MOTOR VEHICLE TRACKING AND SECURITY TECHNOLOGY USING GPS u-blox NEO 6M BASED ON ANDROID APPLICATION

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Abstract

Design a security system for motorbikes that uses Internet of Things (IoT) technology. This system is equipped with emergency safety features which aim to provide a sense of security to motorbike owners.This technology will be installed on motorbikes using microcontrollers such as NodeMCU ESP8266 V3 and ESP32-CAM., GPS module, Buzzer. The GPS module functions to determine the coordinates of the motor vehicle's position which will be sent and then displayed via a mobile application found on the motor vehicle owner's smartphone and the ESP32-CAM functions to take a picture of the theft perpetrator's face if a motorbike theft occurs, while the buzzer functions as an alarm on bicycle vehicles. motorbike Based on the test results, in testing the GPS connection, the smallest delay value was 1,800s and the largest delay was 3,600s. In sending images, the smallest delay value is 2.2s at a distance of 50m and the largest delay is 8.8s at a distance of 4000m, while for the buzzer the delay value is 60s after the SW-420 sensor sends vibrations to the buzzer.

1. Introduction

The increasingly rapid development of technology certainly makes work easier[1]. Cases of vehicle theft, especially motorbike theft, still occur frequently and constitute the largest number of theft cases. One of the main reasons motorbike theft occurs is generally because the motorbike is only locked by locking the ignition on the handlebars using a letter T key. This method allows the use of a weak alternative security key[2]. Apart from that, additional security that is often used is a padlock, which can also be damaged using chemical water or a chainsaw. Vehicle protection devices such as handlebar locks or anti-theft alarm systems aim to slow down the theft process[3]. In addition, insurance and vehicle safety devices are not able to return vehicles that have been lost or stolen. Based on the results of distributing questionnaires to class 20 students majoring in computer engineering at the Indonesian Technocrat University, Bandar Lampung, there are still many motorbikes for students at the Indonesian Technocrat University, Bandar Lampung. which are not yet equipped with safety equipment due to the high price of vehicle safety equipment and concerns about short circuits occurring in vehicles, to prevent and reduce theft, and at the same time, an effective way to increase the possibility of finding a motorbike is to use GPS (Global Positioning System) technology in a security context[4].

By utilizing GPS, vehicle owners can monitor the location of their vehicle wherever it is located, thus providing a real solution to vehicle security problems. The GPS NEO-6M is an innovative GPS module used for vehicle navigation purposes[5]. This module is tasked with checking positions on Earth and producing location point information. This module is obtained from a group of GPS receivers that are independent of other devices and have the latest technology, namely the state-of-the-art U-blox 6 positioning engine. Flexible receivers offer more connectivity options in a smaller package[6]. Even though there are many monitoring tools based on microcontrollers, most of them are still based on sending via SMS or SMS gateway, which is often misunderstood. Installing motorcycle security equipment requires expensive costs. Therefore, the author wants to develop a two-wheeled vehicle security system that monitors the condition of motorized vehicles. two uses an Android application on a smartphone with a Global Positioning System (GPS) and an interface displayed on the smartphone so that it can monitor the location of the vehicle, and the author adds the ESP32-CAM module as a camera to monitor the perpetrator's face if there is an act of theft on a motorcycle more effectively[3].

1.1 Literature Review

The author investigates and reports on the preparation of this research in a previous background study behind this research issue. There are previous studies that have been carried out related to this research. Further information on this can be found in Table 2.1, presented below.

Table 1. Literature review

No	Journal Details	
1	Title	Development of an Internet of Things-Based Tracking Device for Motorcycles Using GPS and ESP8266.
	Writer	[7].
	Problem	There has also been an increase in crime, for example, cases of theft and motorcycle theft. There have been no maximum results in preventing this case; please remember the safety of motorbikes produced by companies that produce motorbikes that are still in use. Security is available. Handlebar locks and motorcycle ignition covers are protected by manual action.
	Discussion	This research discusses the development of an Internet of Things-based tracking tool to obtain motorcycle area coordinates.

