

Application Of Security System Of Motorcycle Used Fingerprint Optical Sensor And Vibration Sensor With Fuzzy Logic Based On Arduino Uno R3

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Abstract

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The Increasing case of motorcycle theft in North Sumatera and lack of human control of safety locks is an important factor for every motorcycle owner to add dual security system. The research aimed to add double protection of the motorcycle by utilizing the advantages of the Fingerprint sensor plus a vibrating sensor SW-420 and IR Proximity sensor which is controlled by a microcontroller with fuzzy logic as process logic. The fuzzy logic used to produce the output of motorcycle condition which is silent, shifted by early is the alarm if there are the other individuals who try ignite or move the motorcycle position. The microcontroller is used to control relay based on verification results from Fingerprint optical sensor FPM10A module as well as do the process of fuzzy logic at vibrating sensor SW-420 module and IR Proximity sensor then it will produce the alarm output is sound. These protection system tools can increase the safety of the motorcycle owner..

Keywords: Fingerprint, Fuzzy Logic, Microcontroller, Vibration Sensor

1. Introduction

Based on data from the Central Statistics Agency (BPS) in the 2018 Criminal Statistics book, North Sumatra Province ranks second in Indonesia regarding the high number of motor vehicle theft cases with 4726 cases after West Java Province with 5234 cases. This happened, one of which was due to the lack of a security system in motorized vehicles that only relied on the ignition key. In addition, the lack of a human surveillance system is often overlooked. The dual security system is one way to overcome the problem of motor vehicle theft [1], [2].

The definition of automatic recognition in the biometric definition is by using technology (computer), the recognition of a person's identity can be done in real-time, it does not take hours or days for the recognition process. The biometric system will automatically recognize a person's identity based on the biometric characteristics stored in the database. One of the most popular biometric technologies used is fingerprints.

Fingerprints are permanent, which means the pattern doesn't change like the outline of a hand from infancy to adulthood. Each finger has a different pattern [3].

The SW-420 module is a module that reacts to vibrations from various angles. This electronic component is in a normally closed condition and is conducive. This vibrating sensor is commonly applied to security systems, such as earthquake detection, malfunction detection in mechanical systems, automatic railway doorstop systems, and so on [4].

An infrared proximity sensor or IR Proximity sensor is a module consisting of infrared and photodiode which functions to detect obstacles or objects in front of it. This sensor is commonly used in line follower robots or obstacle robots (4). In this study, the author uses fuzzy logic, fuzzy logic was first

developed by Lothfi A. Zadeh in 1965 (5). Fuzzy algorithms have been widely used in many fields of science [5].

Based on these things, the authors developed a tool as a motorcycle protection system using a fingerprint optical sensor FPM10A module and an SW-420 module with microcontroller-based fuzzy logic. There were various previous studies written by Hendra Panggabean with the title "Fingerprint Based on the Atmega8535 Microcontroller and using the GSM module as a remote controller" and Dwi Ely Kurniaan and Muhammad Nahharus Surur with the title "Designing a Motorcycle Security System Using a Raspberry Pi Microcontroller and an Android Smartphone" [6], [7].

2. Literature Review

The protection system is a security system created to prevent, avoid, or minimize something unwanted, such as damage, loss, safety risk, or others that have an impact on losses. So that by creating a protection system is expected to be able to solve existing problems. Some examples of security systems include computer protection systems, vehicle protection systems, industrial equipment protection systems and so on.

Private vehicles usually cannot be used by anyone except the owner. To maintain this security, a good security system is needed to prevent theft. To ensure this level of confidentiality, it can be used with various variations of code combinations, so that only certain people can access the code. All codes can be realized by using a combination of special characteristics possessed by the owner, especially in fingerprints, because every human fingerprint is unique [8], [9].

Biometrics serves as an authentication process. Biometrics can theoretically be more effective for identifying a person's personality because biometrics measure the characteristics of each person to distinguish each person. Unlike conventional identification methods that use something you have, for example an identity card for access to a building, or something you know, such as a password to log on to a computer system and so on.

When used for personal identification, biometric technology measures and analyzes the behavioral and physiological characteristics of humans. Identifying a person's physiological characteristics based on direct measurements of parts of the body—fingertips, hand geometry, facial geometry and eye retinas and irises [10].

Fuzzy logic is a branch of the field of soft computing. Fuzzy logic was first introduced in 1965 by (A.Zadeh, 1996), a professor of computer science at the University of California at Barkley. Fuzzy logic is a logical set theory that was developed to overcome the concept of value that exists between true and false.

