Journal of Electrical Engineering and Computer Sciences
Vol. 6, No. 2, December 2021
P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

IMPLEMENTATION OF INTELLIGENT PARKING SYSTEM USING IoT-BASED DEVICES (CASE STUDY OF GALAXY MALL SURABAYA)

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ABSTRACT

Many parking spaces available today generally require drivers to find their own location empty parking. Especially in parking lots located in large areas such as the Galaxy Mall area Surabaya. This will cause problems getting parking location information because drivers are not uncommon have to circle the parking building to get an empty parking location. The problem can avoided if the driver already knows the state of the parking location in the area to be seven. Driver can find out the availability of vacant parking locations in the destination area. In this case, we need a a system that can help drivers find vacant parking locations. Internet of things is a a concept or program by which an object has the ability to transmit or transmit data through the network without using the help of computers and humans. Internet of things or often called IoT is currently experiencing many developments. From the test results it can be concluded that the average Raspberry Pi boot delay on this system is 221.1 seconds. Sensor, From the test results it can be concluded that the average delay in scanning the QR Code using a Raspberry Pi camera at the entrance bar is 59.3 seconds, From the test results it can be concluded that the average delay in scanning QR Code using a camera The Raspberry Pi on the exit bar is 59.4 seconds

Keywords: *Internet of things, Raspberry, Parker, Camera.*

1. INTRODUCTION

Many parking spaces available today generally require drivers to find their own location empty parking. Especially in parking lots located in large areas such as the Galaxy Mall area Surabaya. This will cause problems getting parking location information because drivers are not uncommon have to circle the parking building to get an empty parking location. The problem can avoided if the driver already knows the state of the parking location in the area to be seven. Driver can find out the availability of vacant parking locations in the destination area. In this case, we need a system that can help drivers find vacant parking locations. Currently, there are many ways which can be used to detect cars in parking locations. One of them is by using a camera, to be able to know with certainty the location of the empty or filled parking lot. To build a system that can provide information on empty parking locations, a server is needed for data storage and data processing. The server stores all the information regarding the parking slots and will provide the information it to the driver. The driver can find out the availability of parking locations by accessing the application especially on android. air conditioning, and other needs to support daily train operations in carrying out their duties in mobilizing people to their destination.

2. THEORETICAL BASIS

2.1 Information System

Systems are related activities in order to achieve company goals such as: investment control or production scheduling (Norman L. Enger in Jogiyanto, 2005).

2.2 Parking Meaning

Parking is stopping and storing vehicles (cars, motorbikes, bicycles, and so on) temporarily in a certain space. The space can be in the form of a roadside, garage or courtyard that is provided to accommodate the vehicle. 3. Described in the traffic rule book (1998) the meaning of from parking, which is a place to stop vehicles for a long or short period of time depending on the vehicles and needs. (Pignataro, 1973 and Sukanto, 1985).

2.3 Understanding Smart Parking System

According to the book [6] smart system literally means intelligent system, in this case it means capable of do something well, orderly, and neatly in accordance with applicable rules and be able to obtain information well and quickly as a result of learning. While the smart parking system is a an intelligent system that specializes in managing parking areas so that they are more organized. In this research parking area management is intended to provide information to car drivers regarding availability parking slots in a parking area.

2.4 The Meaning of IoT (INTERNET OF THINGS)

IoT, is a concept that aims to expand the benefits of internet connectivity that continuously connected which enables us to connect machines, tools, and objects other physical devices with network sensors and actuators to acquire data and manage their own performance, thereby enabling machines to collaborate and even act on new information independently obtained.

2.5 Sensor Meaning

A sensor is something that is used to detect changes in the physical or chemical environment.The output variable from the sensor which is converted into an electrical quantity is called a transducer. At this time, the sensor has been made to a very small size on the order of nanometers. This very small size is very convenient consumption and save energy.

2.6 Raspberry

Raspberry Pi 3 According to (Helmi Muhammad Shadiq, Sudjadi, 2014), the Raspberry Pi is a microcomputer sized like a credit card developed by the Raspberry Pi Foundation, UK. Single board computer It was developed with the aim of teaching the basics of computer science and programming to students schools around the world. Although a microcontroller that has a physical like Arduino which is better known as prototyping projects, not so with the Raspberry Pi which is very different from a microcontroller mostly, and actually, more like a computer than an Arduino. The Raspberry Pi is a very flexible.

Figure 2.1. Raspberry
(Source : https://whalebird.org/best-prebuilt-raspberry-pi/)

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

2.7 GPIO Raspberry

GPIO is a pin or additional input output terminal specifically installed on the raspberry pi board for connection to external devices, the image is circled in red, commonly referred to as the GPIO header. GPIO is used as an alternative raspi communication to the outside world just like a USB port or Ethernet. What distinguishes it is more flexible in wiring. Through the GPIO terminal we can turn on the LED light, rotate the dynamo, read the temperature from the sensor and much more. The main content of the GPIO header is.

1. Power supply (3.3 V dan 5 V, 2 sets each)
2. UART (Universal asynchronous receiver transmitter, 1 set)
3. SPI (Serial Peripheral Interface)
4. I2C (Inter-Integrated Circuit) -EEPROM
5. GPIO (General Purpose Input Output)
6. PWM (Pulse width modulation)

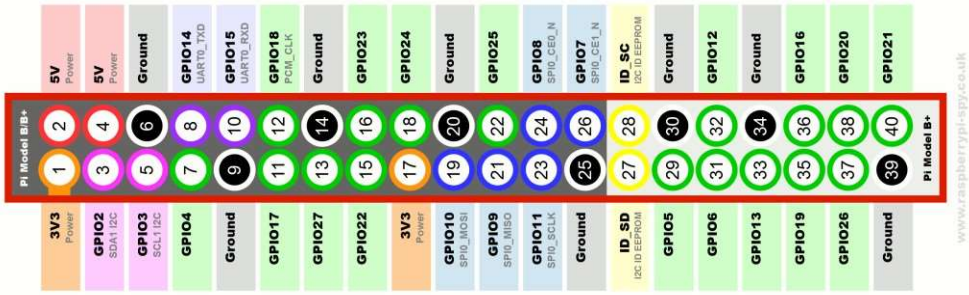


Figure 3.4 GPIO Raspberry
(Sumber : https://raspberrypi.stackexchange.com/questions/62754/gpio-pins-available-for-switches)

3. RESEARCH METHODOLOGY

3.1 Problem Analysis

Implementation of a smart parking system at Galaxy Mall Surabaya using an IOT sensor-based device. Raspberry is an application that functions to view the status of the number of empty parking slots.

