Design and Construction of GPSMU as a Motorcycle Safety System Based on SIM800L

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Abstract. Motorbike theft in various regions is increasing from year to year and results in financial losses for owners. This research aims to design and develop a SIM800L-based motorbike security system with location tracking features, motorbike control, and the use of voice commands. The research methods used are literature studies and research and development (R&D). The results of this research are the GPSMU system module and the GPSMU application as a communication interface between the user and the motorbike. This system allows motorbike owners to track location in real-time. Location is sent via SMS and displayed on the GPSMU application which is integrated with Google Maps. In addition, users can control the motorbike engine remotely via the application. The test results show success in designing and implementing the GPSMU system as demonstrated by the location tracking and machine control features functioning well and accurately.

Keywords: GPSMU, SIM800L, Location Tracking, Motorcycle Control.

1. Introduction

In the current era of digitalization, technological developments are very rapid, even though it is accompanied by the Covid-19 pandemic. It cannot be denied that this pandemic has caused an economic downturn, such as layoffs and reduced income for MSMEs (Micro, Small and Medium Enterprises)[1]. Apart from that, theft is still a major problem in several areas, especially motorbikes with a high number of cases [2]. Public motorbikes are a means of transportation used by many people because they are affordable and efficient for daily activities [3]. Behind the advantages of motorbikes, there are disadvantages, one of which is that they are prone to theft because motorbike security is currently not able to maximally prevent motorbike theft [4]. The main reason behind motorbike theft is economic factors which are the dominant motivation [5].

The use of motorized vehicles also has the potential to face risks such as loss of vehicle keys and theft due to burglary of the motorbike ignition[6]. Motorbike theft is becoming an increasingly worrying problem in various regions, with statistics showing a crisis in

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motorbike theft cases from year to year [7]. In addition to the financial loss for the owner, motorbike theft also causes significant inconvenience and worry [8].

Based on the urgent need to improve motorbike security in the face of the challenges of theft and the resulting financial losses. In this context, this paper offers an interesting solution by using advanced tracking technology to protect motorbikes and provide a sense of security to their owners.

The following are the theories related to this research:

1.1. Arduino Nano

Arduino nano is an open source device that is often used to design electronic devices using the ATmega328p or Atmega 168 chip [9]. This device has a small size and specifications sufficient for this research [10].

1.2. SIM800L

SIM800L is a GSM/GPRS module for remote control[11]. The SIM800L GSM/GPRS module functions as a communication intermediary between the main monitor and the cell phone[4]. ATCommand is a command that can be used to control a GSM/CDMA modem, such as sending and receiving GSM/GPRS based data, or sending and receiving SMS. The SIM800L GSM/GPRS module is controlled using AT commands[10].

1.3. GPS NEO 6M

GPS (Global Positioning System) is a system that provides accurate locations throughout the world with the help of satellites. The satellite is monitored continuously via ground stations at various locations. They send signals that can be received by a GPS Receiver. By using this receiver, we can know our exact position[12].

1.4. Relay Module

The relay module is an electromechanical component consisting of an electromagnet (Coil) and a mechanical (Switch Contact). Relays use electromagnetic principles to actuate switch contacts[4].

1.5. Step Down 5V

The Stepdown Module is a module that reduces 12 V power to 5 V[10].

1.6. Kodular

Kodular is a web or open source IDE tool which is usually used for making mobile applications, namely Android and IOS. Kodular makes it easy to make applications because

in designing the interface it uses a drop and drop palette element system and for the programming system it uses a code creation system called "block"[13].

In this research, Kodular was used to create a GPSMU application to make it easier to access commands to run the system.

2. Method

This research uses literature study methods and research and development (R&D) methods, as methods for collecting data to develop a new product. According to Sugiyono (2016: 407), Research and Development is a research method used to produce certain products and test the effectiveness of these products.

2.1. Object of research

The research will be carried out on a two-wheeled vehicle which is an automatic motorbike with the Honda Beat 2013 brand.

