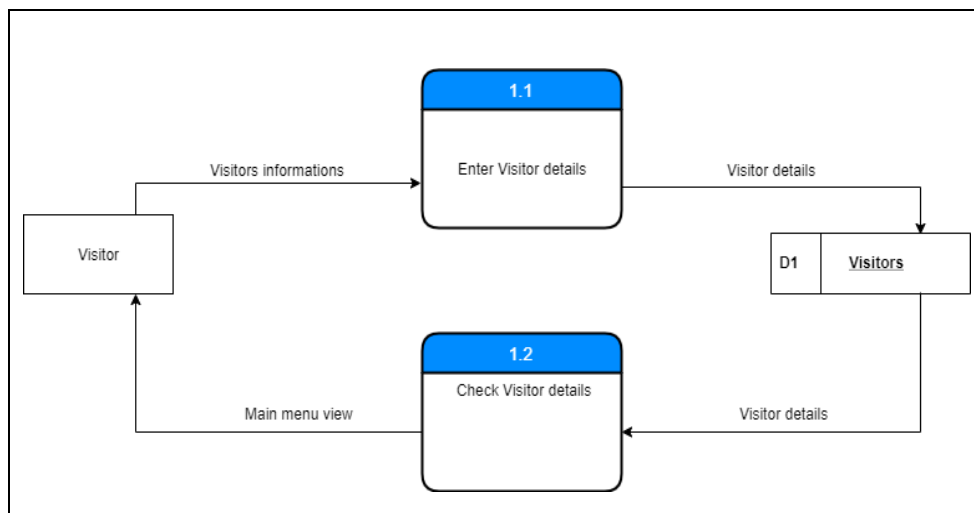

Figure 5: Data flow diagram level 0

4.2.3   Data Flow Diagram Level 1

Each of the process inside figure 5 will be explored deeper with Data Flow Diagram level 1. Data Flow Diagram Level 1 will explain more on each process. Each of the processes that were available

inside the application will be explained more as all of the process had more minor process inside them that will allow the main process to be functioning.

In Figure 6 shows the data flow in Register New Visitor process. The visitor is required to enter visitor's information for the first process inside Register New Visitor process. The application will store new visitor details inside Visitor data store. The entered details will be passed through Check Visitor Details process to confirm to its validity and will allow main menu access to the Visitor if the entered details are valid.

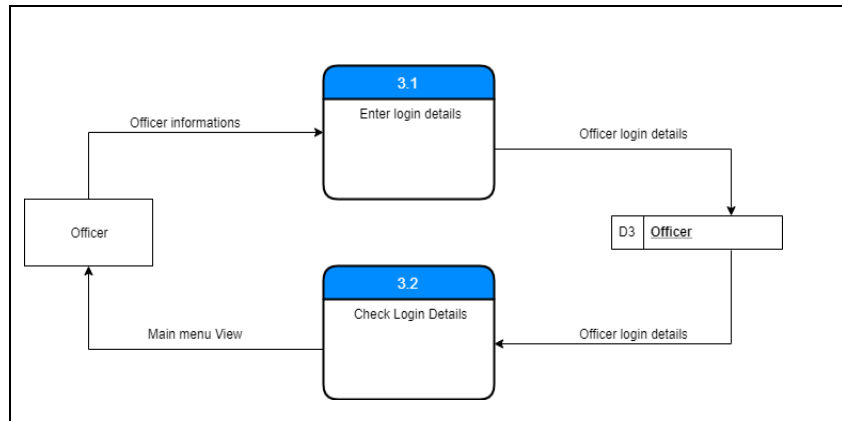**Figure 6: Level 1 data flow diagram of register new visitor**