3. Method

The Motorcycle Protection System in this study uses a fingerprint sensor as an authentication module, an SW-420 vibration sensor module as a vibration detector and an IR Proximity sensor to detect the number of tire rotations. Safe, shifted by officers and stolen by thieves who will then activate the buzzer as an early warning. So it is expected that motorcyclists can feel more secure. So the author will apply this technology to a motorcycle protection system using a fingerprint optical sensor FPM10A module and an SW-420 module with fuzzy logic based on a microcontroller [11], [12].

Fuzzy rules on a motorcycle protection system using the fingerprint optical sensor FPM10A module (input 1) and SW-420 module (input 2) with a microcontroller-based fuzzy logic have each condition, namely Weak, medium, and strong, at input one and for conditions input two i.e., Near, Medium, and Far. Therefore, a fuzzification process is needed to be able to determine the safety status of the motorcycle. Fuzzy logic allows membership values between 0 and 1, gray levels, as well as black and white, and in the form of linguistics, the advantage of the fuzzy logic theory is the ability in the reasoning process so that in its design, it is not necessary to require mathematical equations of the object to be controlled. The

microcontroller detects movement with a value of 0-100 cm and detects the number of tire rotations from 0-4cm with a range of values for each input will be used as three linguistic variables, namely:

Table 1. Fuzzy Sets (Input 1)

No.	Status Variable	Vibration Value
1.	Weak	0 – 150
2.	Medium	150 – 250
3.	Strong	250 - 500

Table 2. Fuzzy Sets (Input 2)

No.	Status Variable	Tire Rotation Value
1.	Near	0 – 1 cm
2.	Medium	1 – 2 cm
3.	Far	2 – 4 cm

Table 3. Fuzzy Sets (Output)

No.	Status Variable	Tire Rotation Value
1.	Off & Safe	0 – 1 cm
2.	Off & Shift	1 – 2 cm
3.	On & Stolen	2 – 4 cm

The value of each input is divided into three conditions where when the motion detector and tire rotation are in a weak and close condition, the Alarm and LED will automatically provide a notification that the motorcycle is off and safe, and if the tire movement and tire rotation detector is in a state of strong and close, the Alarm and LED will automatically provide a notification that the motorcycle is On & Stolen and so on the microcontroller will automatically provide a notification with the value of each specified fuzzy.

System Block Diagram Design. Block diagrams have a very important role. The block diagram of the system in the design made is as follows:

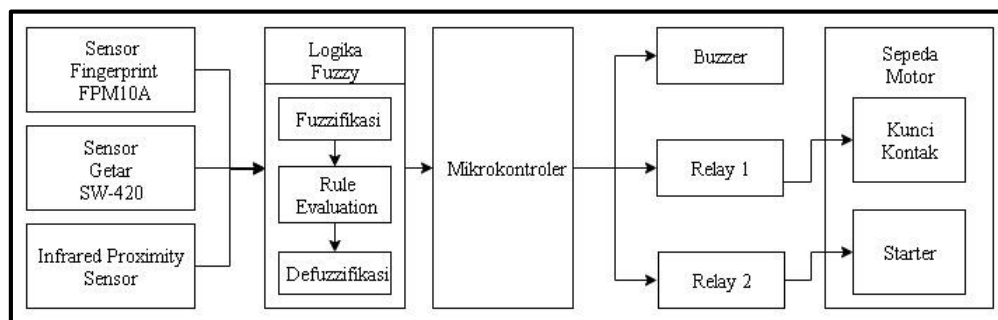


Figure 1. Block Diagram

The block diagram describes the protection system on the motorcycle as a whole and the relationship between the Arduino UNO R3 circuit. As for the explanation of the block diagram circuit in the image of the vibration sensor and infrared detecting conditions on the motorcycle when it is parked, the value of the vibration sensor and IR Proximity sensor is processed by Arduino UNO R3, when the value meets the

"stolen" condition in fuzzy logic, the buzzer will be turned on, the relay fully controlled by Arduino UNO R3 as a switch for motorcycle electricity, the FPM10A fingerprint sensor functions as an authentication tool to turn on the motorcycle, if the first fingerprint detection is correct, relay one is turned on and will activate the ignition, if the second fingerprint detection is correct, then relay two is turned on and will activate the starter, if the third fingerprint detection is correct. The two relays will be turned off and will turn off the motorcycle, if the fingerprint detection is incorrect, it will turn on the buzzer and disable the fingerprint sensor function.