2.2. Research Flow Chart

This is the research flow that will be carried out.

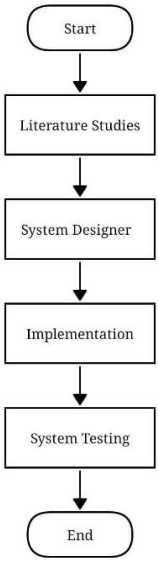

Fig 1. Diagram System

2.3. Circuit Block Diagram

By looking at the block diagram, we can analyze the working system of the tool better and understand how each component interacts with each other[6]. The following is a block diagram of the circuit in the design of the tool that will be made:

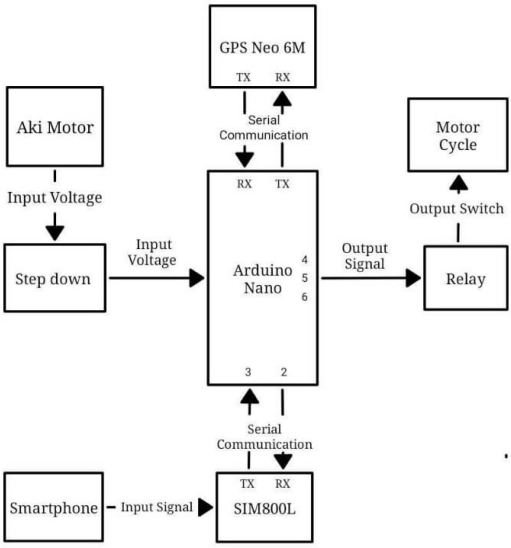

Fig 2. Circuit Block Diagram

2.4. How the Tool Works

At this stage, the flowchart and how the tool works are explained, the block diagram of which is depicted in Figure 2. SIM800L plays an important role in this system as a communication module used to connect applications with the motorbike system.

GPS Tool Flowchart

The following is an image of the GPS tool flowchart in this research.

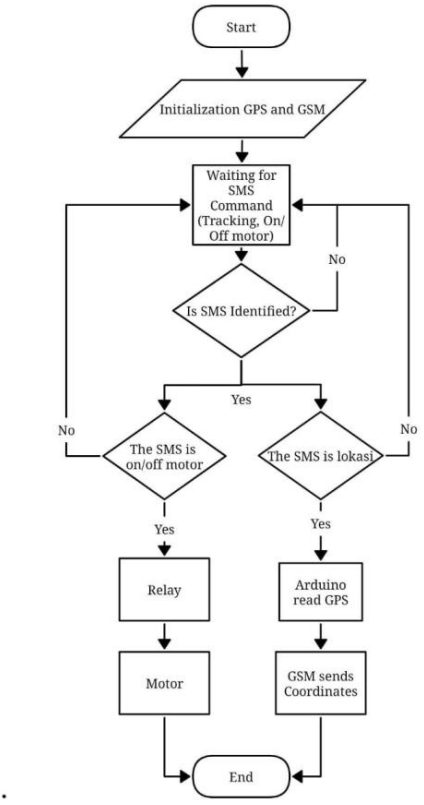

Fig 3. Flowchart System

1) Track the location of Motorbike Coordinates

A GPSMU smartphone application sends code instructions (location) via text message (SMS) to the SIM800L. Then, Arduino reads these characters, and if the code is correct, then Arduino will read coordinate data from the GPS module. Then send it back using SIM800L. This data will be received via SMS on the smartphone in the form of a Google Maps link whose coordinates are displayed in the GPSMU application.

2) Control your motorbike using the application

A smartphone GPSMU application sends data commands in code form (Engine on/Engine off/Total Off/Reset) via SMS message to the SIM800L. Then, the code will be read by the Arduino. If the code received matches the correct command, the Arduino will process it to

activate the relay which is responsible for controlling the motorbike's electricity so that it is in the on/off position.