Next, figure 7 shows the process for the View Parking Spaces process. The process will be involving both user which are Visitor and Officer. Both of the user will required to click view parking button. Then, the application will request for parking view from the Parking datastore. Next, Parking Datastore will send to the next process in order to display the parking spaces. This process should display the parking spaces to both users.
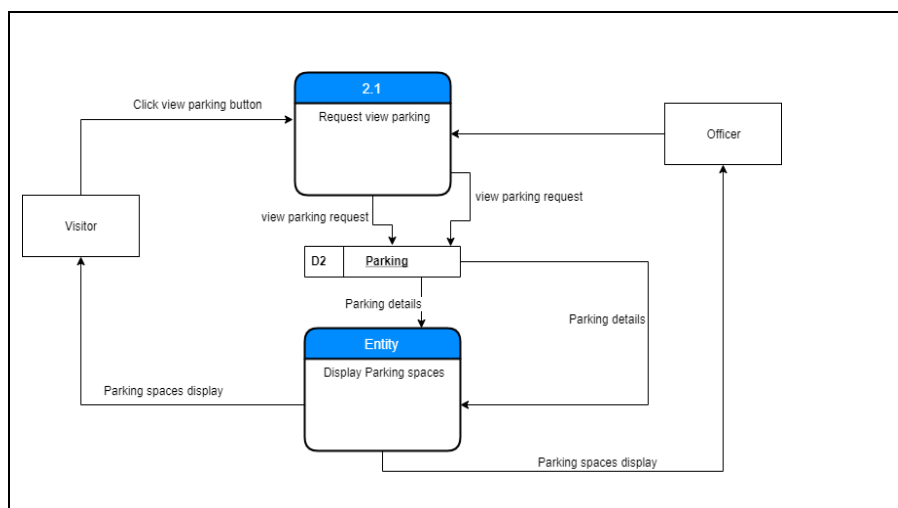
Figure 7: Level 1 data flow diagram of view parking spaces

In Figure 8, the figure shows the processes involves in Login for Officer Process. The user in this process is the Officer is required to enter the information for login. The entered login details next will be sent to data store Officer where it will be stored. Next, the details will be passed through for

Check process where the details will be checked its validity. If the details are valid, the application will display main menu view to Officer.

Figure 8: Level 1 data flow diagram of login for officer

Next, in Figure 9 the process for View Usage Report were explained further for the process inside the main process. The process will start if the Officer click View Usage Report button where it will initiate the first process to request data store to send the details to next process which will display the details from three data stores that were available which are Visitor, Parking and Officer. Next, the application will display the details to the Officer as a usage report on the parking spaces.
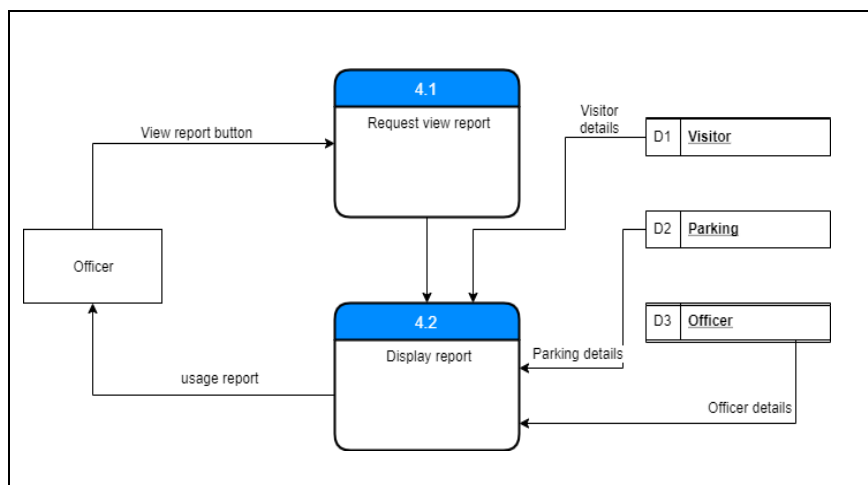