3.2 Needs Analysis

This stage analyzes the needs that will be needed in making an Android-based smart parking application, starting from the concept, flow, and tools needed in making this application. Both from hardware and software. So that later the smart parking system at Galaxy Mall Surabaya uses a Raspberry IOT sensor-based device that can be used as information media for empty parking slots.

3.3 Data Analysis

In designing an Android-based smart parking application, reference data is needed which is taken from books and journals related to the material needed.

3.4 System Analysis

System analysis is the development of the initial phases used in describing and describing intact parts into their component parts with the aim of identifying and evaluating an application in order to find out the obstacles that occur, as well as the expected needs so that the Android-based smart parking application can run in accordance with the requirements function

3.5 Smart Parking

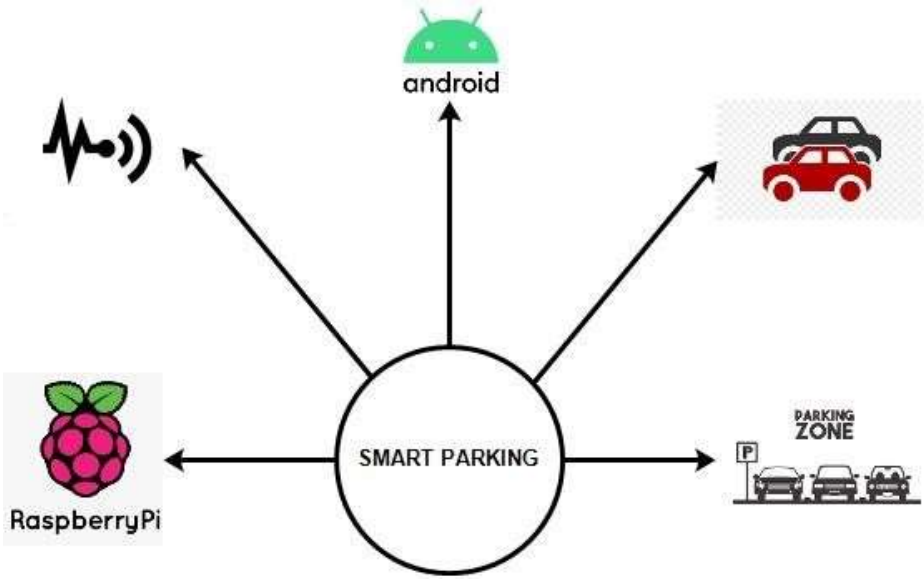


Figure 3.1 Smart Parking

To create an intelligent parking system at the Galaxy Mall Surabaya using a Raspberry IOT sensor-based device, the following components are needed:

1. Raspberry Pi

Raspberry pi as an os that contains control sensors and a cloud server to store smart parking data.

2. Sensor

The sensor used in this smart parking is ultrasonic as a control slot and opens the door latch

3. Android

Android is used to control slot status.

4. Vehicles

In smart parking, the vehicle is the main object that does parking and each vehicle has its own uniqueness such as the type, number plate and color of the vehicle

5. Parking lots.

The parking lot is a place that is used to park vehicles. This parking lot requires a strategic place and a large number of slots.

3.6 System Design

System design aims to provide an overview of the system planning to be built or developed. At this stage will also be given an overview of the flow of information and processes in the system. The following steps will be carried out in system design.

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

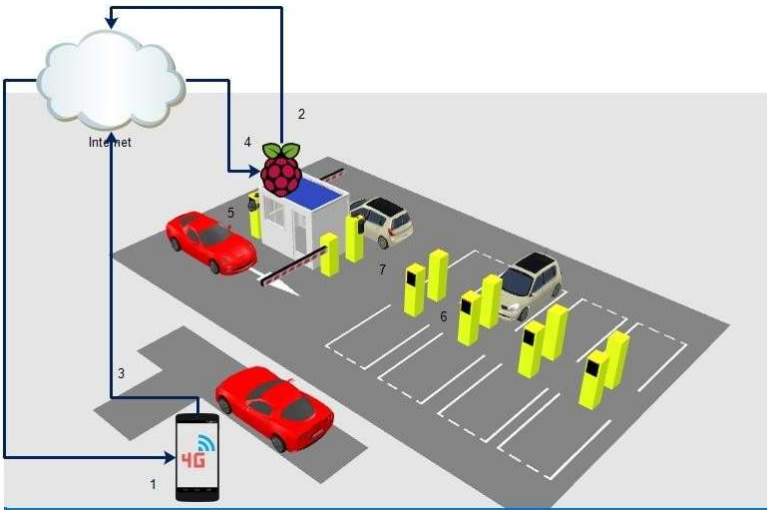


Figure 3.2 Smart parking process design

From Figure 4.2 it can be explained as follows:

1. The customer registers then logs in and sees the remaining slots available via the internet
2. Parking slot data sent by raspberry via internet connection
3. Customers book an empty slot via a smart phone then send it via the internet and receive QRCode information as a doorstopper
4. Raspberry receives slot booking data via the internet and stored in the database
5. Customers enter the parking lot by scanning the QRCode into the raspberry camera and if it is correct then the doorstop will open
6. Customers enter and park the vehicle according to the slot booked
7. Customers exit the parking lot by scanning the QRCode booking data to open the exit bar.

3.7 Flowchart

Flowchart of the smart parking system at Galaxy Mall Surabaya using Raspberry IOT sensor-based devices is the process flow for using applications to view and book parking slots.

