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CUSTOMIZED FINGERPRINT-BASED MOTORCYCLE IGNITION SYSTEM

Rolando Real Codilan
Faculty, College of Computer Studies, Eastern Samar State University Main Campus, Borongan City, Philippines

ABSTRACT
The objective of the study is to design and develop a fingerprint-based motorcycle ignition system that will allow the user to start the engine using fingerprint and send a notification to the owner if the engine starts. Fingerprint sensor and Arduino were combined in this study for vehicle security. The study used a developmental-evaluative design to evaluate the developed system. Based on the results, it shows that the system has passed the Software Quality Evaluation Tool using the IBM Computer-System Usability Scale. The study was able to design and develop a fingerprint-based motorcycle ignition system that provides high technology and security to a motorcycle.
KEYWORDS – *Fingerprint-based ignition system, biometric, Arduino, SMS*

I. INTRODUCTION

In the 21st-century technology competition rise-up and inevitable, the uses of biometric-based systems have seen an exponential increase. This is because of remarkable advancement in this field making it promising to bring down their prices. Furthermore, biometrics is becoming a new state of the art scheme for security systems. Biometrics are used to provide secure access to major functioning systems like ATM, cellular phones, cars, laptops, offices, and other things that need authorized access. Biometrics have made significant changes in security systems making them more secure than before, efficient and cheap in the study of Z. Brijet, B. Santhoshkumar*, N. Bharathi,(2017).

The biometric fingerprint security system is now being used in the four corners of the world. Each person's finger is unique so this is more secure. Vehicle security is more important nowadays. More vehicles are stolen and cannot be found back. Security system like fingerprint system can lessen this incident, especially in cars. Fingerprint sensor and Arduino were combined in this study. The starting system of the vehicle was customized. The basic connection was from ignition switch that supply voltage and relay to the voltage regulator then to the Arduino to turn it on and off, when input was given to the fingerprint sensor, it scans finger and if the fingerprint match to the database it will activate the relay that controls the starter and this will start the engine. If no finger scanned or finger image do not match to the database the starting system is disabled and it will not crank or start the engine.

This study aimed to develop a Fingerprint-Based motorcycle ignition system. The motorcycle ignition system was controlled using arduino board with a fingerprint sensor. The person's fingerprint was identified whether the person was registered or not. Only registered user/person can start the engine otherwise the engine will not start. The System provides a secure hassle-free way to start and stop vehicle engine. The user/s just need to ignite the motorcycle using the key itself to start up the system, to start the engine the user needs to scan his/her fingerprint. Otherwise, the engine will not start. The fingerprint sensor was connected to the arduino and so with the GSM. When the engine starts, it will send automatically a Short Messaging Service (SMS) to the owner in order him/her to notify.

Objectives of the study:

Specifically, the study sought to achieve the following objectives:

1. To design and develop a Customized fingerprint-based motorcycle ignition system that will:

a) Allow the user to start the engine using a fingerprint.
b) Send a notification to the owner if the engine starts.
c) Allow enrolling multiple users.
d) Only registered user/person to start the engine.

2. As perceived by respondents, what is the extent of acceptability of a Customized Fingerprint-based motorcycle ignition system in terms of:
   a.) Accuracy
   b.) Usability

II METHODOLOGY

Technical feasibility

The extent to which the system can be successfully designed, developed, and installed by the Developer. In technical feasibility, there was no difficulty in getting the required resources for the development and maintaining the system as well. All the resources needed to develop the software as well as for the maintenance are available.

Table 1. Software Requirements of the Developers

SOFTWARE NEEDED	SOFTWARE ON HAND	COMPATIBILITY	SOLUTION
Arduino Compiler	Arduino Compiler	Yes	None
MC programming: C	MC programming: C	Yes	None

Table 1 shows the minimum software requirements of the system and the technical specifications by comparing both components for compatibility.