GPSMU Application Flowchart

The following are the operating steps and flowchart of the GPSMU application in this research:

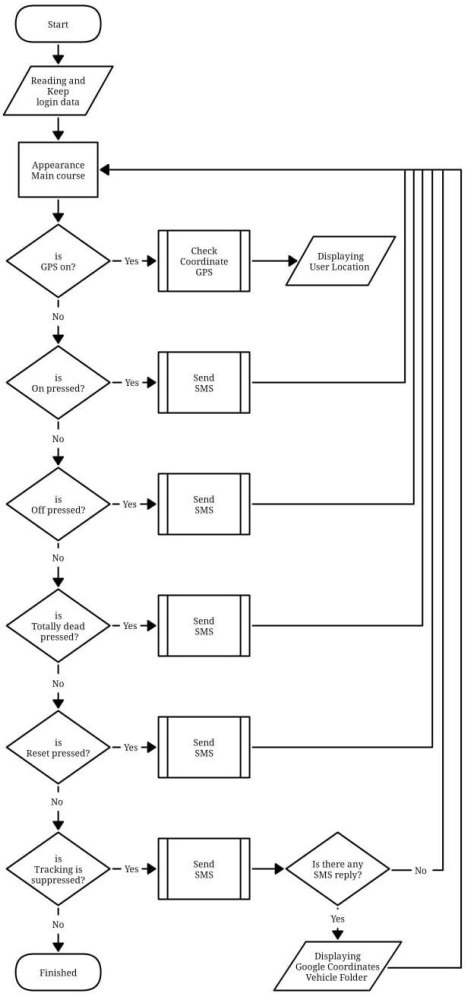

Fig 4. GPSMU Application Flowchart

2.5. Tool Design

Tool planning will discuss the steps in designing GPSMU as a SIM800L-based security system. The following is the system plan that will be implemented:

Hardware Design

In designing the GPSMU security system hardware, it contains a series of prototypes that will explain the schematic design for each component that will be connected to each other using a cable.

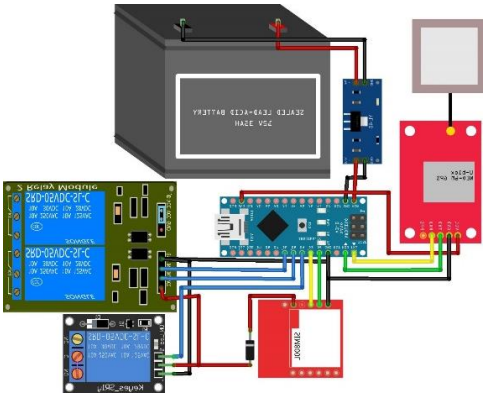

Fig 5. Circuit Schematic

Software Design

The creation of the GPSMU application software was carried out using a website called "Kodular".

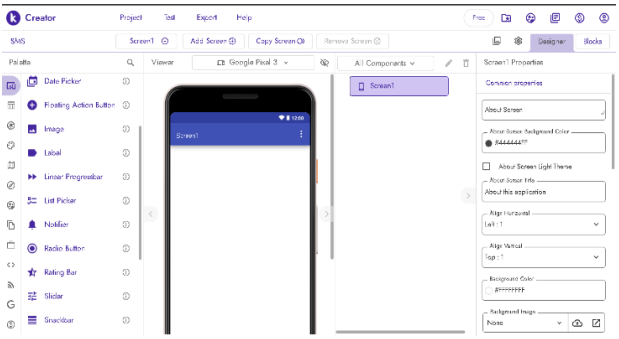

Fig 6. Codular Web View

3. Results and Discussion

3.1. Realization of Hardware Arrangement

The results of the realization of the hardware arrangement have been adjusted to the circuit schematic drawing. The results can be seen as follows.