	Results	The results of this research show that the results of reading location coordinates from the NEO6Mv2 GPS module are sent to Firebase, where they can see the results of the distance difference using the Google Map application. For Find out the difference in distance between the original coordinates of
2	Title	Motorcycle Safety Design Based on the IoT (Internet of Things) using Blynk.
	Writer	[1].
	Problem	This research discusses designing and building motorcycle security using the Internet of Things with Blynk tracking locations. motorbike coordinates without being limited by distance.
	Discussion	This research aims to develop a security plan for motorcycles based on the IoT (Internet). using Blynk, and determining the correct level of motorcycle safety from the IoT (Internet of Things) using Blynk,
	Results	The results of connectivity distance testing with the Blynk application showed a score of 80.30%, which stated that designing and building motorbike security Internet of Things with Blynk using Blynk is very valid. and can be used.
3	Title	Research entitled IoT Implementation in Mobile System Application Design Motorcycle Security and Tracker.
	Writer	[8].

	Problem	Applying IoT to Mobile Applications Design a motorcycle security and tracking system to monitor the safety of motorcycle vehicles and use web-based applications. Discussion This research aims to use IoT to design mobile applications for motorcycle security and tracking systems.
	Discussion	This research aims to apply the use of the Internet of Things (IoT) to design and develop mobile applications related to motorcycle security and tracking.
	Results	Based on the results of research regarding the application of the Internet of Things (IoT) in the development of mobile applications for security and tracking systems for motorbikes, it was concluded that the mobile application was successful in obtaining the coordinates of the motorbike's position sent from the tackle via Garçon Firebase for display, as well as creating a route or point on Google charts. Then the motorbike can be successfully turned off or turned on via the application when driving or parked.
4	Title	Implementation of the ESP8266 Nodemcu in the Design and Development of an IoT-Based Motorcycle Security System.
	Writer	[9].
	Problem	This study examines how the NodeMCU Esp8266 can be used as an integrated processing unit with a smartphone.
	Discussion	In this research, a motorcycle security system based on the IoT NodeMCU ESP8266 WiFi module is used, which can be controlled using an application.

	Results	produce tools that can be directly implemented on motorcycles and can Accessed via Telegram and Blynk.
5	Title	Design and build a two-wheeled motorcycle vehicle security system based on the Internet of Things with NodeMCU ESP8266 V3 and ESP32-CAM modules.
	Writer	[10]
	Problem	Design a study on developing a security system for motorcycles that connects the device to the Internet of Things. In this research, the NodeMCU ESP8266 V3 and ESP32-CAM modules were used to monitor the location of the vehicle and photograph the perpetrator if there was an act of theft on the motorbike.
	Discussion	In this research, a security system has been designed for two-wheeled motorbikes based on the Internet of Things. This system uses the NodeMCU ESP8266 V3 and ESP32-CAM modules.
	Results	The system is able to display on the software on the smartphone and is capable of capturing images of the vehicle motorbike via Telegram software.

Based on several journals collected, there are differences from all previous research, namely the aim of research on tracking and protecting motorbikes carried out on campus as stated in the journal by tracking using Telegram, Blynk, and SMS applications. Meanwhile, the next research will focus on real-time tracking and monitoring via an Android application that can be controlled directly on a smartphone.

1.2 Internet of thing

Internet of Things, or more familiarly heard with the abbreviation IoT is a theoretical basis that functions to use internet technology, which is developing very rapidly, so that it can be applied to a prototype so that humans can connect with objects to transmit data and carry out remote control in real time. IoT is a future industry that aims to make prototypes more efficient, tested, and sustainable. IoT technology can make work easier because internet connectivity can be accessed in real time. The IoT capability itself can share data, control, and monitor an object, or it could be a security system[4], [6].

1.3 Mobile Application

A mobile application is a software platform that is openly developed for use on smartphones and tablet computers. This mobile application gives developers the opportunity to create applications that can be used on various mobile devices. This mobile application was first developed by Android Inc. with financial assistance from Google[11].

Fig 1. Mobile Application Logo(Source : https://www.manadonews.co.id)

1.4 NodeMCU ESP8266

Nodemcu ESP8266 is an open-source IoT platform as well as a development kit that uses the C programming language. Its main purpose is to support the creation of IoT product prototypes[4], [5], [10]. Additionally, this kit is also compatible with the Arduino IDE. The development and design of this kit are based on the ESP8266 module, which has integrated features such as GPIO, PWM (pulse width modulation), IIC, 1-wire, and ADC (Analog to Digital Converter) in one comprehensive board. NodeMCU ESP8266 GPIO NodeMCU ESP8266. And as a tool to operate GPS and relays.