Figure 9: Level 1 data flow diagram of view usage report

4.3   Entity Relationship Diagram

The uses of Entity Relationship Diagram in the project were intended for data storage for the application. This allows the developed application the ability to possess data storage to its functionalities. This will allow more useful data that were stored to be called upon in any processes. Figure 10 shows the ERD model for the developed project.
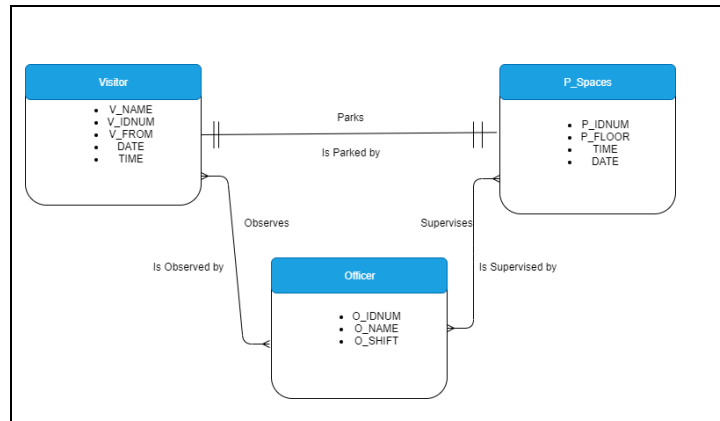
**Figure 10: Entity relationship diagram**

4.4   Interface Design

The developed application will provide a GUI (Graphical User Interface) for the user to easily navigate the application. Different design of interface for different application are important to maintains its usability to each of the application [8].The interface will allows the user to enter command to the application more easily. Figure 11 shows the Application first screen for both users.
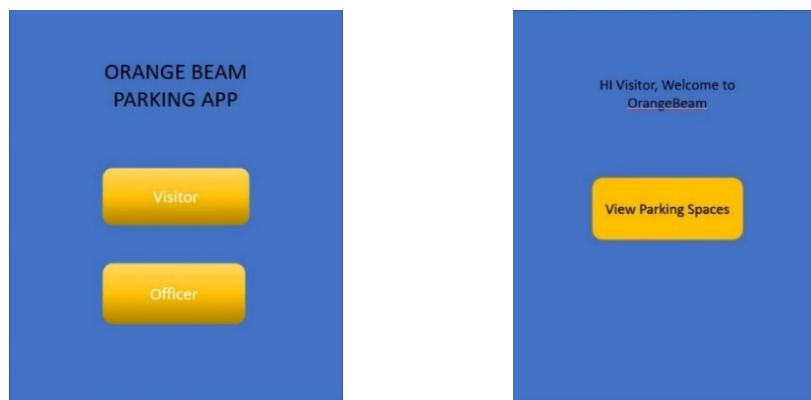

Figure 11: Application first and visitor main menu screen

Next, figure 12 shows the main menu for visitor main menu where there selection of commands can be made in this section of menu. From this menu, visitor can select two features that were availables. Figure 13 display the first feature where the visitor can view the parking spaces that were available to be selected
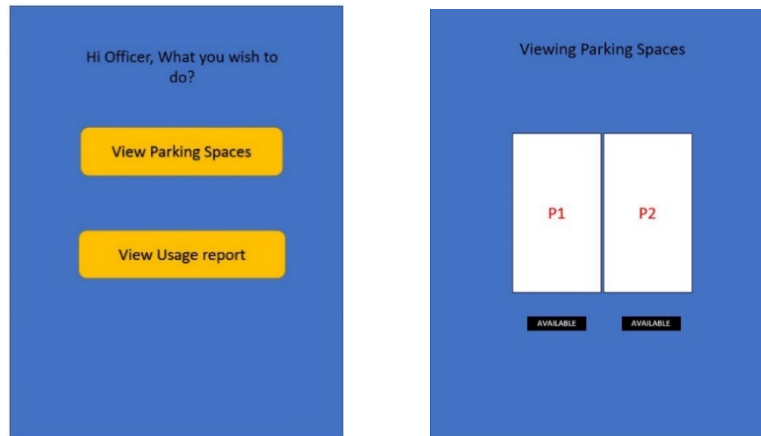
Figure 12: View parking and main menu for officer

