Design of Parking Brake Lock: RFID based Motorbikes Security Module

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Abstract: The project is related to the design of a module that serves to increase the security of motorbikes, which will be used to prevent vehicle theft. The developed module works based on the Parking Brake Lock and RFID system. Wheel locking is enabled when the motorbike is parked using a smartphone synchronization with a microcontroller as a control unit, and an RFID reader will identify the ID tag for the function of starting and turning off the motorcycle engine. The designed security module shows good results as expected.

1 INTRODUCTION

In general, many security systems have been developed for vehicles, especially cars and motorbike, which aim to prevent the theft of these vehicles. Another use of a security system on a vehicle is that we can add a function to track the position of the vehicle if a thief manages to break into the existing security system. In developing countries, vehicle theft crimes are counted quite a lot every year (Pranata et al., 2020). The average number of motorbike theft cases is always more than car theft, this is because the motorbike security system is simpler and easier for thieves to penetrate, compared to the car security system. Besides, the business of selling stolen motorbike is also quite large, easier, profitable, and organized.

A new type of security developed for today's modern vehicles is the smart keyless entry and start system (Francillon, Aurélien; Danev, Boris; Capkun, 2014). This system is a technology to replace conventional keys or physical keys which are generally used to start the vehicle. The drawback from the user's point of view is that if the remote key is damaged or lost, the replacement of the remote key must be by the immobilizer ID registration programmed by the manufacturer. We can use our additional safety for our vehicles as an alternative solution. As in research that developed an anti-theft vehicle security system for preventive action, vehicles are equipped with GPS and GSM technology to protect, monitor and track the vehicle (K. A. Mamun, 2016). In another study, a security system for motorbike was designed using three security systems in the form of an RFID scanner, RF communication module, and a GPS function. The RFID scanner functions as an additional key, if other than the registered card (tag) it cannot turn on the relay. The RF communication module functions to turn off the motorbike engine automatically if there is a distance of n meters between the driver and the motorbike. The GPS functions to monitor and track the location of motorbike (Isyanto et al., 2018). Another variation of the antitheft vehicle security system was presented by (Naina Kaushik, Mayur Veralkar, Pratik Parab, 2014), the security system works by matching the fingerprints of registered car drivers. The matching process uses Matlab and the results will be displayed on the LCD. If a car is stolen, the car's fuel tank will be locked so that when the tank is empty, it cannot refill fuel.

In this paper, the author proposes an additional vehicle security system that utilizes parking brake locks and RFID sensors. The parking brake lock is the first layer of security and the RFID sensor is the second layer of security that is connected to the vehicle's electrical system for the prevention of motorbike theft.

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2 METHOD

2.1 System Overview

For the design of this study, we used an experimental method which was used to determine the effect of the independent variable on the outcome variable under controlled conditions. At the initial stage, the equipment and components needed are determined in advance, and as the control unit, the Arduino microcontroller is chosen to run the program created. Arduino Uno is a microcontroller board that is fully controlled by the ATmega328. The Arduino Uno has 14 digital input or output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button (Kadir, 2017). The other main components used in this design are RFID MFRC522, df player, speaker, Bluetooth HC-06, smartphone, DC motor, compact step down, APK boarduino, and relay module.

The steps in designing the motorbikes security module that we propose follow the control flow as shown in Figure 1. The way of module works is when the motorbike is stopped and parked, the driver will use the parking brake lock and after the ignition switch is OFF the motorbikes security module will automatically disconnect the starting system. Meanwhile, to be able to run a motorbike, the driver must follow the vehicle security procedures that have been set according to the design in this study. After the ignition switch is ON, the first step is to synchronize the module with the smartphone via a Bluetooth connection, so that the microcontroller can disable the parking brake lock. Next, the microcontroller needs to get a signal from the registered ID tag scan and activate the motorbike starting system. Figure 2 shows the system architecture consisting of hardware and software used as components of this motorbikes security module. The software used for programming syntax is Arduino IDE as an intermediary device between the microcontroller and the Arduino compiler (Banzi & Shiloh, 2014).

