

Development Of Two-Wheel Vehicle Security System Based On Internet Of Think

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Abstract – Motorcycle theft and robbery have drastically increased the ease of losing motorcycles in public places, especially motorcycles that do not have more safety such as keyless in general. The current motorcycle security system still uses the key as the main security or uses additional security electronic devices such as an alarm that sounds if there is a hard touch on the motorcycle. However, security like this is not fully guaranteed that the motorcycle is safe. The problem of this research is how to design a security system based on RFID, GPS and telegram applications. The purpose of this research is to design a motorcycle security system based on RFID, GPS and telegram applications that can monitor and secure motorcycle vehicles and know the difference in distance between GPS coordinate points to facilitate detection of the location of our motorcycle and also to turn on the motorcycle electricity must scan the identity of the motorcycle owner. The research method consists of hardware and software design and testing of the RFID system, GPS testing, monitoring testing through the telegram application and testing the overall electric current. In the RFID distance test, the tag is perfectly read up to a distance of ± 3 cm with a success rate of 100%. However, at a distance of ± 4 cm and above, the readings were inconsistent, and above ± 5 cm, the tags were not read at all. GPS sensor testing was conducted to detect the location of the motorcycle based on latitude and longitude coordinates at several points. The difference between two points is calculated using the Euclidean distance formula, where the difference in latitude and longitude is converted into meters. For example, a 1-second latitude difference is equivalent to 30.92 meters, and a 2-second longitude difference is equivalent to 61.85 meters. By calculation, a distance difference of 69.14 meters is obtained between the two points. This shows that the GPS sensor can detect position differences with sufficient accuracy.

Keywords: *rfid sensor, gps sensor, remote controller, IoT*



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I. INTRODUCTION

Motorcycles are the most practical vehicle and can be obtained among all communities. The reason motorcycles are often used is because motorcycles are relatively cheap and fuel-efficient. In Indonesia, the number of motorcycle users is around 125.3 million units by the end of 2022. Motorcycle vehicles are considered to be the most efficient transportation.[1]

Radio Frequency Identification (RFID) is a system that can transmit and receive data by utilizing radio waves. transmitting and receiving data by utilizing radio waves, which consists of 2 parts, namely tags or transponders and readers. RFID tag is a chip that stores a unique ID number, where each RFID tag has a different ID number.different. The 13.56 MHz RFID reader is used to read the ID number on the RFID tag.

Various reasons are known as to why the snatchers committed the act. One of the main reasons is economic. They usually sell the snatched motorcycle to be used for daily living expenses because many of the snatchers are unemployed. The emergence of new motorcycle products each year is also alleged to be a trigger for robbery because they want to own the vehicle without having to spend money. The absence of motorcycle security when the condition is snatched also makes the robbers free to take the victim's motorcycle. In general, security on vehicles is still passive. Such as handlebar locks, key covers and so on.

In this study the authors provide problem limitations in building this security system, including: the system cannot work if the GPS module does not get a signal; does not discuss the electrical system on the vehicle; Can use more than one e-KTP.

II. METHOD

The operating principle of this device is based on the system structure in the form of block diagrams and workflows in the form of flowcharts. This device utilizes Arduino Uno as the controlling center and Android smartphone as input to send instructions to the system, with the connection bridged by the Wemos WiFi module.

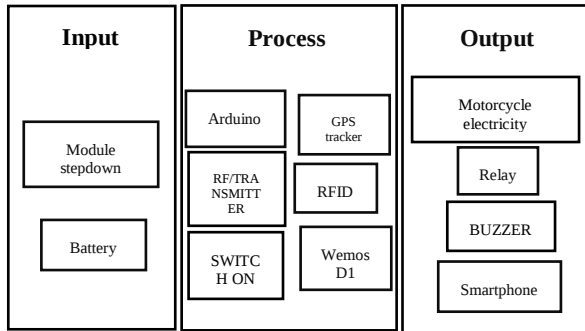


Figure 1. Tool working process

The Android app has two main options: Safe Mode and Normal Mode. When the smartphone is connected to the WiFi module in Safe Mode, the system automatically activates without the need to use the ignition key. System instructions are executed through the menu selected on the Android app, and the signals will be processed by the Arduino Uno. The Arduino Uno will disconnect the relays according to the options selected through the app.

