4thICITB

# DESIGNING ARDUINO-BASED INTEGRATED MOTORCYCLE PARKING SYSTEM AT PARKING AREA OF IBI DARMAJAYA

Tri Suratno[1)], Nurfiana[2)]

Informatics and Business Institute Darmajaya[1)], Informatics and Business Institute Darmajaya[2)]
trisuratno.1711068002P@mail.darmajaya.ac.id[1)], nurfiana@darmajaya.ac.id[2)]

**ABSTRACT**

*The parking area for IBI Darmajaya employees is the parking area where IBI Darmajaya employees put their vehicles. The problem statement of this research was the high number of IBI Darmajaya students putting their vehicle in the parking area for IBI Darmajaya employees due to limited parking space. This problem was able to be overcome by designing a system to open an access into the parking area through fingerprint system as the identifier (input) and Arduino Uno as the main controller. This system consisted of 4 main components i.e., the fingerprint sensor, the ultrasonic sensor, the servo motor, and the parking bar. The parking bar control system used Arduino Uno-based fingerprint system that was useful to shorten the verification process so that the vehicle was able to get into the parking area. The result of this research was that the fingerprint system-based parking bar control was able to save the 1,000 employee fingerprint records. An average for matching fingerprints to the closing bars was 4.86 seconds form the entrance bar and 4.8 seconds to the exit bar with 450 cm of the maximum distance between the ultrasonic sensor and the vehicle.*

**Keywords: Parking; Microcontroller; Arduino; Fingerprint**

## INTRODUCTION

IBI Darmajaya campus parking area is divided into 6 points, namely 2 points of employee parking area and 4 points of student parking area, but with the increasing number of IBI Darmajaya students causing irregular parking area of IBI Darmajaya, so many students park in the employee parking area. This makes it difficult for employees to get parking locations that are close to the workspace.Parking is a temporary stopping or immobile state of the vehicle because it is abandoned by the owner or driver. While the parking space unit

is an effective size for putting a vehicle, one of which is a motorcycle. The parking space unit is a unit of size needed to park a vehicle according to various forms of supply. The amount of parking space is affected by vehicle dimensions and free space (Gawe, 2017).

IBI Darmajaya campus parking area is divided into 6 points, namely 2 points of employee parking area and 4 points of student parking area, but with the increasing number of IBI Darmajaya students causing irregular parking area of IBI Darmajaya, so many students park in the employee parking area. This makes it difficult for employees to get parking locations that are close to the workspace.

The scope of the research is among others the microcontroller used by the Arduino Uno module, The fingerprint sensor module is used as a fingerprint scan to open the parking bar when the fingerprint matches the data in the fingerprint sensor module database, The motor detection sensor that has passed the parking bar is the HC-SR04 ultrasonic sensor, The display media used is LCD (Liquid Crystal Display) 20 x 4, Buzzer is used as a beep about fingerprint compatibility, Able to store up to 1,000 fingerprint databases, Do not give tickets or evidence to vehicle owners, Does not provide information on the amount of remaining parking space and available locations, The parking bar is a prototype consisting of two parking bars.

The purpose of this research was to design an Integrated Motorcycle Parking System in the Darmajaya IBI Based Parking Area of Undu using input in the form of a fingerprint sensor module. The benefits of this research are speed up the motor verification process when exiting, providng security in Darmajaya IBI employee parking area, Limiting access to Darmajaya IBI employee parking area.

## LITERATURE REVIEW

Some studies that make information systems on parking systems, namely "Car Parking Monitoring System using RASBERRY PI Infrared Sensors" (Nataliana, Syamsu, & Giantara, 2014). The purpose of the research is to design and realize a monitoring system model parking with Raspberry Pi based parking area selection facilities as well use infrared as a sensor. The system can display availability status from the parking area that appears on the display and is equipped with a tariff calculation parking. The system is equipped with a button that is used to select a parking area, 2 pieces of sensors in each parking area to detect vehicles, cameras for Security and LED lights serve as an indicator of parking area availability. Software used in this system is designed using Python 2 and the database system used is SQLite3. The weakness of this research is that there is no sensor that allows entry to the parking area.

"Implementation of Automatic Parking System by Determining Parking Position Based on RFId" (Imbiri, Taryana, & Nataliana, 2016). This study uses RFID (Radio Frequency Identification), Numpad, Sensor LDR and LED as the main input. The disadvantage of using RFID (Radio Frequency Identification) is that the input requires a card as an identity.