Then, the application also has different user inter face for officers' usage. The interface can be entered by the officer only where various features can be accessed in this mode. Figure 11 displays the main menu for officer's interface. In Figure 12, it shows the view of parking spaces from the Officer point of view. Then, Figure 13 shows the usage reports that can be view by the Officer.
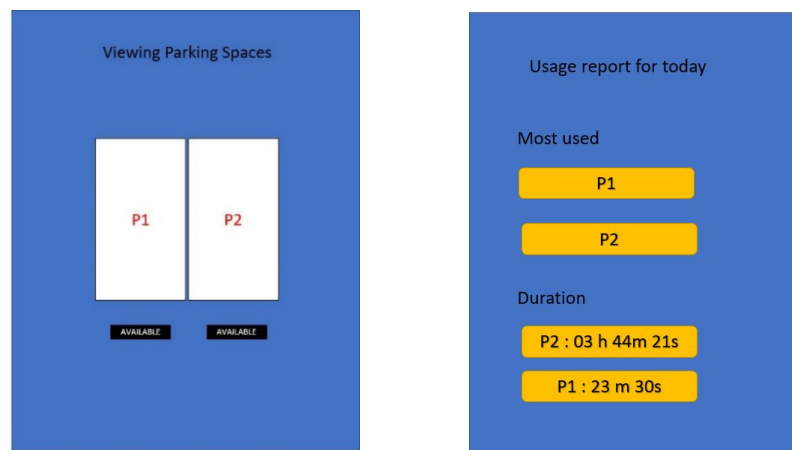
Figure 13: View parking and usage reports

## 5   Implementation and Testing

The development of the application that will be used to display the data that been collected from the IOT model will be developed by using a suitable programming language. The development phase of the application will be producing an application that will be connected to the IOT model that had been built before. In this chapter, there will be testing to be made in order to test the functionalities of the project.

5.1   Application Development

The development for the application that will acts the display point for the data that were collected from the Thingspeak will be explained. The development for the application will covered from the model of IOT instruments, the connectivity of the model to Thingspeak database and the application.

5.1.1   System Prototype

The prototype system of the project willconsist of 2 type of Arduino components that will be used. The Arduino components will be the main data collector that will allows the system to be functioning properly. Figure 14 shows the schematic diagram for the system.
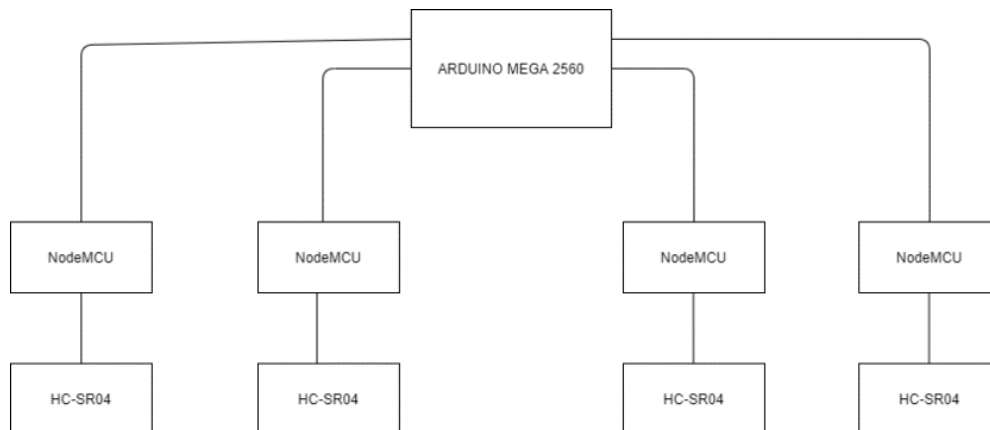

Figure 14: Schematic diagram for the IOT model

The two type of components that been used during the project are consists of two type which are Microcontrollers and Sensors. The Microcontroller that been used in the project are Arduino NodeMCU ESP8266 Wifi Module and Arduino MEGA 2560. The microcontroller will be functioning as where the data will be processed and sent to databases. The database been used in the project is Thingspeak. The data will be collected through sensor that been used in the project. The sensors areconsists of only Ultrasonic Sensor type HC-SR04. The amount of sensors that been used in this project are 5, 2 of them will be used to determine if the parking space are available or not. While the other 3 will be used to detect any vehicles that been parked are parked correctly or not. The Programming language that been used to coded for the project is C programming language had been finished. Below is the diagram of the circuit.