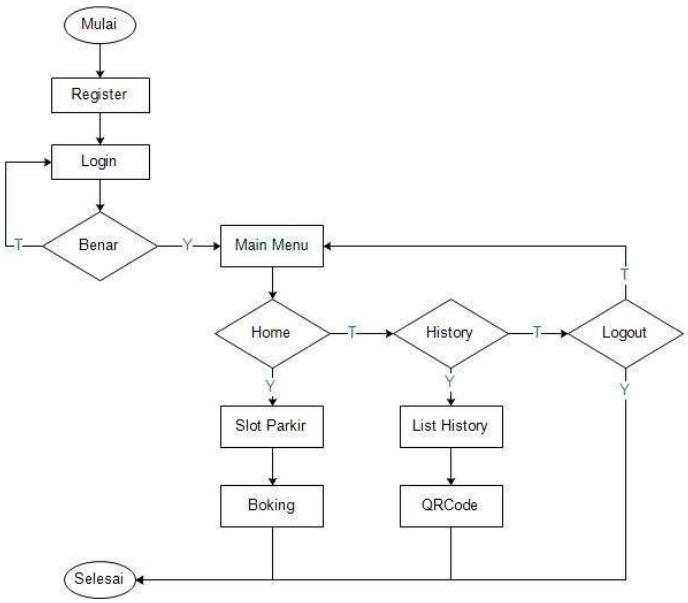


Figure 3.3 Application Flowchart

The application flowchart is the process that the customer does to run the application. Before the customer uses the application, the customer must register first, after registering the customer can login. On this user page there is a feature to view the home page and history.

3.8 Contexs Diagram (CD)

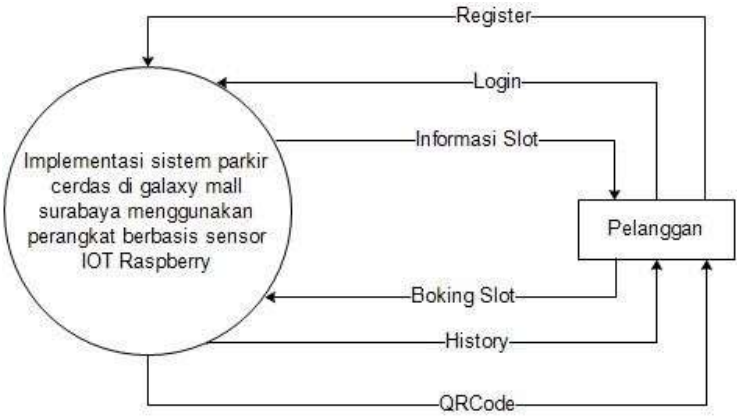


Figure 3.4 Contxs Diagram

Context Diagram is the highest level in the data flow diagram and contains only one process, showing the system as a whole. In the context diagram there is one entity, namely the customer. To use the smart parking application, the customer must register first after registering the customer can log in, after the login is successful, the user can see information on the status of the parking slot. unlock latch on hardware.

3.9 Data Flow Diagram (DFD)

A. Data Flow Digram Level 0

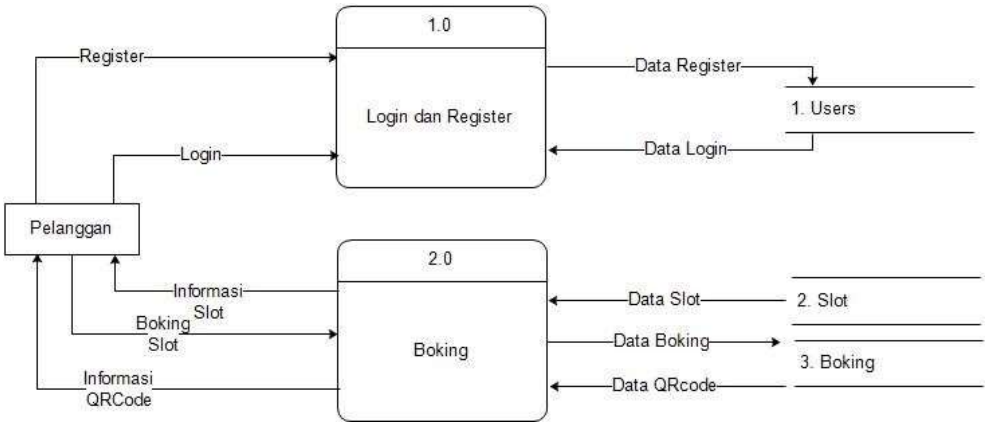


Figure 3.5 Data Flow Diagram Level 0

This DFD is a system design tool oriented to the data flow with the concept of decomposition. In the DFD above, there are 2 processes and 1 entity which are explained below:

1. Login and Register

The login and register processes are processes carried out by customers to register which are stored in the users table and the login process functions to enter the smart parking application, the data is taken from the users table.

2. Booking

The booking process is a process carried out by admins and members to login in this process the table used is the users table.

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

B. Data Flow Diagram Level 1

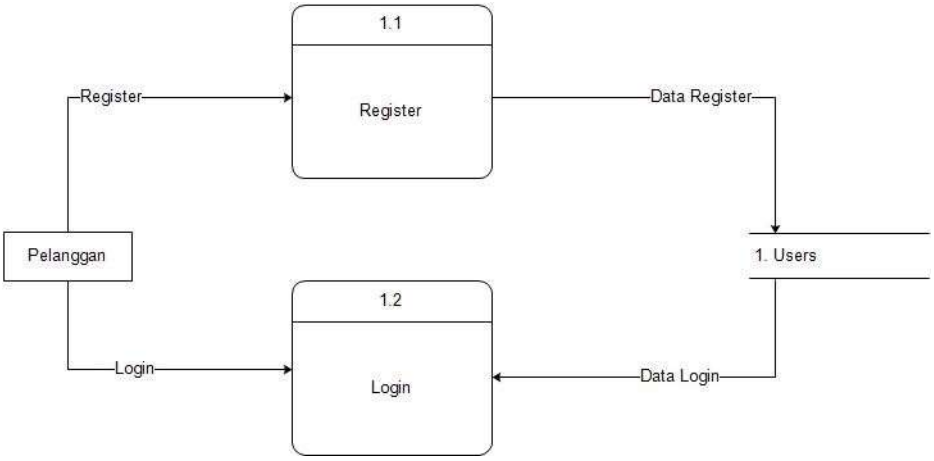


Figure 3.6 Data Flow Diafram Level 1

DFD Level 1 is a system design tool oriented to the data flow with the concept of decomposition. In the DFD above there are 2 processes and 1 entity which are explained below:

1. Register
The registration process is a process carried out by customers who do not have an account. After registering the data will be stored in the users table.
2. Login
The login process is a process carried out by customers to log in. In this process the table used is the users table.