In Normal Mode, the system is returned to its factory configuration and the app cannot control it. Another advantage is that the ignition key can still be used when the smartphone battery is low. If the vehicle is stolen, the system will automatically shut down the vehicle and the engine will not be able to be started, even if using a T key or trying to crank, except in Safe Mode.

The purpose is to position the components so that they can be installed correctly and neatly. Furthermore, in the process of designing this tool, a flowchart is required. This flowchart is used to plan the sequence of steps in the operation of the tool, so as to produce results in accordance with the desired objectives.

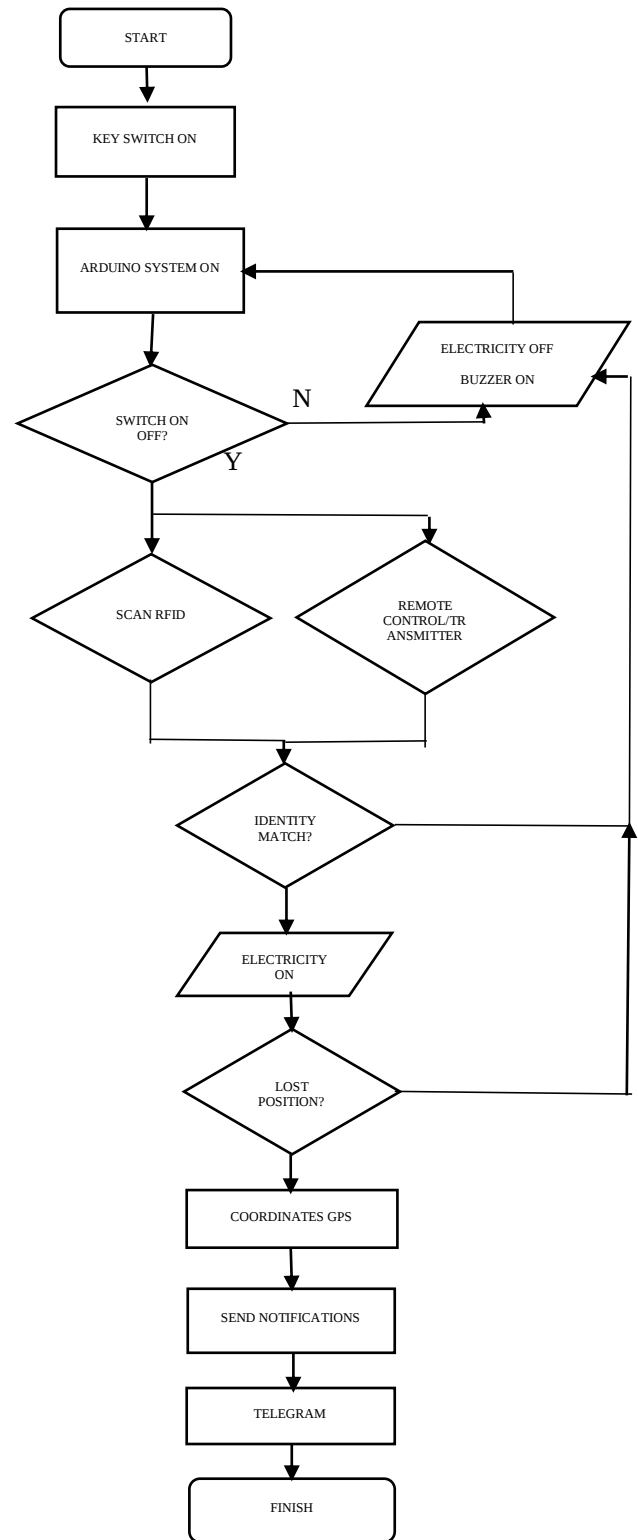


Figure. 1 Flowchart

The circuit schematic is a schematic of the electronic components and equipment that you want to make. The purpose of making a circuit schematic is to find out what electronic components are needed to make a vehicle safety system tool and by making the circuit schematic, can estimate what components are needed. In addition, making a circuit schematic

can help researchers in the process of making a vehicle safety system tool.