Scheduling Feasibility

Table. 2 Hardware Requirements of the client

HARDWARE NEEDED OF THE CLIENT	HARDWARE ON HAND OF THE DEVELOPERS	COMPATIBILITY	SOLUTION
Laptop	Acer Laptop	Yes	
Arduino	Arduino UNO R3		
Fingerprint sensor	R307 Fingerprint		
Relay	5V relay		
GSM module	GSM SIM800L		

Table 2 shows the hardware components used during system development. This part illustrates the methods or steps that the study have.

System Architecture

This part illustrates the connection of the hardware components to other components. In this system, the fingerprint module was used. The fingerprint enrolment and fingerprint matching. The System will compare the finger which was enrolled with templates stored in Module.

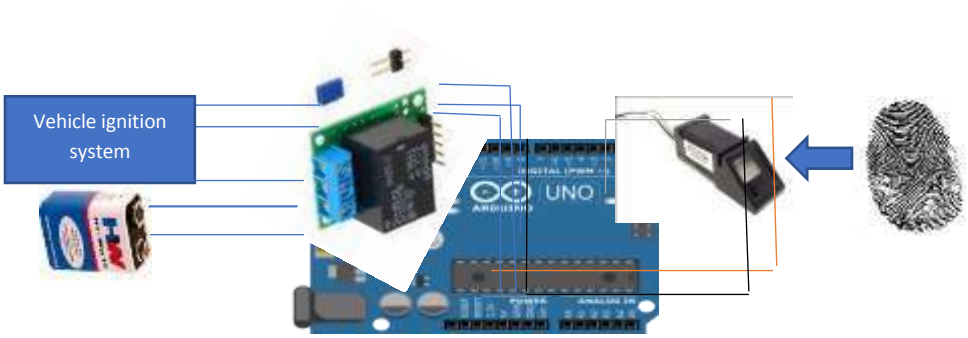

Figure 1. System Architecture

Figure 1 illustrates the interconnection of the process of the system.

Table 3 Fingerprint sensor serial communication pin configuration

Pin number	Name	Function description
1	5V	Regulated 5V DC
2	GND	Common ground
3	TXD	Data output.
4	RXD	Data input.
5	TOUCH	Active low output when there is a touch on the sensor by finger
6	3.3VT	Use this wire to give 3.3V to the sensor instead of 5V

There are six pin connections in the fingerprint sensor. These pin connections are explained in Table.3. Fingerprint sensor built inside the fingerprint module scans the finger and verifies with the pre-loaded data and shows the result whether it is a match or not. The fingerprint module is connected and gives the data to the Arduino board. If the result matches, then it made the relay to supply voltage. If not match, then to the unit stopped.

Software Evaluation

Research Design

The study used a developmental-evaluative design to evaluate the developed system. Structured Questionnaires were used to evaluate the system using the Software Quality Evaluation Tool based on IBM Computer-System Usability Scale. It consists of questions that measure the end-user and expert satisfaction with the system usability, and accuracy.

Data Analysis

The descriptive statistics using the mean to present the demographic characteristics of the respondents and the level of the system effectiveness.

The Expert evaluated the system using this following scale:

5 – Strongly Agree
4 – Agree
3 – Neither Agree or Disagree
2 – Disagree
1 – Strongly Disagree

The obtained mean was interpreted using the following:

Numerical Rating Scale	Adjectival Rating
4.20 – 5.00	Highly Usable
3.40 – 4.19	Usable
2.60 – 3.39	Moderately Usable
1.80 – 2.59	Moderately Unusable
1.00 – 1.79	Highly Unusable

System Evaluation

To record the system performance, system testing was scrutinized by respondents who are the end users and experts in the field. Their expertise and valuable recommendations for the efficient use of the system would be a great help to the overall progress of the system before the acceptance testing was carried out.

Acceptance Evaluation

An acceptance testing was recommended to determine the usability to confirm if the system was complete and ready for its full-scale implementation. The acceptance testing was usually conducted by its end users to see how firm and how beneficial the system was.