C. Data Flow Diagram Level 2

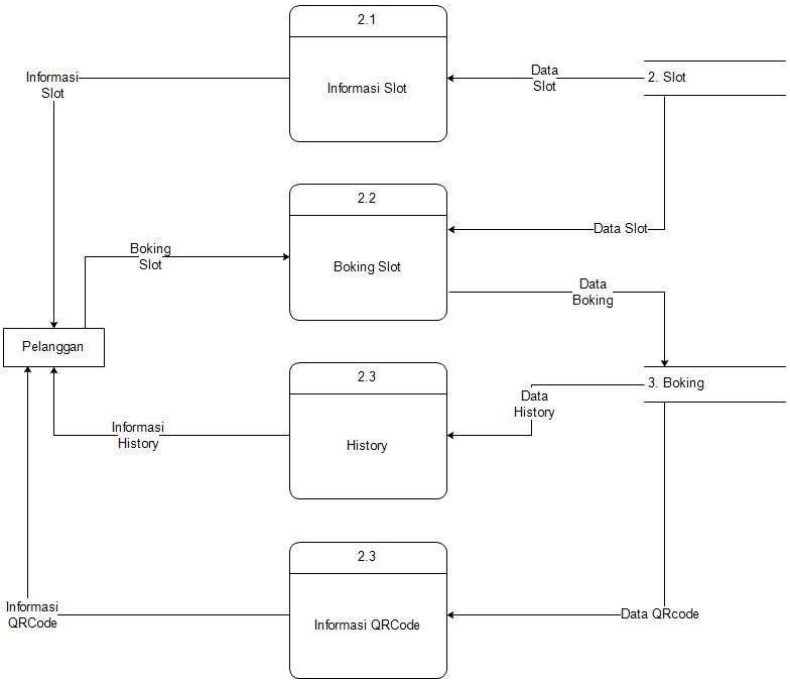


Figure 3.7 Data Flow Diagram Level 2

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

DFD Level 2 is a system design tool oriented to the data flow with the concept of decomposition. In the DFD above there are 4 processes and 1 entity which are explained below:

1. Slot Information
The slot information process is a process carried out by customers to view parking slot status information. This slot information process is taken from the slot table
2. Booking Slots
The slot booking process is a process that is carried out by the customer to book a slot. This slot booking process uses two tables, the slot table serves to display empty slot data and the booking table serves to store booking data.
3. History
The history process is this process carried out by the customer to view the parking history information. This data is taken from the booking table.
4. QRCode Information
In this process, the QRCode information process functions to display the QRCode, this data is taken from the booking table.

3.10 Entity Relationship Diagram (ERD)

ERD (Entity Relationship Diagram) is a graphical representation of an information system that shows the relationship between tables in a system. ERD describes the relationship between attributes where the attribute has a function to describe the characteristics of the entity, the content of the attribute has something that can identify the contents of one element with another.

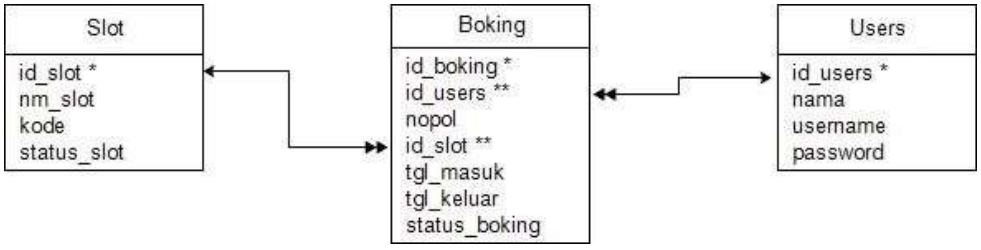


Figure 3.8 Table Realtion

3.11 Software Design

Software design is a gradual process in which all the requirements or requirements contained in the SRS document are translated into a blueprint that will be used to build software.

Figure 3.9 Register Page Design

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

The design of the register page serves to design the register page to register as a smart parking customer.

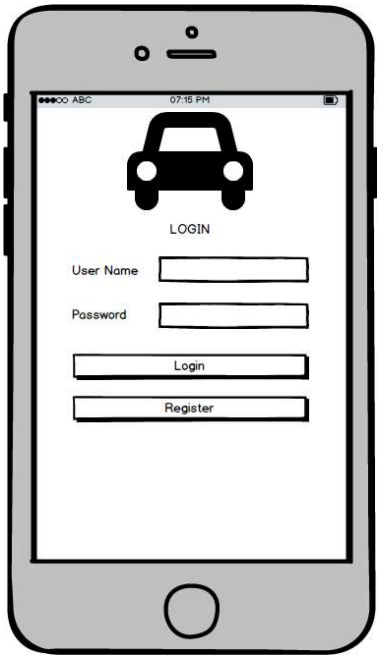


Figure 3.10 Login Page Design

The design of the login page serves to display the login page, this page serves to protect the smart parking application.