The function of Arduino is as the processing brain of a tool so that it is able to run the program that has been programmed. The microcontroller circuit requires a reset circuit which is useful for restarting the system on the Arduino UNO R3, this is needed if the Arduino UNO has problems in program execution [13], [14].

Below is a picture of the whole circuit,

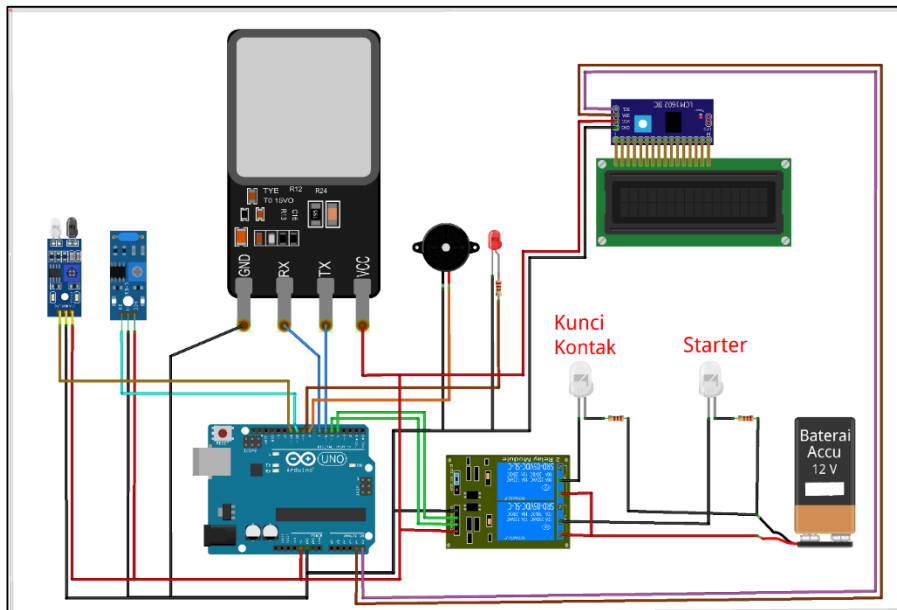


Figure 2. Design of System Components

The design of the motorcycle protection system flowchart is an illustration of the work system that will run on the motorcycle protection system and makes it easier to design a work system on the motorcycle protection system.