5.1.2   Menu Module

The menu module is the first page that the users will saw at the start of the application. The application at initial will provide the display of user interface to allow the selection for the type user access.
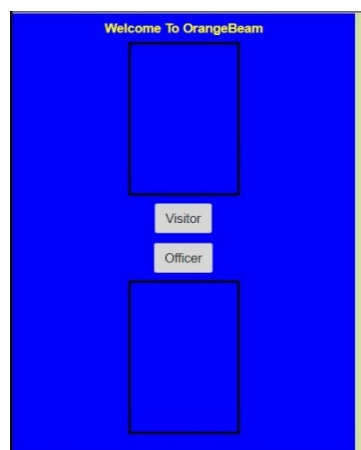

Figure 15: User access selection interface

The operation for the page can be seen in Figure 16 shows the operation is being done through the logic blocks.
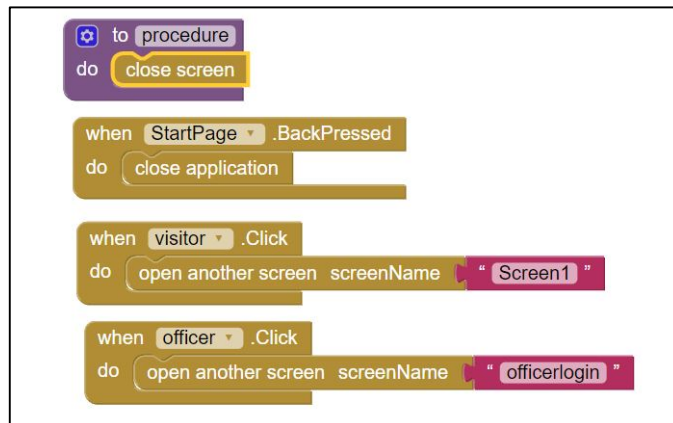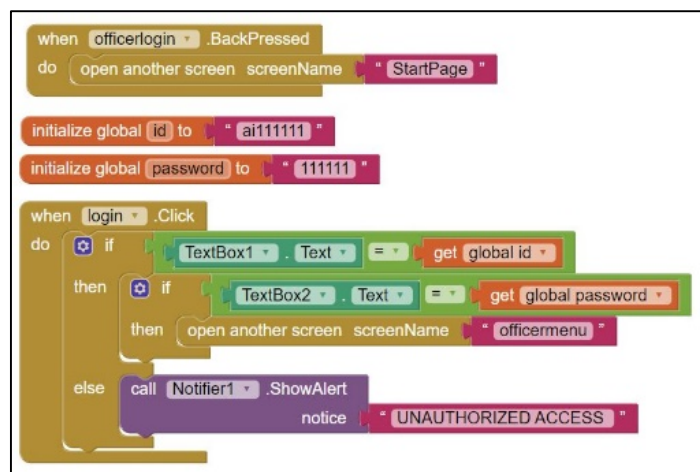

Figure 16: Design blocks for user selection page

After that, if the user chooses to enter as an Officer, the page will be directed to Login Officer page. This page required the user to enter the password in order to gain access. Figure 17 shows the interface for the page.
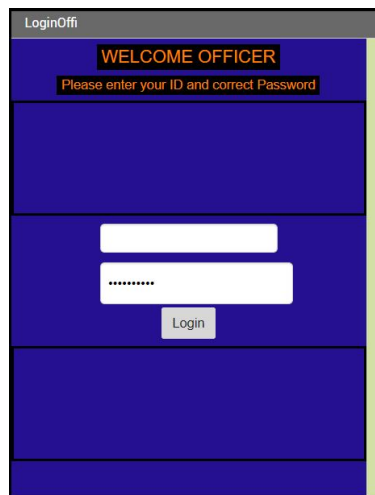
Figure 17: Officer login page