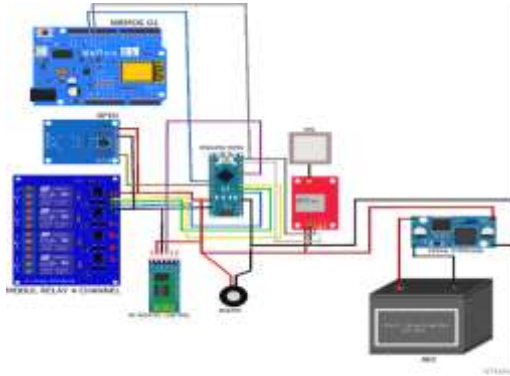


Figure 2. Circuit Schematic

1. When turning on the motor key outlet when the position on arduino and other components will live. To start the motor engine, you must switch the output cable from the side standard, the switching is done automatically through the remote control.
2. Switching has been activated, after which an rfid scan to read the identity of the privately owned motorcycle. When the identity scan is detected correctly, the motor engine can be started.
3. Remote Control functions as starting the motorcycle engine, can be through the starter and can also turn off the motorcycle engine. Among the keyless remote control buttons there are several functions, button 1 functions as a motorcycle starter, button 2 functions as turning off the motorcycle engine and button 3 functions as switching off the tool through the side standard of the motorcycle.
4. The GPS module functions as knowing the position of the motorcycle. If the motorcycle is not known to exist, it can directly request the GPS coordinates of the motorcycle position and also the position of the motorcycle in the begal or in the forced theft can directly request the position of the location point in real time.

III. RESULT AND DISCUSSION

This measurement has the aim of knowing the success rate of the tools that have been made, where testing will be carried out with several measurement points. The measurement points can be seen in the figure below. :

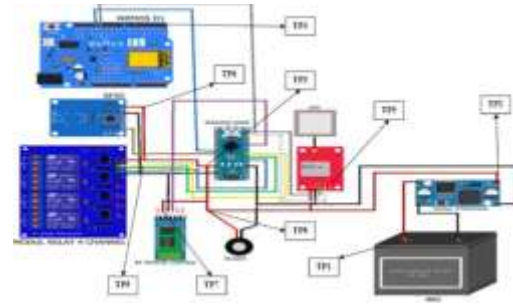


Figure 4. Measurement Point

Description:

TP 1 = Measurement point for the output voltage and current from the battery.

TP 2 = Measurement point of output voltage and current from battery to step down.

TP 3 = Measurement point of step down output voltage and current to Arduino nano.

TP 4 = Voltage measurement point on the wemos. TP 5 = Voltage measurement point on the gps sensor. TP 6 = Voltage measurement point on the rfid module.

TP 7 = Voltage measurement point on the keyless module.

TP 8 = Voltage measurement point on the buzzer.

TP 9 = Voltage measurement point on the relay module.

This measurement is carried out 5 times at each measurement point that has been determined on the tool. After measuring 5 times, the average measurement calculation is determined using the following formula 4.3:

$$X = \frac{1 + 2 + 3 + 4 + 5XXXXX}{n} =$$

$$\frac{\sum Xi}{n} \quad (4.4)$$

Where:

$\sum Xi$ = is the total number of samples n = number of measurements

$\bar{X}$ = average price

The results of the average measurements and calculations can be seen in table 4.1. Example of average calculation of TP1 battery voltage:

$$X = \frac{12.3 + 12.2 + 12.3 + 12.2 + 12.3}{5} = \frac{61.3}{5}$$

$$X = 12.26 \text{ V}_{DC}.$$

No	Measurement Position	Measurement Point	Unit	Many Measurements					X	
				1	2	3	4	5		
1.	Battery/ Charges	TP 1 (Output Battery)	beginning	V _{DC}	12,3	12,2	12,3	12,2	12,3	12,26
				I _{DC} (mA)	205	204	204	205	205	204,6
			½ hour	V _{DC}	12	12	12	12	12	12
				I _{DC} (mA)	200	199	198	199	197	198,6
			1 hour	V _{DC}	11,7	11,6	11,7	11,7	11,7	11,7
				I _{DC} (mA)	185	186	185	185	185	185,2
2.	Voltage Stabilizer Circuit	TP 2 (Input Module Stepdwon)		V _{DC}	12,3	12,2	12,3	12,2	12,3	12,26
				I _{DC} (mA)	205	204	204	205	205	204,6
			TP 3 (Input Arduino Nano pin 5V)	V _{DC}	5,05	5,05	5,06	5,05	5,07	5,056
			TP 4 (Input Wemos pin 5V)	V _{DC}	5,05	5,05	5,06	5,05	5,07	5,056
3.	Sensor GPS	TP 5 (Input Sensor GPS)		V _{DC}	4,93	4,93	4,93	4,93	4,93	4,93
4.	Module RFID	TP 6 (Input Module RFID)		V _{DC}	3,34	3,34	3,34	3,35	3,34	3,342
5.	Module Keyless	TP 7 (Input Module Keyless)		V _{DC}	4,96	4,96	4,96	4,96	4,96	4,96
6.	Buzzer	TP 8 (Input Buzzer)		V _{DC}	5,0	5,0	5,0	5,0	5,0	5,0
7.	Module <i>Relay</i>	TP 9 (Input Module <i>Relay</i>)		V _{DC}	4,96	4,96	4,96	4,96	4,96	4,96

Table 1. Measurements

For measurements other than TP1, all measurements are carried out at the start of battery use.

The battery capacity used is 1500 mAh with a measured current of 205 mAh. To find out the battery energy used, the battery resistance calculation is carried out using equation 2.2 in chapter II, namely:

$$\text{Time (t)} = \frac{\text{"battery capacity"}}{\text{measured current}}$$

$$\text{Time (t)} = \frac{1500\text{mAh}}{205}$$

$$\text{Time (t)} = 7,31 \text{ h}$$

The battery can last for ± 7.31 hours. After getting the results of the battery life calculation, the next calculation is the calculation of energy which can be used the energy formula.

$$W = V.I.t$$

This formula is used to calculate the energy consumed or generated by a device or electrical circuit in a certain period of time. Then the calculation is obtained:

Full battery capacity

$$t = 10.73 \text{ O'clock}$$

$$W = V.I.t$$

$$W = 12.26 \times 0.204 \times 7.31 \text{ O'clock}$$

$$W = 18.28 \text{ J}$$

Use for ½ hour

$$W = V.I.t$$

$$W = 12 \times 0.198 \times 0.5 \text{ O'clock}$$

$$W = 1.188 \text{ J}$$

So the remaining battery energy for ½ hour is :

$$W_{\text{beginning}} - W_{\text{during } \frac{1}{2} \text{ O'clock as big as}}$$

$$\text{Remaining battery energy} = 18.28 \text{ J} - 1.188 \text{ J} = 17.092 \text{ J}$$

Usage for 1 hour

$$W = V.I.t$$

$$W = 11.7 \times 0.185 \times 1 \text{ O'clock}$$

$$W = 2.164 \text{ J}$$

So the remaining battery energy for 1 hour is :

$$\text{Remaining battery energy} = W_{\text{beginning}} - W_{\text{during 1 o'clock as big as}}$$

$$\text{Remaining battery energy} = 18.28 \text{ J} - 2.164 \text{ J} = 16.116 \text{ J}$$

To find out the percentage of measurement error, you can use equation 4.2.

$$\% \text{ Error} = \left| \frac{\text{"Data sheet"-measurement}}{\text{Data sheet}} \right| \times 100\% \dots \dots \dots (4.2)$$

$$\% \text{ Error} = \left| \frac{5,056V_{dc} - 5V_{dc}}{5V_{dc}} \right| \times 100\% = 0,0112 \%$$

The results of the measurements taken obtained the average voltage of TP 3 is 5.05 volts

$$\% \text{ Error} = \left| \frac{\text{Measurements} - \text{Data Sheet}}{\text{Data sheet}} \right| \times 100\%$$

The error of the measurement is 0.41%. With the same formula as above, we can find the % error at each measurement point (TP) that has been determined.