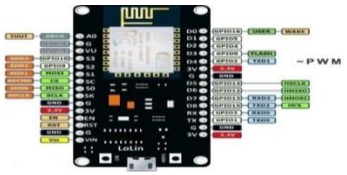


Fig 2. Nodemcu 8266(Source : https://indobot.co.id)

The following is a table of specifications for the Nodemcu 8266, which can be seen in below:

Table 2. Specification for the Nodemcu 8266(Source : https://eprints.utdi.ac.id)

Parameter	*Specification*
Tegangan Operasi	3.3V
Tegangan Input	7 – 12V (Vin)
Digital IO Pin (DIO)	16
Analog Input Pin (ADC)	1
Analog Output Pin (DAC)	2
UART	3
SPls	1
I2C	3
Flash Memory	4 mb
SRAM	64 kb
Clock Speed	80 Mhz
Wi Fi	IEEE 802.11 b/g/n

1.5 Ublox NEO 6M GPS Module

The Ublox NEO 6M GPS module is a very good device for obtaining coordinates from GPS. The Ublox Neo 6M module is capable of tracking up to 22 satellites on 50 channels with an industry-unmatched sensitivity level of -161 dB for tracking and very low power consumption of only around 45 mA.Unlike other GPS modules, this module can update the position every 5 seconds with a horizontal position accuracy of around 2.5 meters. The u-blox 6 positioning engine also provides a time-to-First-Fix (TTFF) of under 1 second! This sensor component will be installed on the motorbike tracking and security technology with the aim of detecting the location and tracking the motorbike when theft occurs.

Fig 3. Ublox Neo 6M GPS Module(Source : https://www.nn-digital.com)

The following is a table of specifications for the U-BLOX NEO 6M GPS Module, which can be seen in below:

Table 3. Specifications for the U-BLOK NEO 6M GPS Module (Source : https://repository.unikom.ac.id)

Specification	
Recipient Type	Recipient Type
50 channels, GPS L1 (1575.42 MHz)	50 channels, GPS L1 (1575.42 MHz)
Horizontal Position Accuracy	Horizontal Position Accuracy
2.5m	2.5m
Navigation update speed	Navigation update speed
1 Hz (maximum 5 Hz)	1 Hz (maximum Capum time) 1 Hz
Capture Time	Capture Time
27 seconds Hot start: 1 second Cool start	27 seconds Hot start: 1 second

1.6 Arduino IDE

Arduino IDE (Integrated Development Environment) is a software program that will be implemented on the microcontroller board[12]. Arduino IDE can be used for several types of microcontroller boards, such as Arduino and NodeMCU.

Fig 4. Arduino IDE

1.7 Stepdown Module

Stepdown 12 volts to 5 volts is an electrical device that transfers electrical energy from one electrical circuit to another circuit, or several electrical circuits. A step-down transformer, or what is often called a step-down transformer, basically has the same function as a step-up transformer, namely to change the level of an electric voltage. To reduce the voltage from the battery to the relay and microcontroller.

Fig 5. Stepdown module (Source : https://www.tokopedia.com)

1.8 ESP32-CAM

The ESP32-Cam module is a camera module with WiFi and Bluetooth capabilities. With its affordable price, this module has received high interest, making it very suitable for Internet of Things (IoT) projects. With this camera module, such as smart home devices, you can control wireless industry, security systems, QR code identification, and various other IoT applications. And in this research, the ESP32-Cam can be used to see motorcycle users[12].