## RESEARCH METHOD

**consists of literature review, system design analysis, analysis materials, Testing implementation, work analysis and how the device works.** Literature Review is conducted to determine the extent of research on parking systems that were previously made**.** Integrated Motorcycle Parking Design in the Arduino Uno IBI Darmajaya Parking Area includes the design of hardware and software. The block diagram of Integrated Motorbike Parking in the IBI Darmajaya-based Uno Parking Area can be seen in Figure 2 and Figure 3.

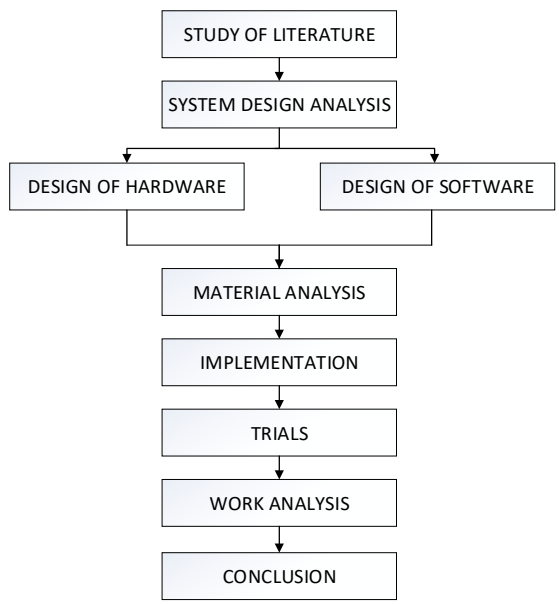


**Figure 1. Research Flow**

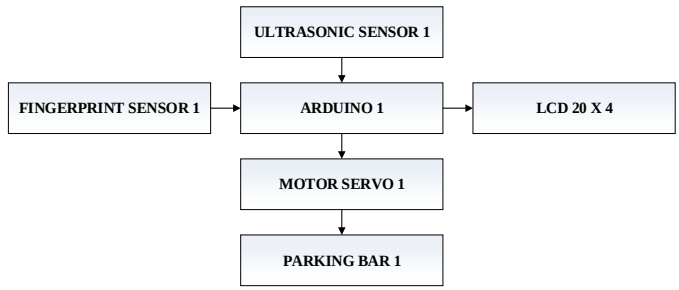


Figure 2. Block Diagram of Parkir Bar (ENTER)

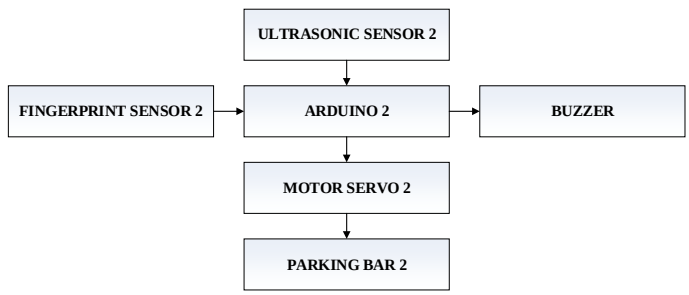


**Figure 2. Block Diagram of Parkir Bar (EXIT)**

figure 2 shows components in the block diagram of Parkir Bar **(ENTER) :**
**Fingerprint Sensor Module 1** = It functions as an input to read fingerprint recordings of motorized parking users in the database at the entrance.
**HC-SR04 Ultrasonic Sensor 1** = It functions as a motorbike detector that has passed the parking bar when entering and gives an order to Arduino to close the parking entrance bar again.
**Arduino Uno 1** = Functioning as a microcontroller to process input from the sensor then produce output to the actuator on the entrance bar.
**20 x 4 LCD (Liquid Crystal Display) module =** Function to display information about the fingerprint data compatibility that has been received by the fingerprint sensor.

figure 3 shows components in the block diagram of Parkir Bar **(EXIT) :**
**Servo Motor 2** = Serves as an actuator to move the parking bar out
**Fingerprint Sensor Module 2** = Function as input to read fingerprint recordings of motorized parking users in the database at the exit.
**HC-SR04 Ultrasonic Sensor 2 =** It functions as a motorbike detector that has passed the parking bar when exiting and gives an order to Arduino to close the parking bar again.
**Arduino Uno 2 =** It functions as a microcontroller to process input from the sensor and then produces output to the actuator on the exit bar.
**Servo motor 1** = Serves as an actuator to move the parking bar in.