III RESULTS AND DISCUSSION

This chapter discusses the several objectives determined during the early period of the study to ensure that the system was created to address the concerns that are currently faced. The output is obtained for both registered and unregistered users/persons fingerprints. The Fingerprint scanner was connected to the arduino. When a finger was placed over the fingerprint sensor it scans and compares with preloaded data. If the fingerprint matches then the ignition system turned on. If the fingerprint does not match then the ignition system turned off.

The first objective was to allow the user to start the vehicle using the fingerprint.

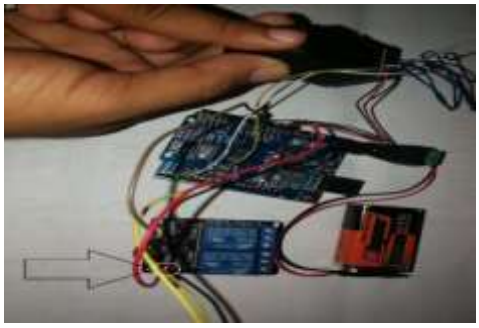

Figure 2 Scanning of registered Person's Fingerprint and Turning the Engine on.

Figure 2 shows when fingerprint matches, registered person input was given the Arduino controller leads to turn on the engine.

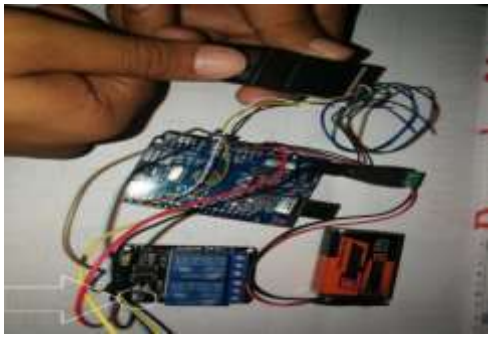

Figure 3. Unregistered person's fingerprint was scanned and the engine remains off.

Figure 3 shows when fingerprint does not match, the Arduino controller does not perform its action and the relay kept in the off state.