Fig 6. ESP32-CAM(Source : http://eprints.umg.ac.id)

The following is a table of specifications for the ESP32CAM, which can be seen in Table 1.4 below:

Table 4. Specification for the ESP32CAM (Source : http://eprints.umg.ac.id)

Product Specifications	
Model modules	Model modules
ESP32-CAM	ESP32-CAM
Package	Package
DIP-16	DIP-16
Size	Size
27*40.5*4.5(±0.2)mm	27*40.5*4.5(±0.2)mm
SPI Flash	SPI Flash
Default 32Mbit	Default 32Mbit
RAM	RAM
520 KB SRAM + 4 M PSRAM	520 KB SRAM + 4 M PSRAM
Bluetooth	Bluetooth

Bluetooth 4.2 BR/EDR and standard	Bluetooth 4.2 BR/EDR and BLE standard
Wi-Fi	Wi-Fi
802.11 b/g/n/	802.11 b/g/n/
Support interface	S.upport interface
UART, SPI, I2C, PWM	UART, SPI, I2C, PWM
Support TF card	Support TF card
Maximum support 4G	Maximum support 4G

1.9 Relays

A relay is a switch that functions electrically and an electromechanical component that has two main parts, namely electromagnetic and mechanical (a kind of switch)[1], [9], [13]. Relays use electromagnetic patterns to activate switch contacts so that the electric current is low, meaning there is something that allows more electricity to flow through them. In principle, a relay is a switch driver, which is equipped with a coil of wire that has a solenoid on the side. If an electric current flows through this solenoid, then what happens is that the lever is attracted due to the magnetic force that occurs in the solenoid, which causes the switch to turn off.

Fig 7. Relays (Source : https://www.Shopee.co.id)

1.10 Buzzers

A buzzer is an electronic device used to convert vibrating current into sound.

Fig 8. Buzzer(Source : https://www.Tokopedia.co.id)

1.11 SW-420 sensors

Komponen Sensor SW-420 adalah suatu alat yang digunakan untuk mendeteksi getaran dan mengubah menjadi sinyal.

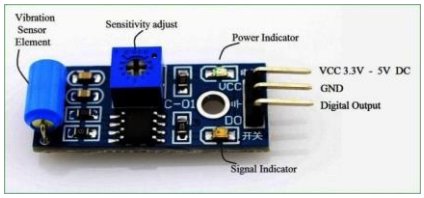


Fig 9. SW-420 Sensors(Sumber : https://www.Tokopedia.co.id)

2. Research Methods

2.1 Time and Place of Research

This research was carried out over a period of two months, starting in September 2023 and ending in November 2023. This research was carried out at the Indonesian Technocrat University.

2.2 Research Approaches and Types

This research uses a mixed-methods research method. The mixed-methods method is a planned, systematic, structured, and measurable effort to utilize things together. This research method uses two research methods, namely quantitative and qualitative, so that it can emphasize the advantages and minimize the disadvantages of each method. Data collection uses research instruments; data analysis is quantitative or statistical, with the aim of testing predetermined hypotheses. This research is quantitative-causal in nature, where it examines whether there is a cause-and-effect relationship.

2.3 Sample Population and Data Collection Techniques

2.3.1. Population

Population is the total number consisting of objects or subjects that have certain characteristics and qualities determined by the researcher to be studied and then conclusions drawn. The population studied in this research were computer engineering students in class 20 at the Indonesian Technocrat University. The population size is based on data from the 20th batch of computer engineers at the Indonesian Technocrat University, namely 30 students.

2.3.2 Sample

According to Sugiyono (2019), ,the sample is part of the number and characteristics of the population. If the population is large and it is impossible for researchers to study everything in the population, for example, due to limited funds, energy, and time, then researchers can use samples taken from that population. Therefore, samples taken from the population must be truly representative.
In this study, the population and saturated samples taken were all computer engineering students in class 20 at the Indonesian Technocratic University, with a population of 30 people who would be used as saturated samples in this research.

According to Sugiyono (2019), saturated sampling is a sample selection technique if all members of the population are sampled. The sampling technique in this study used the saturated sampling technique, where all the population in this study was sampled.

2.3.3. Data collection technique

The data collection techniques used in this research can be explained as follows:

a) **Questionnaire**
   This is a data collection technique that is carried out by giving a set of questions or written statements to respondents to answer. The survey in this research was carried out by distributing questionnaires to respondents, namely class 20 computer engineering students at the Indonesian Technocratic University, regarding the use of tracking and safety technology for motorbikes.