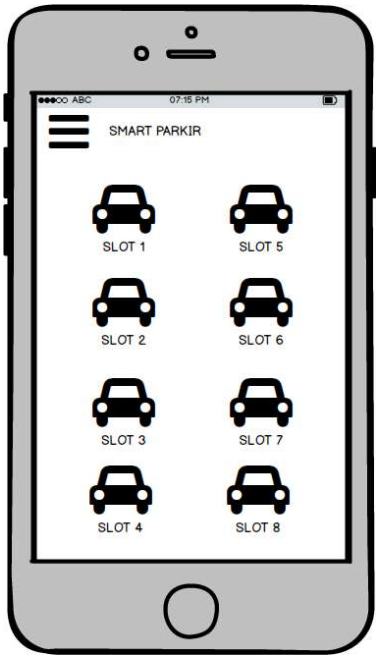


Figure 3.11 Slot Page Design

The design of the slot page is a page designed to display information on the status of smart parking slots.

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

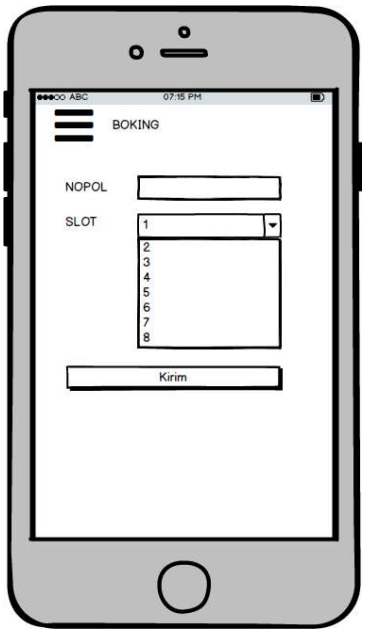


Figure 3.12 Booking Page Design

The booking page design serves to display the parking slot booking page.

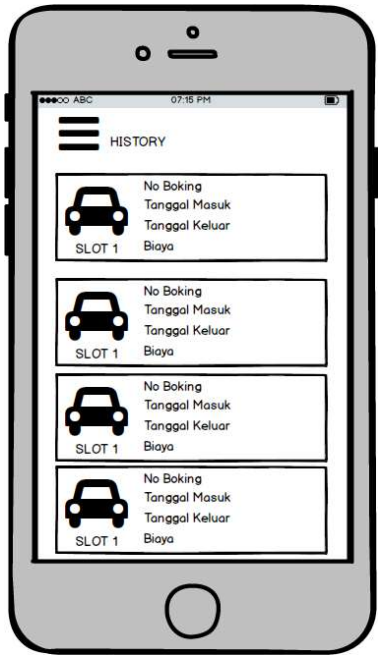


Figure 3.13 History Page Design

The history page design serves to display customer parking history list information

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

Figure 3.14 Detail History Page Design

The design of the detail history page functions to display QRCode information, this QRCode serves to open the parking slot doorstop

3.12 Interface Implementation

The implementation of the smart parking system interface at Galaxy Mall Surabaya was made using android studio 3.6.3 by using the internet connection feature to access the mysql database on the Raspberry pi os.

1. Implementation of smart parking system interface at Galaxy Mall Surabaya
   The following is the implementation of the smart parking system at Galaxy Mall Surabaya, which functions to display information on the number of parking slots, parking for incoming vehicles and the remaining available slots.

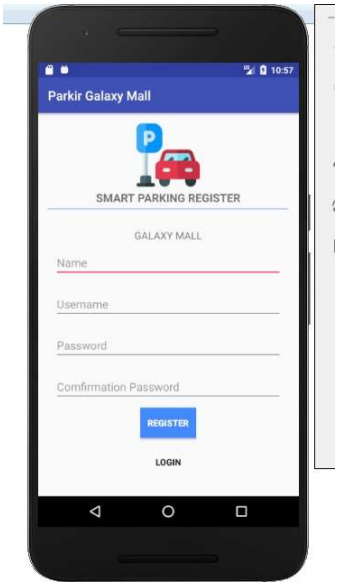


Figure 3.15 Register smart parking system at Galaxy Mall Surabaya

The smart parking system register at Galaxy Mall Surabaya is an interface that works for the user

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

register as a customer before parking at the Surabaya city transportation office, to register the customer must fill in the name, username, password data and when it is finished filling in the data the customer can select the register button to send registration data.

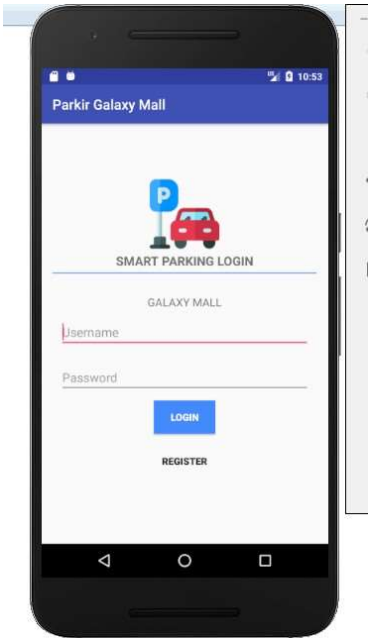


Figure 3.16 Login smart parking system at Galaxy Mall Surabaya

The smart parking system login at Galaxy Mall Surabaya is an interface that functions for users to login to the smart parking system application, this login interface functions to protect the smart parking system application, to log in the customer must fill in username and password data then select login to enter the homepage.

Figure 3.17 Smart parking system slots at Galaxy Mall Surabaya

Smart parking system slot is an interface that serves to display the smart parking system slot status information, this slot information is sent from the raspberry hardware using an infrared sensor.

Figure 3.18 Booking smart parking system at Galaxy Mall Surabaya

Intelligent parking system booking is an interface that functions to book parking slots, to book parking slots the customer must fill in the police number and the booked parking slot and the send button function to send booking data.