Figure 18: Operational block for officer login page

The Visitor will be viewing View parking space page after clicking the visitor user access button Parking view page. Figure 19 shows the View parking space page.
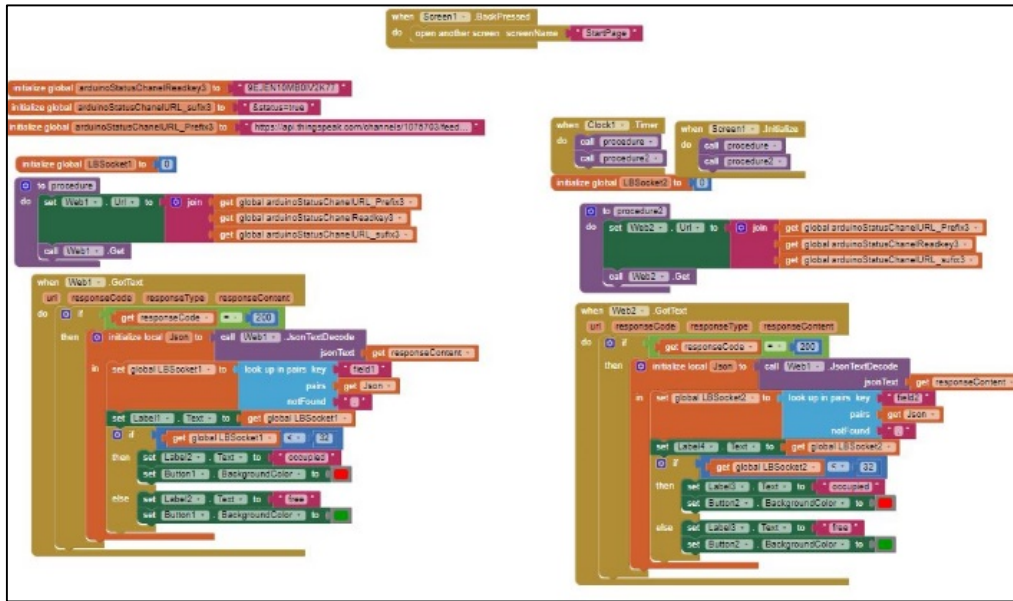

Figure 19: View parking space page operational block

Then, If the user entered as Officer, the user will be directed to the Officer menu. In the menu page, the Officer will be provided with user interface to access to other two pages. Figure 20 shows the interface for Officer Menu page while Figure 21 shows the operational block that functioning in Officer Menu page.
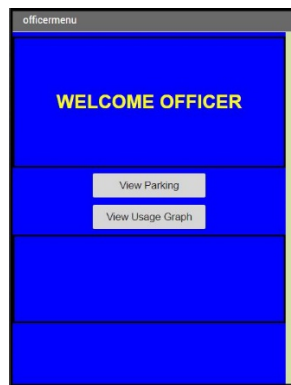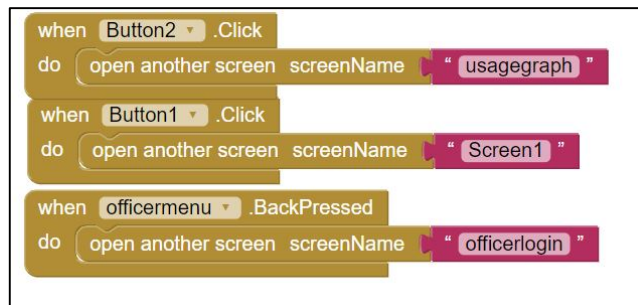