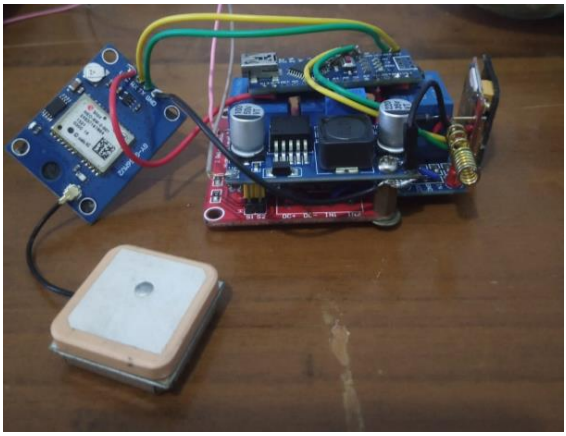

Fig 7. Hardware View

3.2. Realization of GPSMU Application Software

In accordance with chapter 3 regarding software design, making application software for motorbike security systems. The realization can be seen in the following picture.

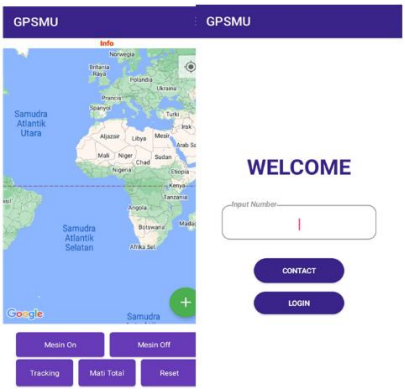

Fig 8. Application Display

3.3. GPSMU System Results

The results of all the realization plans for the system preparation that have been adjusted are in chapter 3. All modules are arranged neatly and tightly and packaged in boxes to protect them and add to the aesthetic aspect. The results can be seen as follows.

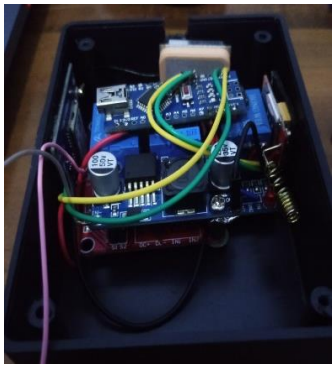

Fig 9. GPSMU Module Results

3.4. System Implementation

The results of the preparation of the GPSMU Design as a SIM800L Based Motorcycle Security System implemented on motorbikes can be seen in the following table.

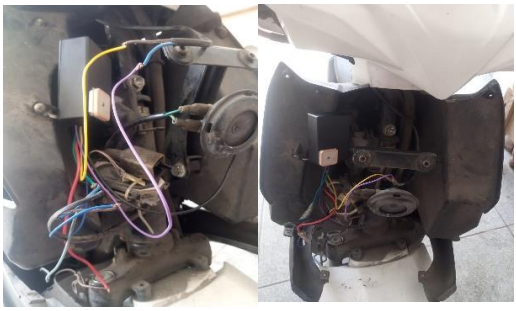

Fig 10. Installation of GPSMU Module

The GPSMU module is placed neatly and bolted securely to protect it from shocks. The cable connection between the GPSMU module and the motor vehicle is arranged as follows:

1. The positive voltage input (red cable) on the module is connected to the motor contact cable which is connected to the positive battery.
2. The ground cable (black cable) is connected to the motor body.

3. Relay 1 (red wire) is connected in series with the motorbike ignition.
4. Relay 2 (green and blue wires) is connected in parallel to the motorbike ignition.
5. Relay 3 (yellow and purple wires) is connected in parallel to the motor starter button.

3.5. System Testing

The system testing sub-chapter in the GPSMU design research as a SIM800L-based motorcycle security system aims to evaluate the performance and functionality of the system that has been designed. Testing is carried out to ensure that the system can operate properly and in accordance with the specified design.

Voltage Source Testing

The voltage entering the system has a significant influence on the performance of the security system. This test aims to determine the voltage value on the motorbike battery when it is in the off position, as well as the output voltage produced by the step down which will be used in the system. When the motorbike is started, the voltage in the battery will increase, and the voltage produced by step down will also be different.