2.2 Block Diagram Description

The block diagram in Figure 3 below explains how the proposed motorbikes security module works. After the ignition switch is in the ON position, the electric current from the power source for the security module that uses a 12 v battery from a motorbike will be passed through a compact step down so that it drops to 8 v, according to the safe working voltage range for the Arduino microcontroller. The incoming

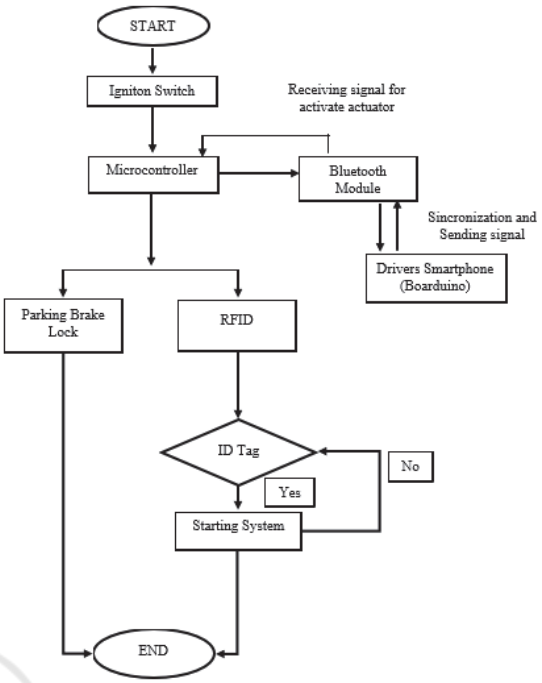

Figure 1: Control flow of the proposed system.

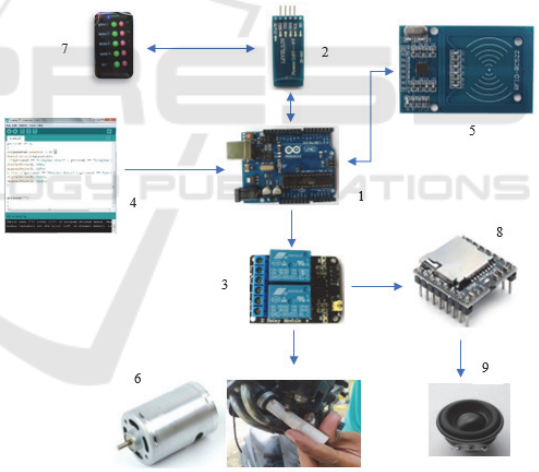

Figure 2: Embedded system architecture.

8v voltage will activate the Arduino microcontroller, and turn on the Bluetooth module to synchronize the signal with the android smartphone. If the synchronization is successful, the driver can drive the actuator by sending commands to the Arduino microcontroller via a smartphone. The first function that is activated is the release of the parking brake lock so that the wheels are not locked, then the RFID sensor identifies the ID Tag that has been registered in the database. To turn on the engine, it takes one time to scan the ID Tag which is recognized by the

system so that the motorbike can run and to turn off the engine, do a second ID tag scanning process.

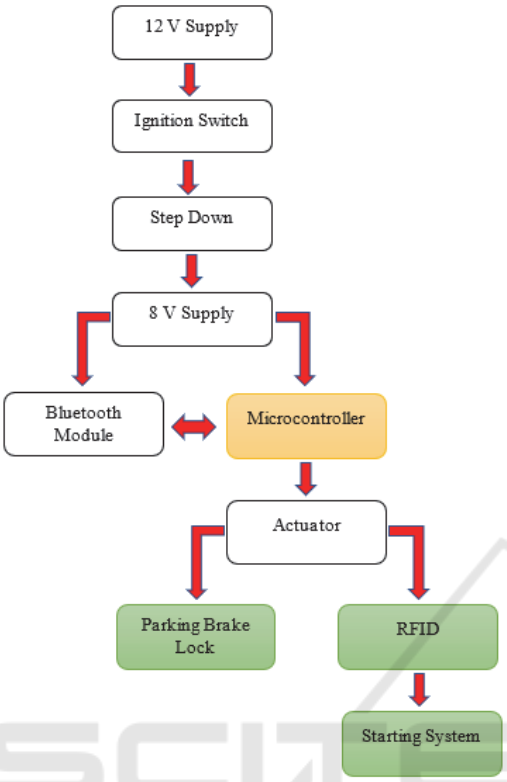

Figure 3: Block diagram of proposed system.

Figure 4: Locking of wheel and starting system.

In the engine OFF condition, and the motorbike will be parked, the driver can lock the front wheel of the motorbike by activating the parking brake lock feature and the module will automatically disconnect the starting system as shown in Figure 4. In this condition, even though the ignition key has been forcibly tampered with, the motorbike still cannot run because the front wheel has been locked and the starting system on the motorbike is not active.