Figure 20: Officer menu page

Figure 21: Operational blocks for officer menu page

5.2.3   Detection Module

As for the detection Module, the operation for detection will first be started by the sensors which are HC-SR04. The sensors will detect the distance between the object and the sensor and then sent the value to Thingspeak. Figure 22 shows the coding segment for sensors HC-SR04.

```
const int trigger = D1;
const int echo = D2;
long T;
float distanceCM;

void setup()
{
  Serial.begin(115200);
pinMode(trigger, OUTPUT);
pinMode(echo, INPUT);
}

void loop()
{

digitalWrite(trigger, LOW);
delay(1);
digitalWrite(trigger, HIGH);
delayMicroseconds(10);
digitalWrite(trigger, LOW);
T = pulseIn(echo, HIGH);
distanceCM = T * 0.034;
distanceCM = distanceCM / 2;
Serial.print("Distance in cm: ");
Serial.println(distanceCM);
delay(1000);
}
```

Figure 22: Shows the code for sensor HC-SR04

5.2.4   Information Display Module

In order for the Application to be able to display the data that collected by the sensor, the IOT model first need to send the collected data to the Thingspeak. Figure 23 shows the coding segments to allows the IOT-Thingspeak connectivity.

```
#include "ThingSpeak.h"
#include <ESP8266WiFi.h>

char ssid[] = "xxxxxx"; //SSID
char pass[] = "xxxxxx"; // Password

WiFiClient  client;

unsigned long myChannelField = 1075703; // Channel ID
const int ChannelField = 1; // Which channel to write data
const char * myWriteAPIKey = "UGI2N8GEPVUXOY8P"; // Your write API Key

void setup()
{
  Serial.begin(115200);
  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client);
}

void loop()
{
  if (WiFi.status() != WL_CONNECTED)
  {
    Serial.print("Attempting to connect to SSID: ");
    Serial.println(ssid);
    while (WiFi.status() != WL_CONNECTED)
    {
      WiFi.begin(ssid, pass);
      Serial.print(".");
      delay(5000);
    }
    Serial.println("\nConnected.");
  }
  ThingSpeak.writeField(myChannelField, ChannelField, distanceCM, myWriteAPIKey);
  delay(1000);
}
```

Figure 23: Code for IOT-Thingspeak connectivity

After the data sent to Thingspeak, The data will be called by the application to allow it to be displayed. Figure 24 shows the Parking Display page while Figure 25 shows the Operational Blocks for operating Parking Display Page.
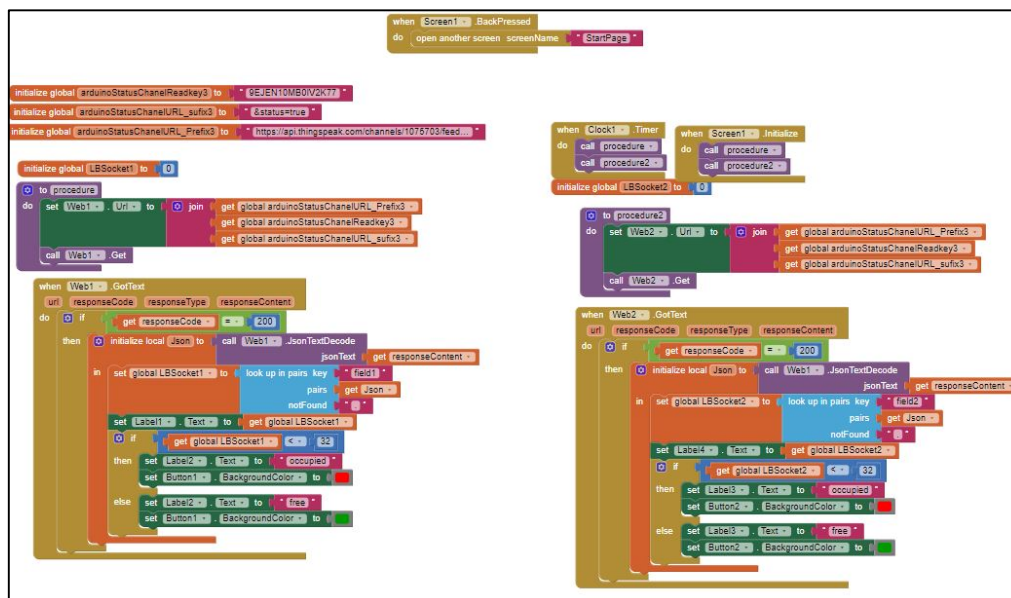
Figure 24: Parking display page

Figure 25: Operational blocks for parking display page.