Table 1. Voltage Test Results

No	Condition	Battery Voltage	Step Down output
1	The Motorbike Does Not Start	12.66 V	4.78
2	The Motorbike starts	12.82 V	4.95

Based on the table above, it can be concluded that the voltage produced by the step down module when the motorbike is on or off is relatively not much different and remains below 5 volts. This shows that the voltage produced is safe and stable for use in the system that has been designed.

GPSMU Application Command Duration Testing

This test was carried out to check the time for sending commands from the application to the GPSMU module.

Table 2. Test Results for Command Delivery Duration

Testing	Open	Closed	Information
	Duration (seconds)	Duration (seconds)	
1	6.67	8.74	Sent
2	9.87	7.79	Sent

Testing	Open	Closed	Information
	Duration (seconds)	Duration (seconds)	
3	8.34	9.85	Sent
4	6.83	8.56	Sent
5	7.28	8.68	Sent
6	5.61	6.79	Sent
7	6.40	9.38	Sent
8	6.98	6.86	Sent
9	8.52	6.77	Sent
10	7.78	6.15	Sent

If you look at the table above, the average duration for sending commands from the application to the GPSMU module ranges from 5 to 9 seconds and is not affected by open or closed conditions.

GPSMU Module Response Testing

This test is carried out to check the system response time to incoming SMS message commands.

Table 3. GPSMU Module Response Test Results

Testing	Duration (seconds)	Information
1	0.64	Accepted
2	0.47	Accepted
3	0.49	Accepted
4	0.51	Accepted
5	0.63	Accepted
6	0.57	Accepted
7	0.53	Accepted
8	0.56	Accepted
9	0.67	Accepted
10	0.75	Accepted
Average	0.58	

GPS Testing to Find Locations

This test was carried out to determine the duration of the system in determining the location of the motorbike.

Table 4. GPS Test Results

Testing	Duration of Sent Location	Information
1	2.01 seconds	Success
2	3.42 seconds	Success
3	2.81 seconds	Success
4	4.86 seconds	Success
5	4.19 seconds	Success
6	3.51 seconds	Success
7	3.66 seconds	Success
8	3.97 seconds	Success
9	2.43 seconds	Success
10	5.13 seconds	Success
Average	3.599conds	

Functional Testing

This test aims to ensure that all the expected features of a SIM800L-based motorcycle GPSMU security system can function properly. For example, tests are carried out to check whether the system can execute commands to turn on, turn off a motorbike, send location.

Table 5. Functional Testing Results

Testing	Order	Results	Note
1	Mesin on	Relay 2 turns on, indicated by the motorbike engine turning on, then a delay of 1.5 seconds, relay 3 turns on, indicated by the starter which activates in 2.5 seconds, then relay 3 turns off.	Respond

Testing	Order	Results	Note
2	Mesin off	Relay 2 is not active, indicated by the motorbike engine turning off.	Respond
3	Tracking	The GPSMU application gets an SMS from the module containing Latitude and Longitude which then displays the location of the motorbike on Google Map.	Respond
4	Mati Total	Relay 1 turns on	Respond
5	Reset	Relay 1 is turned off	Respond

4. Conclusion

The result of this research is the development of a tool that can be used to track the location and control motorbikes. The performance of the tool obtained is in accordance with the expected results, namely providing benefits for motorbike owners in terms of location monitoring and the ability to control the motorbike engine remotely.

Authors' Contributions

Author 1 developed the theoretical formalism, carried out the design and carried out simulations. Author 1, Author 2 and Author 3 contributed to detailed of the article. Both Author 2 and Author 3 contributed to the final version of the manuscript and supervised the project.