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

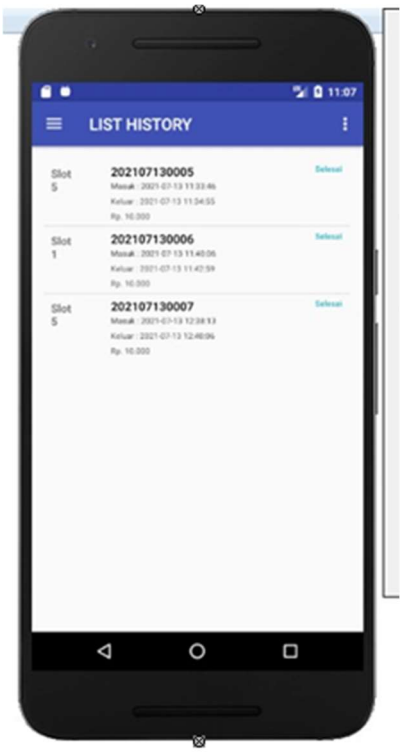


Figure 3.19 List History of the smart parking system at Galaxy Mall Surabaya

List Hostory intelligent parking system is an interface that functions to display customer parking booking information, the information displayed is the booking number, entry date, exit date, and parking status.

Figure 3.20 Payment for smart parking system at Galaxy Mall Surabaya

Intelligent parking system payment is an interface that works to make fee payments parking at Galaxy Mall Surabaya by displaying information on the parking fee transaction number and the pay button

4. DISCUSSION RESULT

In this chapter, we will discuss the testing and discussion of the results made. This aims to determine the extent of accuracy in the execution of the system made and does not rule out the possibility of knowing its weaknesses, so that later it can be concluded whether the system that has been made can run correctly and in accordance with the expected criteria.

4.1 Testing

1. Raspberry Boot Test

Tests were carried out to determine the time required by the system to display the mini desktop interface, here are the results of the raspberry boot test:

Pengujian ke -	1	2	3	4	5	6	7	8	9	10
Waktu (s)	01	99	03	10	30	40	03	06	09	10

Table 4.1 Raspberry Boot Test Results

From the test results it can be concluded that the average Raspberry Pi boot delay on this system is 221.1 seconds.

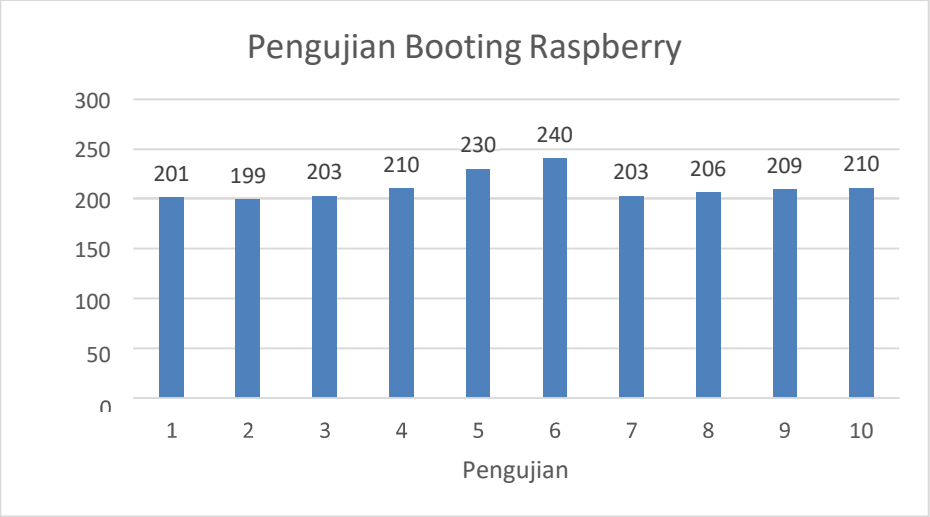


Figure 4.1 Raspberry Boot Test Results Graph

2. Testing the Raspberry Pi Camera.

The test was carried out to determine the time required by the system to open the parking gate, to perform this test the customer creates a QR Code and then scans it using a raspberry camera, here are the results of the raspberry camera test:

Table 4.2 Raspberry Camera Test Results for the Entrance Cross

No	Jenis Pengujian	sil Scan QR Code	Waktu (s)	Status
	Palang Pintu Masuk	202117120001		Terbuka
	Palang Pintu Masuk	202117120002		Terbuka
	Palang Pintu Masuk	202117120003		Terbuka
	Palang Pintu Masuk	202117120004		Terbuka
	Palang Pintu Masuk	202117120005		Terbuka
	Palang Pintu Masuk	202117120006		Terbuka

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

	Palang Pintu Masuk	202117120007		Terbuka
	Palang Pintu Masuk	202117120008		Terbuka
	Palang Pintu Masuk	202117120009		Terbuka
	Palang Pintu Masuk	202117120010		Terbuka

From the test results, it can be concluded that the average delay in scanning the QR Code using a Raspberry Pi camera at the entrance bar is 59.3 seconds.

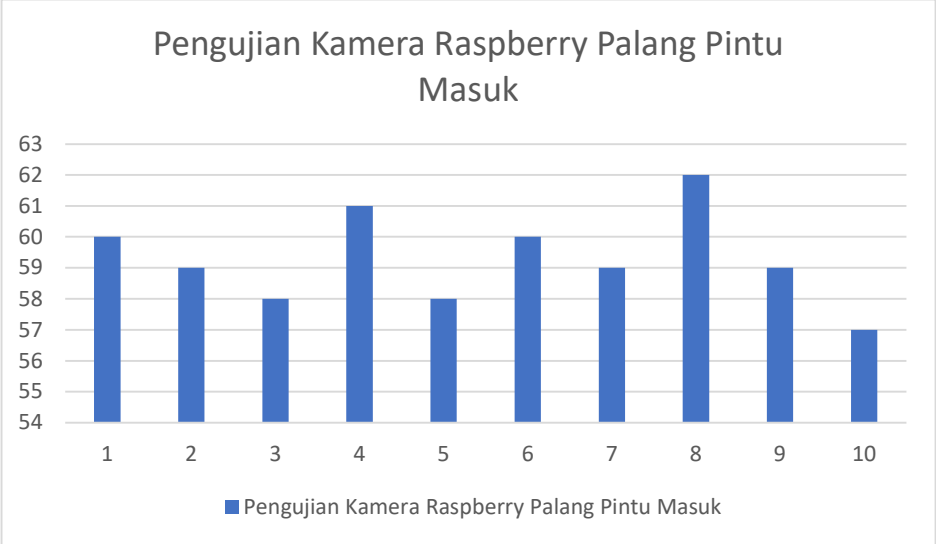


Figure 4.2 Graphics of Raspberry Camera Testing Entrance Cross

Figure 4.3 Documentation of the Raspberry Camera Testing for the Door Cross

Table 4.3 Testing Results for the Raspberry Camera for the Exit Cross

No	Jenis Pengujian	Hasil Scan QR Code	Waktu (s)	Status
	Palang Pintu Keluar	202117120001		Terbuka
	Palang Pintu Keluar	202117120002		Terbuka
	Palang Pintu Keluar	202117120003		Terbuka
	Palang Pintu Keluar	202117120004		Terbuka