5.2.5 Usage Graph Module

The final module allows the officer of OrangeBeam to view the input data that were collected in the thingspeak. Figure 26 shows the interface for the module.
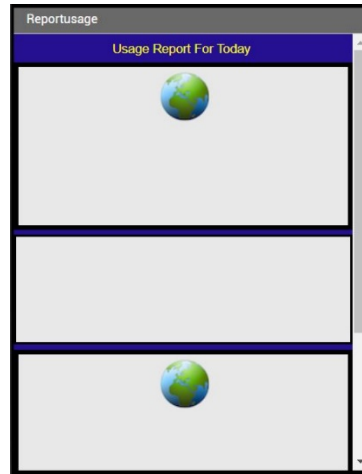
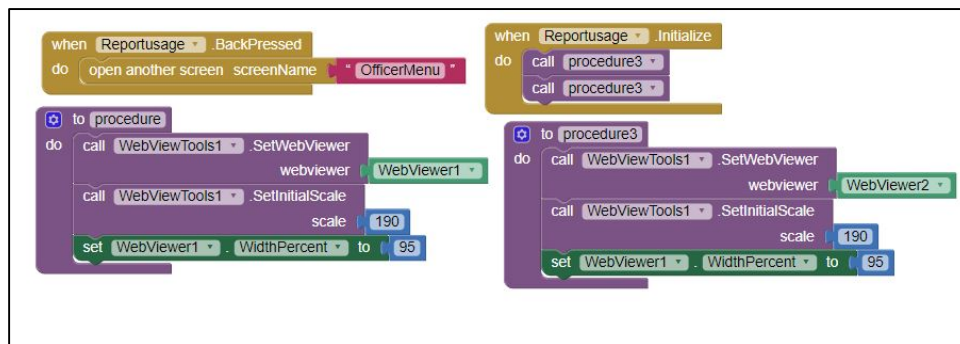**Figure 26: Interface for the usage report module**

Figure 27: Operational blocks for the usage report module

5.3 Application Testing

For the project, the system is required to be test after finishing it. At the current times, the project was only required to test for its Functional Testing for each of the module. The modules were tested in order to check its functionalities

5.3.1 Functional Testing for Information Display Module

Functional testing is required in order to check in order to ensure the functionalities of the application were able to be functioning properly as expected or not. For this module, the module expected to be able to show information gathered from the IOT model and retrieved from Thingspeak. Table 3 shows the result of the testing

Table 3: Result of the testing for Information Display Module

Module	Simulation	Expected Outcome	Real Outcome	Comments
Information Display Module	Click View Parking Button	Display view parking page	Display view parking page	None

5.3.2 Functional Testing for Detection Module

For this functional testing, Detection module were tested to determined if the module were able to detect the object that will representing the vehicle in real life situation. Table 4 shows the outcome of the testing.

Table 4: Results of detection module testing

Module	Simulation	Expected Outcome	Real Outcome	Comments
Detection Module	View parking space page	The page should be able to show the detection process works	The page should be able to show the detection process works	None

5.3.3 Functional Testing for Usage Graph Module

For this testing, Usage Graph module were tested in order to check if the graph were able to be projected in the application. The graph will read from Thingspeak database. Table 5 shows the result of the testing

Table 5: Result for usage graph module

Module	Simulation	Expected Outcome	Real Outcome	Comments
Usage graph Module	Click view usage graph button	The page should be able to show the usage graph	The page should be able to show the usage graph	None

6 Conclusion

This project involves on application of Internet of things (IOT) features to the parking system to improve the usability for the user. The project is created in order to improve on the problems that the current system faced. The problems such as unable to determine the availability of parking spaces at instance and unable to detect the time usage in a parking spaces by a vehicle are solved by using this project. This project can be improved in future times on any parts as this project only consists a small usage of Internet of Things (IOT) capabilities. The project is hopefully to be able to be used in large scale and contributes to human knowledge spectrum.

Acknowledgement

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