Table 1. Percentage of Errors

No	Measurement Position	Measurement Point	unit	Data Sheet Average Measurement		Error (%)	Description								
1.	Battery	TP 1 (Output Battery)	beginning	V _D	11,1-12 V	11,98	0	Normal							
				c											
			½ hour	V _D											
			1 hour	V _D											
2.	Voltage Stabilizer Circuit	TP 2 (Input Module Stepdwon)		V _D	3-30 V	12 V	0	Normal							
				c											
		TP 3 (Input Arduino Mega pin 5V) TP 3 (Input Arduino Nano pin 5V)		V _D	4,8-5,5 V	5,06	0	Normal							
				c											
			3.	Sensor GPS					TP 5 (Input Sensor TCS3200)		V _D	4,8-5 V	4,93	0	Normal
											c				
4.	Module RFID	TP 6 (Input Module TCS3200)				V _D	3,3 V	3,342	0,042	Normal					
						c									
5.	Module Keyless	TP 7 (Input LCD 16x2)		V _D	4,8-5 V	4,96	0	Normal							
				c											
6.	Buzzer	TP 8 (Input Module Driver L298N)		V _D	4,8-5 V	5,0	0	Normal							
				c											
7.	Module <i>Relay</i>	TP 9 (Input Motor Servo)		V _D	4,8-5 V	4,96	0	Normal							
				c											

Testing is done by reading RFID *tags* with vertical and horizontal positions. In the reading test, the position of the card is changed, to estimate the attachment of the *Tag* card to the RFID reader that changes position.

The experiment will be conducted 10 times for the Horizontal position and 10 times for the Vertical position. The card is attached directly to the NFC reader and the response on the serial data on the Arduino is seen.

Table 2. Reading Test with Horizontal and Vertical Position

Position	experiment									
Horizontal	1	2	3	4	5	6	7	8	9	10
Vertical	o	o	o	o	o	o	o	o	o	o

Table 3 is a table testing the reading of RFID *tag* positions with horizontal and vertical positions. In this experiment, 20 experiments were carried out with 10 experiments with a horizontal position and 10 times with a vertical position. From a total of 20 trials, the results obtained are that the RFID *tag* is read well and successfully read where that means that of the 20 trials all trials were successful. In table 4.3 from experiments 1 to 10 with 2 positions that are Horizontal and Vertical successfully carried out which is written with the

symbol "o" which means success and "x" which means failure.

So it can be concluded that from the position reading test, the results obtained are seen in table 3.3 *Tag* card position has no effect on *reader* reading. Both horizontal and vertical card positions can be read well with a percentage of 100% success.

This test is done by increasing the distance between the RFID *reader* and the *Tag* card. The distance will start from ±0cm to ±6cm. The position of the *Tag* card remains in a horizontal position. The following are the results of the *Tag* reading experiment with distance.

Table 3 Tag Reading Testing with Distance

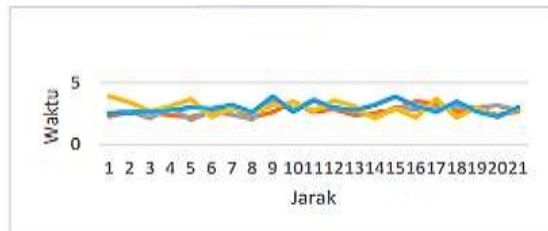
distance (cm)	experiment									
	1	2	3	4	5	6	7	8	9	10
0	o	o	o	o	o	o	o	o	o	o
1	o	o	o	o	o	o	o	o	o	o
2	o	o	o	o	o	o	o	o	o	o
3	o	o	o	o	o	o	o	o	o	o
4	x	x	o	x	o	x	x	o	x	x
5	x	x	x	x	x	x	x	x	x	x
6	x	x	x	x	x	x	x	x	x	x