3 RESULT AND DISCUSSION

After the motorbikes security module design process is complete, the module is packaged in a dimensionally appropriate box. The module is placed at the bottom of the motorbike seat so that it is not visible and avoids water. The next step is to make minor modifications to the brake handle to install a DC motor component that has been given a sleeve so that it can function as a parking brake lock. You do this by adding a bolt of the appropriate length at the end of the DC motor, this bolt will hold the movement of the brake handle later. Followed by connecting the starting system circuit with the motorbikes security module so that it can function as additional security on the vehicle. How it works, the starting system circuit line will be cut off automatically when the ignition is in the off position, in this case, the starter switch is replaced by a relay module for the starter relay input to turn on the motorbike (Figure 5). The process of assembling and testing motorbikes security modules can be seen in Figure 6 below. At the top is the process of inputting the ID Tag pin and testing its identification, then installing the module that has been packaged in a box on the motorbike trunk. While the bottom of the picture shows the installation process on the motorbike starting system circuit, and finally the motorbike turn on and turn off process using the ID Tag.

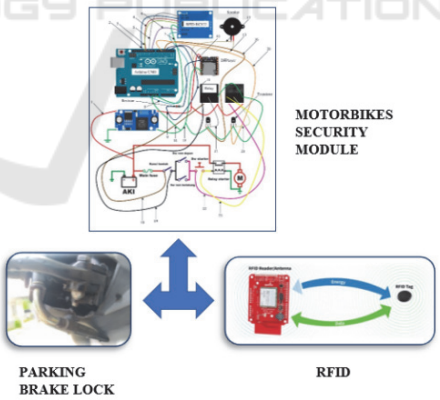

Figure 5: Vehicle security module wiring.

For the safety factor of the module, the voltage that supplies the Arduino microcontroller power is maintained in the 7-9 Volt range. This is to avoid overheating conditions on the Arduino components and several other components that can cause damage. The voltage measurement is carried out using a multimeter in the section before the step down and after the step down, and the measurement results can be seen in Table 1 below.

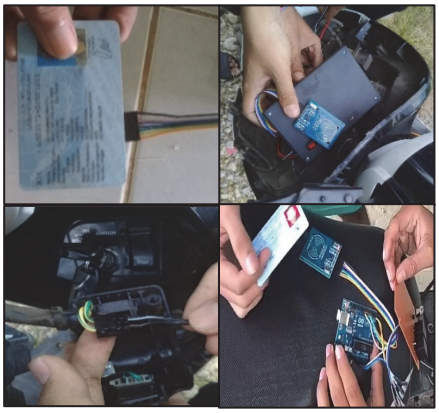

Figure 6: Module assembly and testing processes.

Table 1: Voltage Measurement.

Measurement	Variables	Voltage (Volt)
Vin (before step down)	Voltage	12
Vout (after step down)	Voltage	8.0

The results of the tests that have been carried out show that the module can work according to the initial design. Because the module has functioned as an additional security system on the motorbike, the module will start working when the motorbike is parked to avoid the crime of vehicle theft. If the motorbike stops, the driver can lock the motorbike wheel to park by synchronizing the smartphone with the security module using a Bluetooth connection, and after turning the ignition switch to the off position, the wiring starting system is disconnected. In addition to measuring the voltage, an ID tag recognition test was also carried out which had been inputted into the database module. Based on testing, the module can identify all ID tags well, can distinguish between ID tags that have been inputted and not inputted in the database module. For the ID tag identification position that is given a barrier, the module can still read properly up to a distance of 10 cm. When the motorbike will be used, the first step, as usual, is the ignition switch in the ON position, so that the current from the battery which has been lowered to 8 v provides power to activate the Arduino microcontroller. The driver then unlocks the wheel by activating the actuator on the parking brake lock, through a command given to the microcontroller. For the motorbike starting process, the driver needs to scan the ID tag once on the RFID reader so that the module will start the motor starter. When the engine is running, the speaker will sound “Motor ON” indicating the motorbike starting process is successful. After that, if the motorbike will be turned off, the driver needs to scan the second ID tag on the RFID, and the speaker will sound "Motor OFF".

4 CONCLUSIONS

There are many ways to increase the security of motorbikes from the possibility of theft, one of which is using the motorbikes security module that uses a parking brake lock and RFID device to increase the level of security. This module is used to prevent the crime of motorbikes theft through the release of the parking brake lock via a smartphone and ignition of the motorbike via registered ID Tags. This research can complement the types and methods of using microcontrollers and RFID which are implemented as motorized vehicle security devices.

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