References

1. Kementerian Koordinator Bidang Perekonomian Republik Indonesia, "Laporan Kajian Dampak Pandemi Covid-19 Terhadap Ketenagakerjaan di Indonesia," 2021.
2. V. Fajar Setiawan and A. Ma'arif, "Sistem Keamanan Sepeda Motor (SIKESEM) Menggunakan Kamera dan GPS Berbasis Internet of Things," *JTEV (Jurnal Tek. Elektro dan Vokasional)*, vol. 8, no. 1, p. 57, 2022, doi: 10.24036/jtev.v8i1.113696.
3. M. P. Irwanto, "Sistem Pengaman kendaraan..., Muhammad Puji Irwanto, Fakultas Teknik UMP, 2015," pp. 6–27, 2014.
4. G. E. L. Sinaga, Indra Gunawan, Irawan, and Poningsih, "RANCANG BANGUN SISTEM KEAMANAN SEPEDA MOTOR BERBASIS ARDUINO UNO MENGGUNAKAN GPS DAN RELAY MELALUI SMARTPHONE," *STORAGE J. Ilm. Tek. dan Ilmu Komput.*, vol. 1, no. 1, pp. 1–7, 2022, doi: 10.55123/storage.v1i1.154.
5. A. Tri Wibowo, I. Salamah, and A. Taqwa, "Rancang Bangun Sistem Keamanan

Sepeda Motor Berbasis Iot (Internet of Things)," *J. Fasilkom*, vol. 10, no. 2, pp. 103–112, 2020, doi: 10.37859/jf.v10i2.2083.

6. H. Afrizal, L. Gifhari, A. Solichan, A. H. Saptadi, and N. Sumarno, "Rancang Bangun Sistem Keamanan Ganda Sepeda Motor Berbasis Arduino Nano Menggunakan RFID dan SIM800L," pp. 144–158, 2022.
7. Pusiknas Bareskrim Polri, "Waspada! Pencurian Sepeda Motor Mencapai 700 Kasus dalam Dua Pekan," 2022. https://pusiknas.polri.go.id/detail_artikel/waspada_pencurian_sepeda_motor_mencapai_700_kasus_dalam_dua_pekan
8. Z. Lukman, "Faktor-Faktor Dan Upaya Penanggulangan Tindak Pidana Pencurian Sepeda Motor (Studi Kasus Polresta Banda Aceh)," vol. 13, no. 3, pp. 44–50, 2016, [Online]. Available: https://www.researchgate.net/publication/339354413_Faktor-Faktor_Dan_Upaya_Penanggulangan_Tindak_Pidana_Pencurian_Sepeda_Motor_Studi_Kasus_Polresta_Banda_Aceh/fulltext/5e4d3733458515072da8c901/Faktor-Faktor-Dan-Upaya-Penanggulangan-Tindak-Pidana-Pencurian
9. I. Usman, A. Fuad, and S. Lutfi, "Sistem Keamanan Kendaraan Melalui Short Message Service (Sms) Menggunakan Mikrokontroller Arduino," *JIKO (Jurnal Inform. dan Komputer)*, vol. 2, no. 1, pp. 41–48, 2019, doi: 10.33387/jiko.v2i1.1055.
10. C. Julianto and J. Andika, "Rancang Bangun Sistem Pengendali Lacak Posisi Sepeda Motor," *J. Teknol. Elektro*, vol. 2, no. 02, pp. 308–311, 2022, doi: 10.47709/jpsk.v2i02.1736.
11. D. Andesta and R. Ferdian, "Sistem Keamanan Sepeda Motor Berbasis Mikrokontroler dan Modul GSM," *J. Inf. Technol. Comput. Eng.*, vol. 2, no. 02, pp. 51–63, 2018, doi: 10.25077/jitce.2.02.51-63.2018.
12. F. Rizkidiniah, M. Yamin, and N. F. Muchlis, "Perancangan Dan ImplementasiPrototype Sistem GPS (Global Positioning System) Dan SMS Gateway Pencarian Kendaraan Bermotor Berbasis Arduino Uno," *semanTIK*, vol. 2, no. 2, pp. 87–92, 2016.
13. R. Setiawan, "Rancang Bangun Media Pembelajaran Berbasis Android Tanpa Coding Semudah Menyusun Puzzle," *J. Sist. Inf. dan Sains Teknol.*, vol. 2, no. 2, pp. 1–7, 2020, doi: 10.31326/sistek.v2i2.729.