Table 3.4 is a test of RFID *tag* reading. Testing is done starting from a distance of 0 cm to 6 cm with 10 trials. At a distance of 0 cm with 10 times the

experiment obtained results that the RFID tag can be read properly. Then at a distance of 1 cm with 10 times the tag experiment can be read well too then the third experiment at a distance of 2 cm RFID tag can be read well too. Then at a distance of 3 cm from the first experiment to the 10th experiment the RFID tag was read well in the fifth experiment, namely with a distance of 4 cm the RFID tag was read but not all trials were successful where out of ten trials, seven trials were successful and three trials failed. In the sixth test, namely at a distance of 5 cm, all RFID tags were not read and in the seventh trial with a distance of 6 cm all trials failed or were not read.

So it can be concluded and can be seen in table 3.4 testing card tag reading with distance. Reader can read well from a distance of 0 cm to a distance of ± 3 cm well with the position of the card. While testing at a distance of ± 4 cm to a distance of ± 6 cm the readings are irregular. From these tests it can be concluded that the RFID tag can be read up to a distance of ± 3 cm with a success percentage of 100% and if the distance is increased again between the card tag and the reader. Tag card reading is not good at a distance of ± 4 cm. Even at a distance of ± 5 cm to ± 16 cm the card is not read by the reader.

This test aims to find out how long it takes to activate the motor power source. In this test, the distance between the remote and the motorcycle will be changed. This change in distance is done to determine whether there is an influence between distance and time to activate the motor power source. The test distance parameters that will be tested are based on testing the effect of distance on the success of data reception, because in this test the average time value of each distance will be sought.



Picture 3. 1 Testing the Effect of Time on Distance to Activate the Motor Power Source

The results of testing the time to distance to activate the motorcycle are influenced by the distance between the motorcycle and the remote. The further away the position of the motorcycle, the longer it takes to turn on the motorcycle, but the change in the average difference in time per distance is only slight. To turn on the motorcycle at a distance of 1 meter, the average time is 2.694 s, at a distance of 2 meters, the average time is 2.7745 s, at a distance of 3 meters, the average time is 2.9425 s, at a distance of 4 meters, the average time is 2.986842s. The distance of 4 meters is the optimal distance for motorcycles and remotes to communicate with each other, the rest of the distance the motorcycle and remote cannot communicate optimally.

From tests and observations whose purpose is to obtain data related to the security and control system used in

this study. Changing the input of the tested circuit block and seeing the output of the tested circuit block is how the test is carried out. The test results will be examined and used as a basis for generating conclusions. As a result, the reliability and execution speed characteristics, as well as the weaknesses, of the device created can be seen. As a result, it can be determined whether the device made is able to run the system reliably and in accordance with the predetermined criteria as in Table 3.5

Table 3.5 Motor position location detection test data

No	Start Distance	Place	Latitude	Longitude
1	0 m	Bina Dharma Campus	05° 14'41.59"	97° 00'58.90"
2	100 m	Warung	05° 14'42.52"	97° 00'56.30"
3	200 m	Bina Dharma Hotel	05° 14'43.10"	97° 00'53.09"
4	300 m	Coffee Shop & Simple Dining	05° 14'44.47"	97° 00'50.31"
5	400 m	Alfamart	05° 14'45.41"	97° 00'47.25"
6	500 m	Tegal Plaju Restaurant	05° 14'46.31"	97° 00'44.22"
7	600 m	Grocery Store	05° 14'47.42"	97° 00'41.37"
8	700 m	Pertamina Gas Station	05° 14'48.17"	97° 00'37.95"
9	800 m	Muhammadiyah Campus Square	05° 14'49.27"	97° 00'35.15"
10	900 m	Alun-Alun Kampus Muhammadiyah	05° 14'50.24"	97° 00'32.08"
11	1 km	RM Pngi Sore	05° 14'51.45"	97° 00'29.48"

Based on the results of field testing, the latitude and longitude coordinates are different for both the first trial GPS made and the second trial GPS, so they must be converted first. Then to find out the difference in the distance of the two coordinate points is still the same can be done by converting the latitude coordinates from the "Degrees decimal" format to "Degrees minutes seconds". This also applies to longitude coordinates if there is a difference between the two and the results are subtracted so that the difference in minutes or seconds is obtained and the difference is then converted again into a distance with units of meters.