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

	Palang Pintu Keluar	202117120005		Terbuka
	Palang Pintu Keluar	202117120006		Terbuka
	Palang Pintu Keluar	202117120007		Terbuka
	Palang Pintu Keluar	202117120008		Terbuka
	Palang Pintu Keluar	202117120009		Terbuka
	Palang Pintu Keluar	202117120010		Terbuka

From the test results, it can be concluded that the average delay of scanning QR Code using a Raspberry Pi camera on the exit bar is 59.4 seconds.

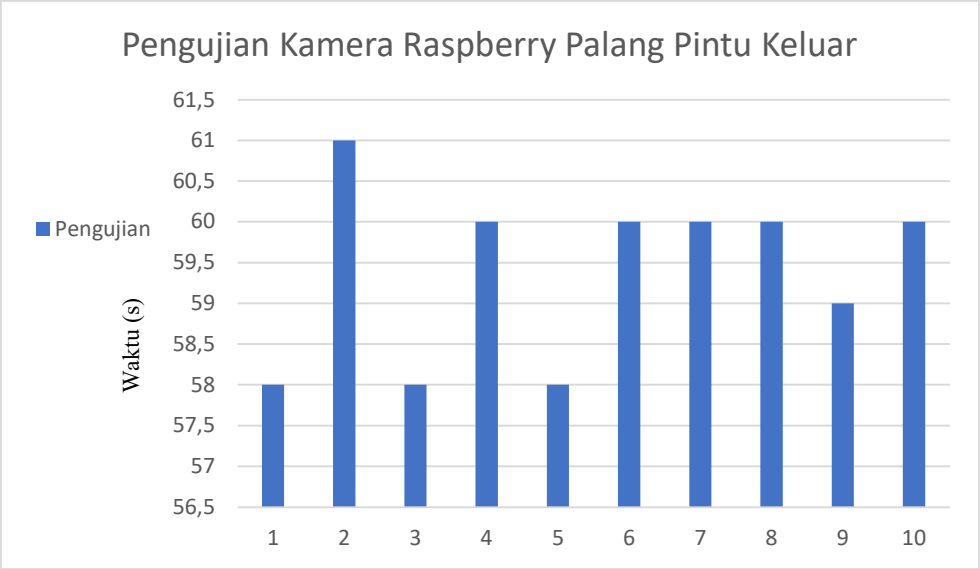


Figure 4.4 Graphics of Exit Cross Raspberry Camera Testing

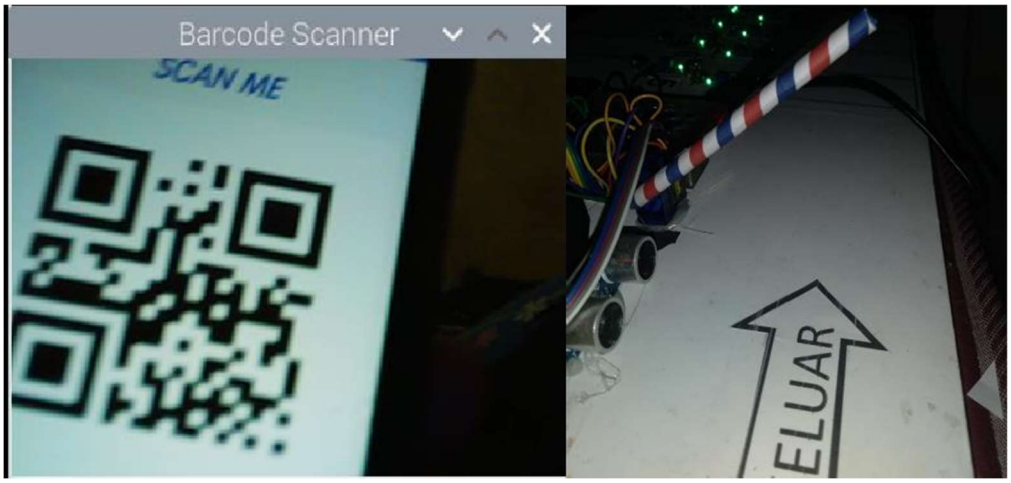


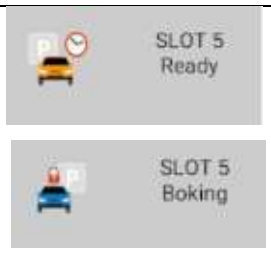
Figure 4.5 Raspberry Camera Test Documentation of Exit Cross

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

3. Parking Slot Testing

The test is carried out to determine the time required by the infrared to determine the slot status, to perform this test, this is done by bringing the vehicle object closer to the infrared so that it gets the input status or is filled, the following is the test :

Table 4.4 Test Results for Booking Status Slots

Slot		Waktu (s)	Status
		62	Berhasil
		63	Berhasil
		62	Berhasil
		61	Berhasil
		62	Berhasil

		64	Berhasil
		65	Berhasil
		66	Berhasil

From the test results, it can be concluded that the average delay in the status of the booking status slot on the Raspberry is 62.4 seconds.