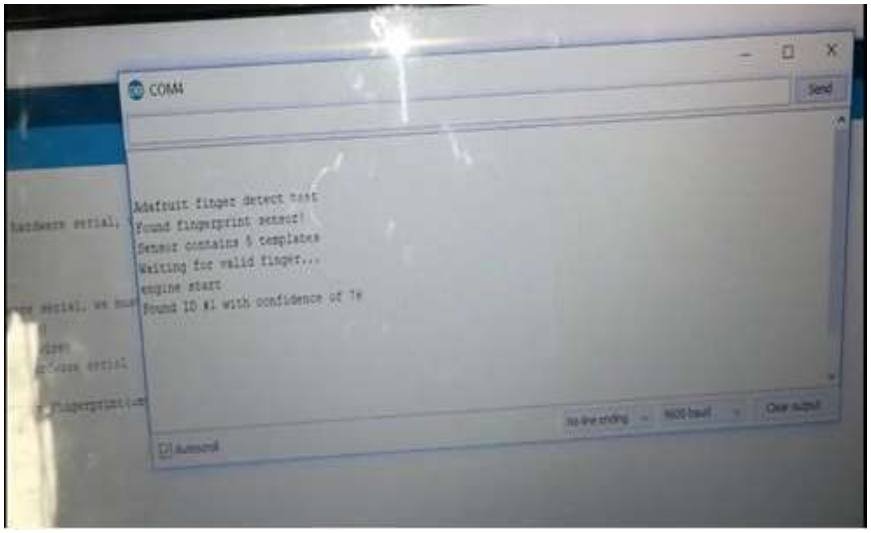

Figure 4 Verification of Authorized Fingerprint

Figure 4 allows the user to start the engine using fingerprint

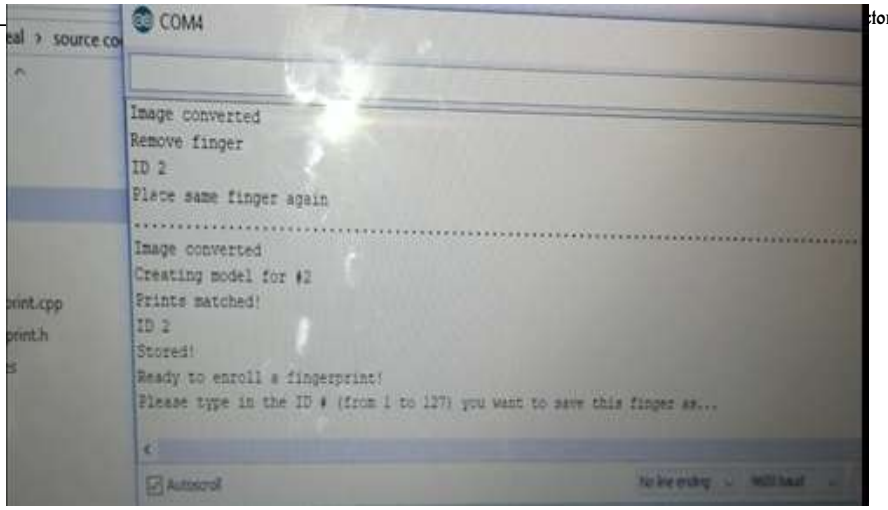

Figure 5 Enrollment

Figure 5 allows the user/s to enroll/register his/her fingerprints.

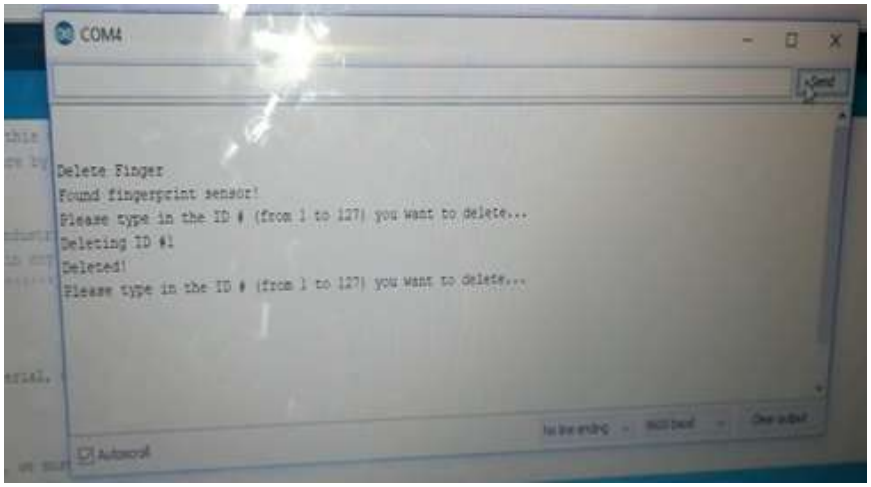

Figure 6. Deletion of Enrolled ID#

Figure 6 allows the user to delete the stored fingerprint.

Expert Evaluation

Table 4. Weighted Mean and Interpretation (Expert)

USABILITY		
Question	**Weighted Mean**	**Adjectival Interpretation**
Overall, I am satisfied with how easy it is to use this system.	4.9	Highly Usable
It was simple to use this system.	5.0	Highly Usable
I felt comfortable using this system.	4.9	Highly Usable
It was easy to learn to use this system.	4.9	Highly Usable
It is user-friendly	4.9	Highly Usable
Average Weighted Mean	4.92	Highly Usable

The results revealed in the table above that the system has passed all the standard or expectations of the expert. In addition, the result shows that the system has a high standard based on its usability with an Average Weighted Mean of 4.92 and interpreted as **Highly Usable**. With the results, the system adhered to the Software Quality Evaluation Tool and based on IBM Computer-System Usability Scale.