**Buzzer** = It functions as the output of the fingerprint match indicator when it exits.

**System Flowcharts**

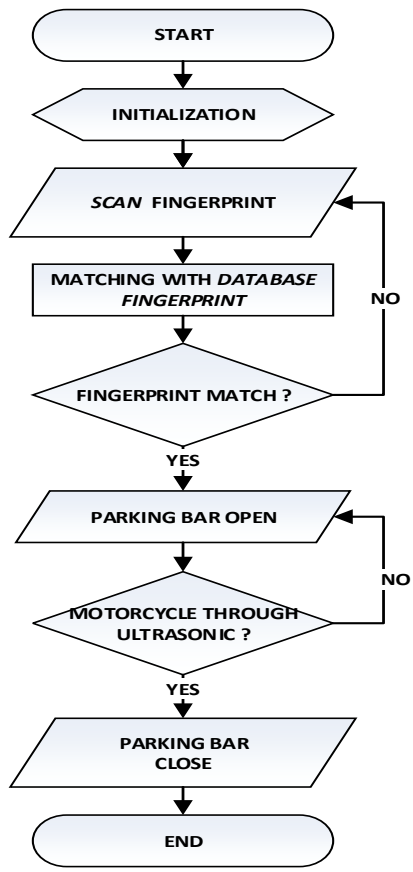


**Figure 3. Flowchart of System**

The flowchart system is made aiming to determine the course of a system made in hardware and software so as to facilitate the making of the program.

**Testing**

System Testings are conducted to find out system performance, whether the series and programs that have been made are in accordance with the design. Several Testings will be carried out to ensure that the system is working well. The Testing will be carried out starting from the permodule test to the entire system testing.

The Testing Procedure includes Activate the power supply, Making arduino scetch in accordance with the system to be designed, Upload the Arduino program, Connect the fingerprint sensor module, Connect the ultrasonic sensor to Arduino, Connect the servo motor to Arduino, Connect the buzzer to Arduino, Connect the LED (Light Emmiting Diode) to Arduino, and Record the results of the test.

**Analysis of Performance**

Work analysis is carried out to determine the performance of the system that has been made and will be analyzed based on the response of the fingerprint sensor module in reading fingerprint and ultrasonic sensor response in detecting objects and the response and speed of the servo motor in opening and closing the parking bar.

## FINDINGS AND DISCUSSION

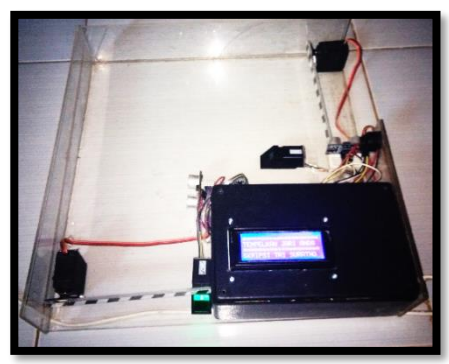

**Figure 5. Prototype of System**

The design of the Arduino Uno-based parking bar controller by using the fingerprint, both hardware and software are made, the next step is to do a testing. System tests are conducted to ensure that the system is made in accordance with the design. Data obtained from the results of the trial will be analyzed to find out the shortcomings and advantages of the system. Figure 5 shows when the entire circuit gets voltage from the power supply. When the entire circuit gets voltage from the power supply, the fingerprint sensor module on the entrance bar will be active and enter standby mode when the system is ready to receive a new fingerprint input that will pass through the bar, the Servo Motor on the entrance bar initializes by moving from $180^0$ to the position $170^0$ and LCD (Liquid Crystal Display) on the entrance bar will display the words "TEMPELKAN SIDIK JARI ANDA", can be seen in Figure 6.


**Figure 6. Display Entrance Bar**

After that, if the fingerprint sensor module on the input bar receives a fingerprint that matches the database then the servo motor on the entrance bar will move to $90^0$ position to open the door bar and the LCD (Liquid Crystal Display) will display the words "SILAKAN MASUK", can be seen in Figure 7.


**Figure 7. LCD Display When Fingerprint Input Is Matching With Database**

If IBI Darmajaya's employee motorcycle has passed the Ultrasonic sensor on the entrance bar, the servo motor on the entrance bar will move to $180^0$ to close the parking bar and the fingerprint sensor module and LCD (Liquid Crystal Display) on the entrance bar will return to standby. If the fingerprint sensor module on the entrance bar receives a fingerprint that does not match the database, the servo motor on the inlet bar does not move and the LCD (Liquid Crystal Display) on the entrance bar will display the words "SIIDIK JARI TIDAK COCOK", can be seen in Figure 8.