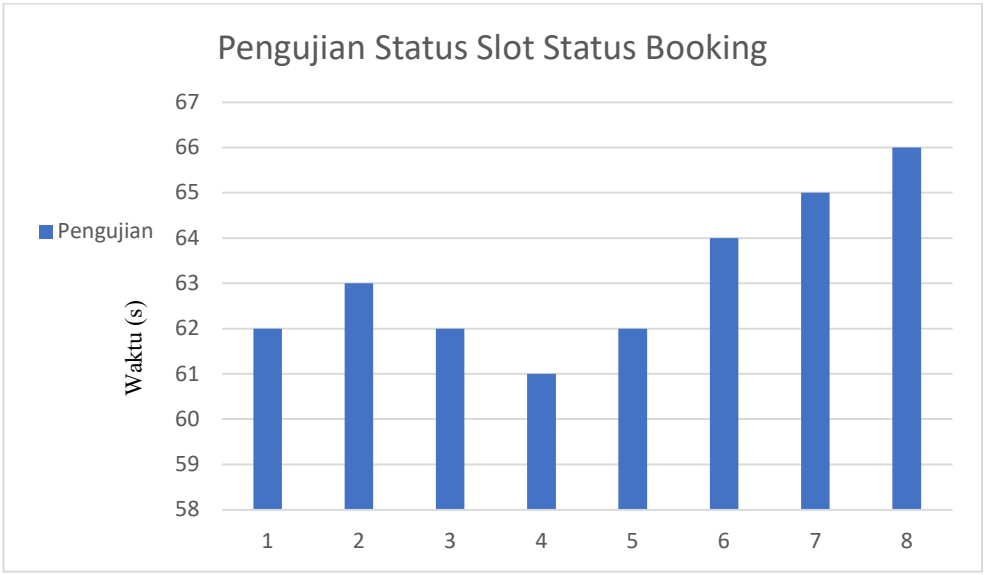
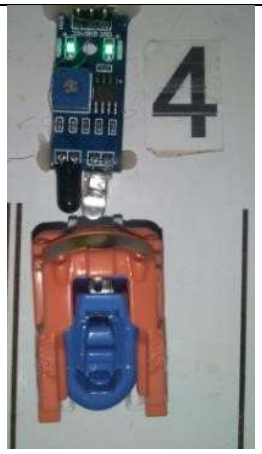


Figure 4.6 Chart of Testing Slot Site Booking Status

Table 4.5 Test Results of Input Status Slots

		Waktu (s)	Status
		65	Berhasil
	 	67	Berhasil
	 	64	Berhasil

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

		62	Berhasil
	 	65	Berhasil
	 	63	Berhasil

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

		60	Berhasil
	 	64	Berhasil

From the test results, it can be concluded that the average delay in the status slot of the input status on the Raspberry is 62.9 seconds.

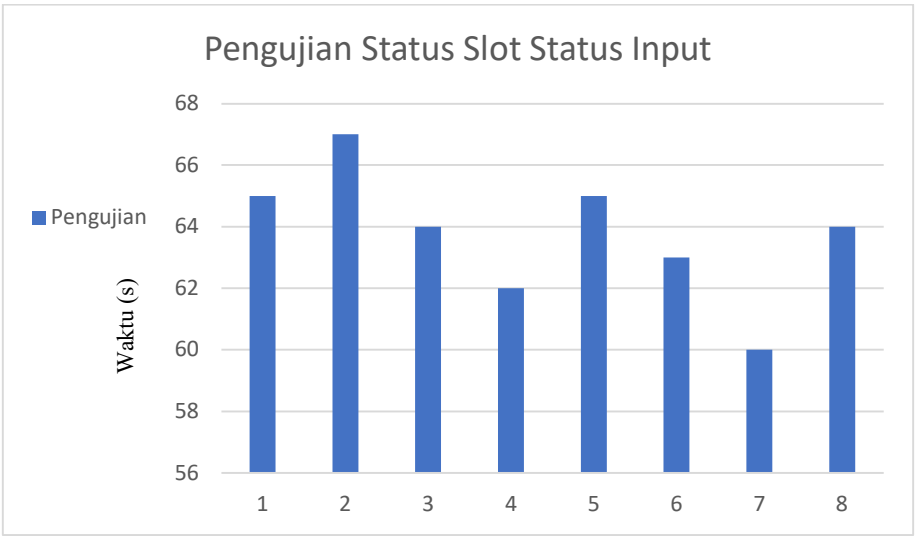


Figure 4.7 Graphics of Testing Site Slot Input Status

P-ISSN: 2528-0260 E-ISSN: 2579-5392
p.1135 - 1158

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclussions

Based on the results of research and discussion on the implementation of a smart parking system at Galaxy Mall Surabaya using Raspberry IOT sensor-based devices that have been carried out, it can be concluded that :

1. From the test results, it can be concluded that the average Raspberry Pi boot delay on this system is 221.1 sec.Sensor
2. From the test results, it can be concluded that the average delay in scanning the QR Code using a Raspberry Pi camera at the entrance bar is 59.3 seconds.
3. From the test results, it can be concluded that the average delay of scanning QR Code using a Raspberry Pi camera on the exit bar is 59.4 seconds.
4. From the test results, it can be concluded that the average delay in the status of the booking status slot on the Raspberry is 62.4 seconds.
5. From the test results, it can be concluded that the average delay in the status slot of the input status on the Raspberry is 62.9 seconds.

5.2 Suggestions

After evaluating the application as a whole, it is hoped that the results of this study can be further developed with development suggestions as follows :

1. This smart parking application still requires the assistance of officers in its implementation, especially in terms of guest entry, exit verification and payment. For future development, the use of human resources can be minimized by using a card dispenser as a substitute for officers when guests enter, security cams as a substitute for officers when verifying residents leave.
2. There is no vehicle verification in the parking allocation system, so anyone can park their vehicle in any parking lot. For future development, each parking lot is designated for each specific occupant, so if there are parties who park their vehicles in a lot that is not their right, the system can give a warning so that each occupant does not have to worry about not getting land to park their vehicles.
3. In further development, facial recognition can be added as an additional feature. This feature serves to increase security in the parking area when residents are about to leave the parking area.

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