For example, here can be converted the coordinate data of the test above. Based on the GPS device made, the latitude coordinate is (5.2115527), when converted to "Degrees minutes seconds" the result is (5°12'41 "N) and for the longitude coordinate on the GPS device is (97.016361), when converted to (97°1'58 "E). Latitude & Longitude coordinate difference:

$$5^{\circ} 12'41'' - 5^{\circ} 12'42'' = 1'' \times 30.9227 \text{ meters} = 30.92 \text{ meters}$$

$$97^{\circ}1'58'' - 97^{\circ} 1'56'' = 2'' \times 30.9227 \text{ meters} = 61.85 \text{ meters}$$

$$\begin{aligned} \text{Distance Difference} &= \sqrt{30,92^2 + 61,85^2} \\ &= \sqrt{956,046 + 3.825,422} \\ &= \sqrt{4.781,46} \\ &= 69.14 \text{ meters.} \end{aligned}$$

From the results of measurements and calculations that have been carried out, it can be analyzed as follows:

1. In the measurements that have been made, the percentage error is at a value of 0.042%. The percentage errors of all components are all below 1%, which means the tool is working well and in accordance with what is expected.
2. In the RFID position reading test, 20 trials were conducted with horizontal and vertical positions, and all trials were 100% successful. The card position did not affect the reading and In the RFID distance test, the tag was perfectly read up to a distance of ± 3 cm with a 100% success rate. However, at a distance of ± 4 cm and above, the readings were inconsistent, and above ± 5 cm, the tags were not read at all.
3. This test measures the time it takes to start the motor based on the distance between the remote and the motor. The results show that the longer the distance, the longer the time required. However, the increase in time is not significant. At a distance of 1 meter, the average time is 2.694 seconds, at 2 meters is 2.7745 seconds, at 3 meters is 2.9425 seconds, and at 4 meters is 2.986842 seconds. A distance of 4 meters is the optimal distance for communication between the remote and the motor. Above this distance, communication does not work well. It can be concluded that the effect of distance on time exists, but the change in average time at each distance is not too large until it reaches the optimal distance of 4 meters.
4. GPS sensor testing was carried out to detect the location of the motorcycle based on latitude and longitude coordinates at several points. The results showed differences in coordinates that had to be converted from "Degrees decimal" to "Degrees minutes seconds" format in order to calculate the distance difference. From the conversion, the difference between two points is calculated using the Euclidean distance formula, where the difference in latitude and longitude is converted into meters. For example, a 1-second latitude difference is equivalent to 30.92 meters, and a 2-second longitude difference is equivalent to 61.85 meters. By calculation, a distance difference of 69.14 meters is obtained between the two points. This shows that the GPS sensor can detect position differences with a sufficient level of accuracy, although there is a slight difference. that needs to be taken into account for detection accuracy

IV. CONCLUSION

Based on the results of measurements and tests on security and control systems using RFID and GPS, it can be concluded as follows: Tool Accuracy: The percentage error in the measurement was 0.042%, with all components having an error below 1%, indicating that the tool is functioning as expected. RFID Testing: RFID testing on 20 attempts, both horizontally and vertically, showed 100% success. The card position did not affect the reading. However, in distance testing, readings were consistent up to ± 3 cm with a 100% success rate, but were unstable at distances of ± 4 cm and above, and at distances of ± 5 cm, tags were not

read. Motor Activation Time Testing: The time taken to activate the motor increased as the distance between the remote and the motor increased. However, the difference in average time at each distance is not significant. A distance of 4 meters is the optimal distance for communication between the remote and the motor. GPS Testing: Testing of the GPS sensor showed that despite slight coordinate differences, the GPS was able to detect the position of the motorcycle with good accuracy after coordinate conversion was performed, resulting in an accurate distance difference.

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