**Figure 8. LCD Display When Fingerprint Input Is Not Matching**

In the fingerprint sensor module the exit bar will also be active and enter standby mode, the Servo Motor on the exit bar initializes by moving from $180^0$ to $170^0$. After that, if the fingerprint sensor module on the exit bar receives a fingerprint that matches the database then the servo motor on the outer bar will move to $90^0$ position to open the parking bar. if the IBI Darmajaya

motorbike has passed the Ultrasonic sensor on the exit bar, the servo motor on the exit bar will move to $180^0$ to close the parking bar and the fingerprint sensor module on the exit bar will return to standby mode. If the fingerprint sensor module on the exit bar receives a fingerprint insert that does not match the database, then the buzzer will emit a beep and servo motor on the exit bar does not move.

**Enroll Testing**

At this stage the fingerprint sensor module will be tried to take a sample of the fingerprint and then save it in the database in the fingerprint sensor module, this test requires the help of input operator and also the recording of employee names according to integer identity.

The steps for enroll Testing are as follows:

The first step is to open the SFG Demo version 2.0 application.

- The second step is to click open device and select the COM port according to the one connected with fingerprint.
- Then click enroll and enter the number / integer as the identity in the database in fingerprint, in this experiment input integer 1 and so on.
- Next is attaching a finger that will be registered in the fingerprint sensor module.
- After that the fingerprint data is stored in the fingerprint sensor module database.

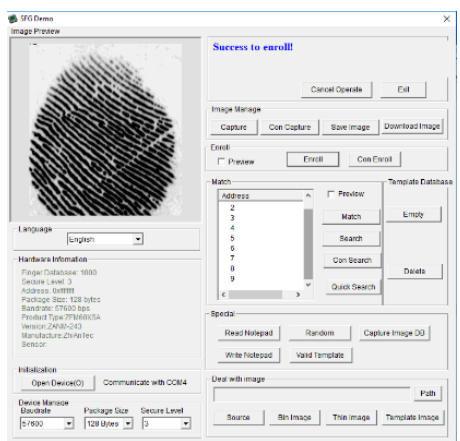


**Figure 7. Enroll Testing**

**Delete Testing**

At this stage, testing of the fingerprint recordings that already exist in the fingerprint module database is done.

The steps to delete delete are as follows:

- The first step is to open the SFG Demo version 2.0 application.

- The second step is to click open device and select the COM port according to the one connected with fingerprint.
- Then input the integer identity of the user to be deleted from the database, in this experiment is inputted 1, to delete the fingerprint database with identity 1.
- Then the SGF Demo version 2.0 application will verify the database will be completely deleted.
- After that the selected data has been deleted from the database.