Table 5. Weighted Mean and Interpretation (Expert)

ACCURACY		
Question	Weighted Mean	Adjectival Interpretation
The system recognizes the fingerprint of the registered user.	5.0	Highly Usable
The system is precise in its result in terms of validating fingerprint.	5.0	Highly Usable
This system has all the functions and capabilities I expect it to have.	3.9	Highly Usable
Average Weighted Mean	4.63	Highly Usable

The table above shows that the system has passed all the standard or expectations of the expert. In addition, the result shows that the system has a high standard based on its accuracy with an Average Weighted Mean of 4.63 interpreted as **Highly Usable**. With the results, the system adhered to the Software Quality Evaluation Tool and based on IBM Computer-System Accuracy Scale.

End-User Evaluation

Table 6. Weighted Mean and Interpretation of (End-User Testing)

USABILITY		
Question	**Weighted Mean**	**Adjectival Interpretation**
Overall, I am satisfied with how easy it is to use this system.	4.7	Highly Usable
It was simple to use this system.	4.8	Highly Usable
I felt comfortable using this system.	4.6	Highly Usable
It was easy to learn to use this system.	4.3	Highly Usable
It is user-friendly	4.5	Highly Usable
Average Weighted Mean	4.58	Highly Usable

Table 6 revealed that the system has passed all the standard or expectations of the end-user with an Average Weighted Mean of 4.58 interpreted as **Highly Usable**. Based on this result, it only shows that the system has passed the high standard according to its usability. The end-user evaluation shows that the system adhered to the Software Quality Evaluation Tool based on IBM Computer-System Usability Scale and was highly appreciated

Table 7. Weighted Mean and Interpretation of (End-User Testing)

ACCURACY		
Question	Weighted Mean	Adjectival Interpretation
The system recognizes the fingerprint of the registered user.	5.0	Highly Usable
The system is precise in its result in terms of validating fingerprint.	4.8	Highly Usable
This system has all the functions and capabilities I expect it to have.	3.5	Usable
Average Weighted Mean	4.43	Highly Usable

It can be gleaned in table 7 that the system has passed the high standard according to its Accuracy with an Average Weighted Mean of 4.43 interpreted as **Highly Usable**. The end-user evaluation shows that the system adhered to the Software Quality Evaluation Tool based on IBM Computer-System Accuracy Scale and was highly appreciated.

IV CONCLUSIONS

Fingerprint Recognition was the first biometric approach to verify the person by downloading the images in the database. The image is first analyzed and then identified, extracted and stored the images in the database. For the identification process, it compares first the query image against the image stored in the database and then verifies it. From the above result, it was clear that the use of the biometric system offers a better and more reliable result. Moreover, it was restricting the starting of the vehicle's engine by an unregistered user/s. Only the fingerprint image verified has the ability to access the engine of the vehicle.

Based on the results of the system testing and evaluation, the study came up with the following conclusions:

1. The study was able to design and develop a Customized fingerprint-based motorcycle ignition system that provides high technology and security to a motorcycle.
2. The user can:
   - 2.1 Enroll or register multiple fingerprints.
   - 2.2 start the engine using a registered fingerprint.
   - 2.3 delete the stored fingerprint.
   - 2.4 received an SMS alert if the engine starts.

3. The expert evaluation resulted in an Average Weighted Mean of 4.2 interpreted as **highly usable** for Usability, and for Accuracy, evaluation resulted in an Average Weighted Mean of 4.63 interpreted as **highly usable**. While the end-user testing resulted in an Average Weighted Mean of 4.58 interpreted as **highly usable** for Usability, and with an Average Weighted Mean of 4.43 interpreted as **highly usable** for accuracy. Based on the results, it shows that the system has passed the Software Quality Evaluation Tool using the IBM Computer-System Usability Scale.

REFERENCES

1. *Z. Brijet (2017). Vehicle Anti-Theft System Using Fingerprint*