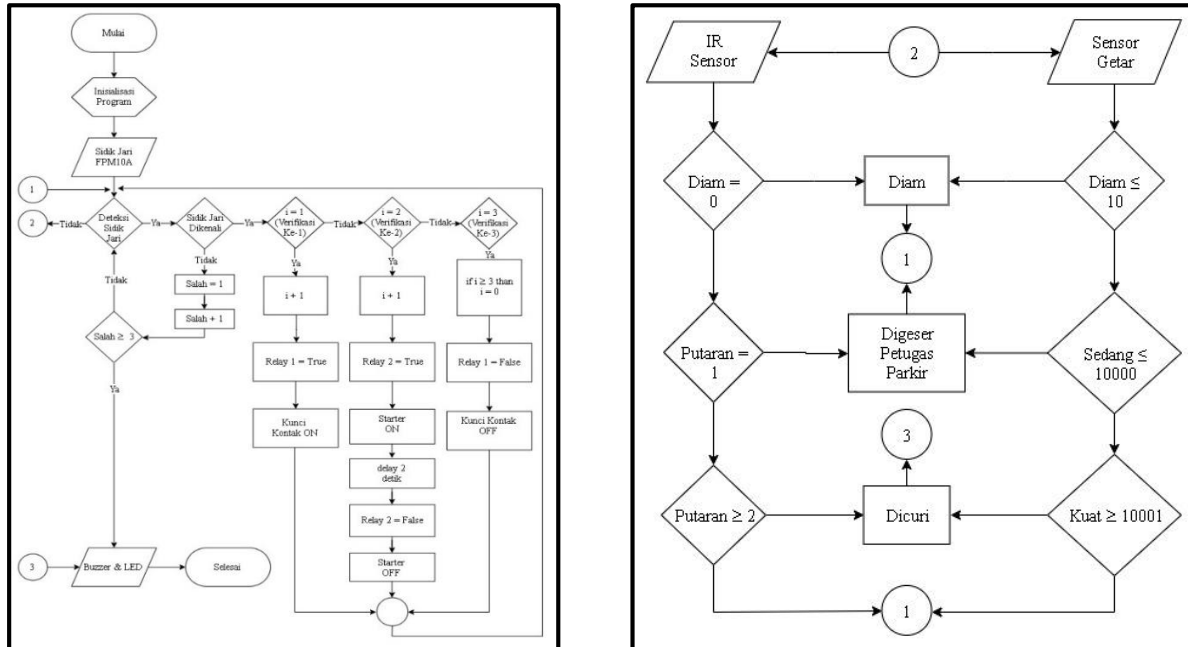


Figure 3. System Flowchart

Flowchart showing the working system of the device on the motorcycle protection system detector. The detection system that will be made is an automatic detection system using the fuzzy method with feedback from the Alarm and LED devices. The working principle is that the system will analyze the data after the start. The data to be analyzed by the system are input and output. Then the fingerprint optical sensor FPM10A module will detect movement with the result data received whether the motorcycle's condition is Weak, Medium, and Strong. If the SW-420 module's vibration sensor detects tire rotation in conditions of Near, Medium, and Far, then the SW-420 module's vibration sensor will work according to its function, namely detecting the presence or absence of motion detected on the motorcycle, if any, it will automatically output Alarm and LCD as notifications and if not then the system returns to the fingerprint optical sensor FPM10A module to work.

Fuzzy system into ATmega328 microcontroller with Arduino IDE compiler in C programming language. This programming flow consists of C program design, compilation process, program upload, and test. In the Arduino IDE compiler, it is necessary to carry out initial programming configurations such as determining the chip according to system requirements and ports based on their function, as input or output. After the configuration is done, then the program is written using C language, after that it is uploaded to the microcontroller after the compilation process is carried out to find out whether there is an error or not. If there are no errors, the program is finished implanted in the microcontroller [15].

4. Results and Discussion

The results of the motorcycle protection system using the fingerprint optical sensor FPM10A module and the SW-420 module with microcontroller-based fuzzy logic can apply this technology to the motorcycle protection system. System implementation and testing are carried out to prove whether the circuit that has been made is functioning as planned or not. Each test is carried out by measuring which will later be used to analyze supporting hardware and software. As shown in the picture below, the results on the design of a motorcycle protection system where each component has been properly installed and ready to run.



Figure 4. Security System of Motorcycle Hardware

Part A consists of three components, namely the FPM10A module which is used to detect fingerprints that have been registered in advance, the SW-420 vibration sensor which is used to detect vibrations and the IR Proximity sensor is used to calculate the number of tire rotations. Part B contains an ATmega328 Microcontroller component that functions for processing input data from Part A components. The data obtained as fuzzy input is then processed by the microcontroller, resulting in fuzzy output. Part C contains an I2C driver circuit and a 16x2 LCD to display information, then the buzzer, LED and resistor serve as visual warnings in the form of sound and LED color.

At this testing stage, experiments were carried out on the vibration and infrared sensors and then a mapping of the values generated by the sensors was carried out to obtain conditions on the motorbike, based on conditions that allow the motorbike to be experienced, namely safe, shifted by officers or stolen.

Table 4. Test Result

No.	Experiment On Motorcycle	Vibration Value	IR Proximity Value	Alarm Response and LCD Display
1.	idle	0	0	Off & Safe
2.	Occupied	46	0	Off & Shift
3.	Moved to the right	398	0	Off & Shift
4.	Moved to the right	809	0	On & Stolen
5.	Moved to the left	403	0	Off & Shift
6.	Moved to the left	379	0	Off & Shift
7.	Pushed forward	124	1	Off & Shift
8.	Taken away	670	4	On & Stolen
9.	Taken away	321	3	On & Stolen
10.	Taken away	504	5	On & Stolen

From the results of the tests carried out, several experiments were carried out. Then the results will be recorded on the motorcycle system and the test is carried out ten times.

5. Conclusions

After conducting a literature study, analysis and design and testing of a motorcycle protection system using a fingerprint optical sensor FPM10A module and an SW-420 module with a microcontroller-based fuzzy logic, it can be concluded that a motorcycle protection device can secure a motorcycle properly. The FPM10A fingerprint sensor functions to turn on the ignition, turn on the starter and turn off the ignition with the help of a relay on the Arduino UNO R3 device. If the motorbike is stolen, it will turn on an alarm in the form of a buzzer and an LED. The FPM10A fingerprint sensor identifies fingerprints properly and correctly. Fuzzification on the SW-420 vibration sensor and IR Proximity sensor can distinguish the conditions of the motorcycle both when it is safe, shifted by officers and stolen.

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