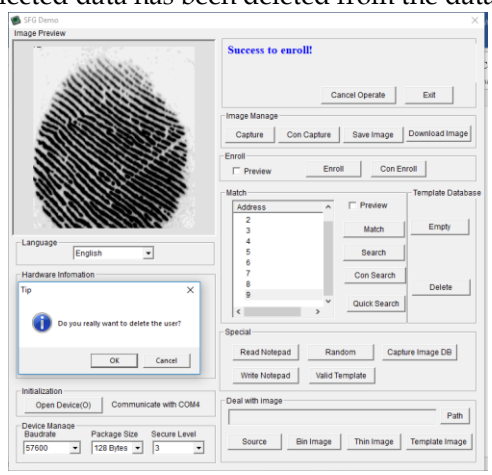


**Figure 8. Delete Testing**

**Overall system testing The overall system testing can be seen in table 1 and table 2.**

**Table 1. Test Results on the Entrance Parking Bar**

| No | Name | Finger print Code | Matching | Servo Motor | Parking Bar Position | LCD Display | Processing Time (Seconds) |
|---|---|---|---|---|---|---|---|
| 1 | Ahmad Soim, S.Kom | 2 | Match | Move to position 90º | Open | Silakan Masuk | 1.9 |
| 2 | Indri Yuliani Putri, S.E | 3 | Match | Move to position 90º | Open | Silakan Masuk | 2.2 |
| 3 | Ratna, S.Kom | 4 | Match | Move to position 90º | Open | Silakan Masuk | 2.1 |
| 4 | Amransyah | 5 | Match | Move to position 90º | Open | Silakan Masuk | 1.9 |
| 5 | Lilis Fauziah | 6 | Match | Move to position 90º | Open | Silakan Masuk | 1.8 |
| 6 | Deka | - | Not Match | Not Moving | Closed | Sidik Jari Tidak Cocok | 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | Mawar | - | Not Match | Not Moving | Closed | Sidik Jari Tidak Cocok | 2 |
| 8 | Hendi | - | Not Match | Not Moving | Closed | Sidik Jari Tidak Cocok | 1.8 |
| 9 | Beni | - | Not Match | Not Moving | Closed | Sidik Jari Tidak Cocok | 2.1 |
| 10 | Iskandar | - | Not Match | Not Moving | Closed | Sidik Jari Tidak Cocok | 1.8 |

Average Time of Fingerprint Matching Process on Entrance Parking Bar :

$$\frac{\textbf{Amount of data}}{\textbf{the number of Experiments}} = \frac{1.9+2.2+2.1+1.9+1.8+2+2+1.8+2.1+1.8}{10} = \textbf{1.96 Seconds}$$

**Table 2. Test Results on Parking Bar Closing Process :**

| Testing | Intitial Conditions | Motorcycle Position | Servo Motor | Processing Time (Seconds) |
|---|---|---|---|---|
| 1st | Open (90°) | Passing the sensor | Move to position 180° (Parking Bar Closed) | 3 |
| 2nd | Open (90°) | Not Passing the Sensor | Not Moving (Parking Bar Open) | 0 |
| 3rd | Open (90°) | Passing the sensor | Move to position 180° (Parking Bar Closed) | 2.7 |
| 4th | Open (90°) | Not Passing the Sensor | Not Moving (Parking Bar Open) | 0 |
| 5th | Open (90°) | Passing the sensor | Move to position 180° (Parking Bar Closed) | 3 |

Average Time of Parking Bar Closing Process:

$$\frac{\textbf{Amount of data}}{\textbf{the number of Experiments}} = \frac{3+2.7+3}{3} = \textbf{2.9 Seconds}$$

**TOTAL OF AVERAGE TIME REQUIRED TO START FROM FINGERPRINT MATCHING UNTIL THE PARKING BAR IS CLOSED BACK IN THE ENTRANCE PARKING BAR:**

So the total time needed for the average - the best process from the fingerprint position, open the bar until the crossbar is closed at the entrance bar is 4.86 seconds.

**Average Time of Matching Process on Entrance Parking Bar + Average Time of Parking Bar Closing Process = 1.96 + 2.9 = 4.86 Seconds**

Strength The advantages of this system are:

a) Based on the tests that have been carried out the system only uses fingerprints stored in the fingerprint sensor module database easily.

b) There are no more students who use Darmajaya IBI employee parking areas.

c) Give a decision on the parking area for IBI Darmajaya employees because only fingerprints can be issued from the parking area of Darmajaya IBI employees.

d) A fingerprint database can be added to 1,000 different fingerprint data.

## CONCLUSION

Based on the results of the system analysis that has been carried out, it can be concluded several things as follows:

1. It has been designed by the IBI Darmajaya employee motorbike crossing control system using the Arduino Uno-based fingerprint.

2. Testings of the IBI Darmajaya employee motorbike parking control system have been tested using the Arduino Uno-based fingerprint that is able to run well according to the design.

3. The parking entrance bar will open when the fingerprint matches the one in the fingerprint module database and on the 20 x 4 LCD (Liquid Crystal Display) command will be displayed to enter the parking area and the door bar will be closed again when an object passes through the ultrasonic sensor.

4. The parking exit door will open when the fingerprint matches the one in the fingerprint module database and then the door bar will be closed again when an object passes through the ultrasonic sensor.

5. The buzzer will emit beeps as a detector of theft if the fingerprint is not suitable when verifying the motor that will come out.

6. The total time taken on average ranging from matching fingerprints to closing bars is 4.86 seconds on the entrance bar with the maximum distance between the ultrasonic sensor and the object as far as 450 cm.

This tool still has many shortcomings so it needs to be developed. Following are suggestions for further research development such as This device needs

to be added to the camera as a plate detector, For further development this tool needs to be installed an alarm that can detect when there is forced damage to the system, This tool needs to be added a sensor to detect an empty parking location.

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