2.4 Research Instrument

This research uses a Likert model attitude scale, which is designed to reveal attitudes of pros and cons, positive and negative, agreeing and disagreeing with a social object. In the attitude scale, the social object acts as an attitude object. The Likert scale is used to measure attitudes, opinions and a person's or group's perception of a social event or phenomenon.
Subjects responded with 4 categories:

Table 5. Subject Response Categories

Tidak Berminat	TB
Kurang Berminat	KB
Berminat	B
Sangat Berminat	SB

Determining the score is called a scaling procedure, using points for each answer as shown in the table below:

Tabel 6. Skor Skala Likert

Jawaban	*responden*	*skor*
Sangat Berminat	19	5
Berminat	7	4
Tidak Berminat	2	3
Kurang Berminat	2	2

2.5 Data analysis

The data analysis method used in this research is a qualitative data analysis method that aims to obtain information regarding the security of motorbike vehicles for class 20 computer engineering students at the Indonesian Technocrat University.

2.6 Research Framework

The research framework is the research method, which is the method used to conduct research so that it can be well organized.

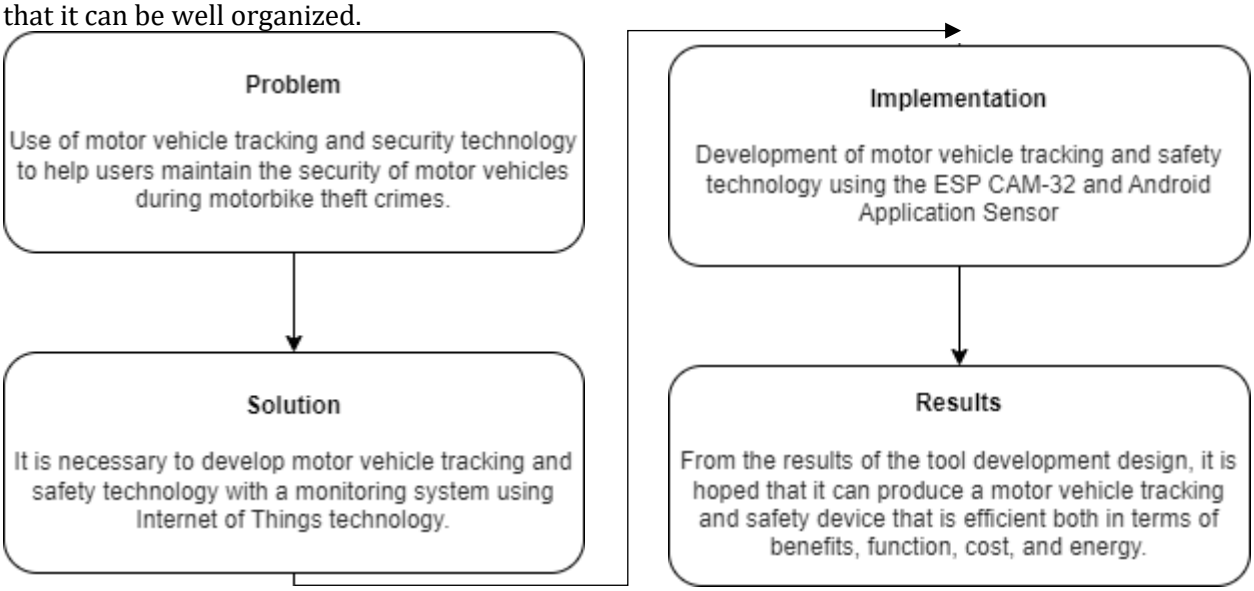


Fig 10. Research Framework Chart

2.7 Research stages

This research involved several steps taken to support the research objectives. The steps taken to conduct this research are as follows:

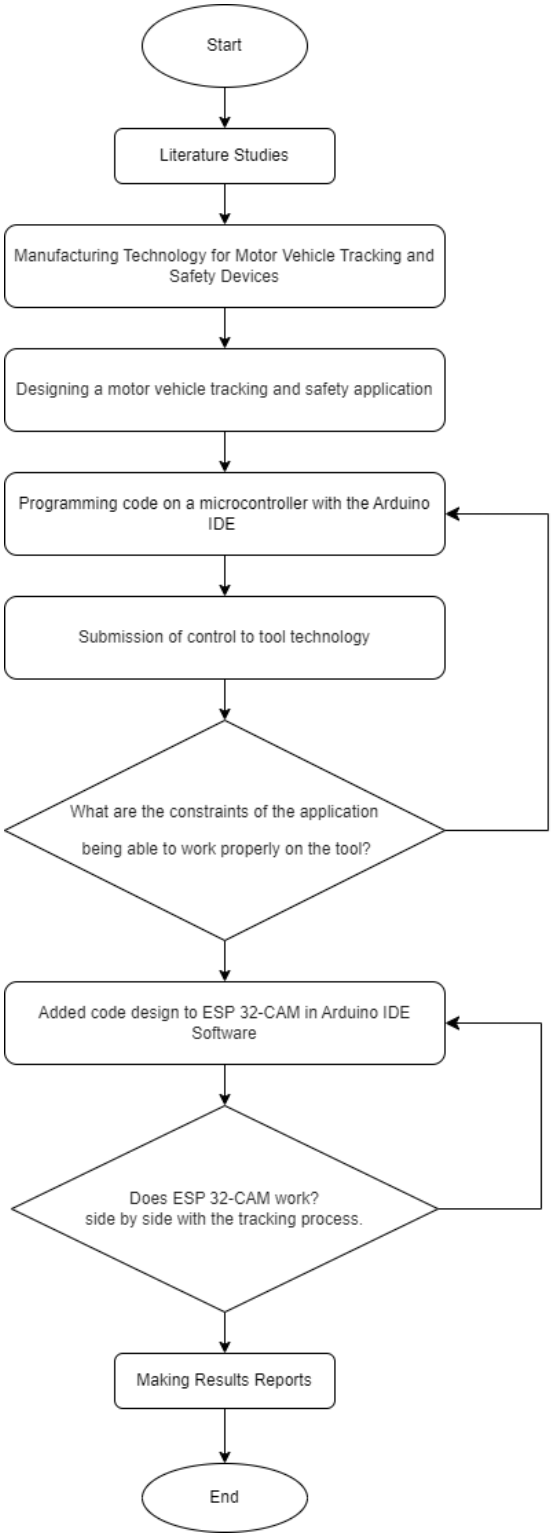


Fig 11. Research Stages Flow Chart

From this chart, researchers will design research procedures to implement a tracking and security system with GPS u-blox NEO 6M based on an Android application on motorcycle vehicle tracking and security technology. This phase includes several steps that are designed systematically and structured so as to increase the success of the technology process for tracking and securing motorbike vehicles on devices that are controlled and monitored with a smartphone application. The research begins with a literature study stage, which aims to obtain the necessary knowledge and research references. Next, the research continued by designing a technology platform for motorcycle vehicle tracking and safety devices, which is the focus of this research. At this stage, the development of a technology platform for motorbike vehicle tracking and safety devices aims to enable the tool to monitor and track in real time with a smartphone application. After the process of creating the technology platform for motorbike vehicle tracking and safety devices is complete, the tool will then be connected to the Arduino IDE software on the PC[14]. The next stage is to build code that can connect the tool with the smartphone application. Next, a comprehensive testing stage will be carried out to ensure the success of the motorcycle tracking and safety technology and the ESP32-CAM for security monitoring in motorcycle vehicle tracking and safety technology[15]. The results of these tests will be discussed and explained in the research report.

2.7 Tools and materials

In implementing tracking and security technology using GPS U-BLOX NEO 6M based on the Android application for tracking and security technology for motorbikes, there are several tools and materials needed. Details of these tools can be seen below:

Table 7. Tools

No.	Tool's name	Function
1.	Buzzer	For alarms
2.	Jumper Cables	used to connect between NodeMCU, GPS, and relay.
3	Crocodile Clip Cable	used to connect the tool to the battery.
4	Relay Module	used as a control tool in electrical circuits that have high voltage using low-level voltage signals.
5	GPS Module	used as a vehicle tracking device.
6	NodeMCU ESP8266	used to control GPS and relays.
7	NYAF cable	Cables are used to connect relays and motors.
8	Stepdown Module	to reduce the voltage from 12V to 5V.

9	ESP32-CAM	as a tool for vehicle monitoring
10	Arduino IDE	used to create Program and upload to the microcontroller.
11	Android Studio	used to create Android mobile applications.
12	SW-420 sensors	Used to provide notifications on smartphones.

2.8 System planning

At this stage, the overall security system is designed. The design of this system can be represented by the tool design flow diagram in Figure 2.3.

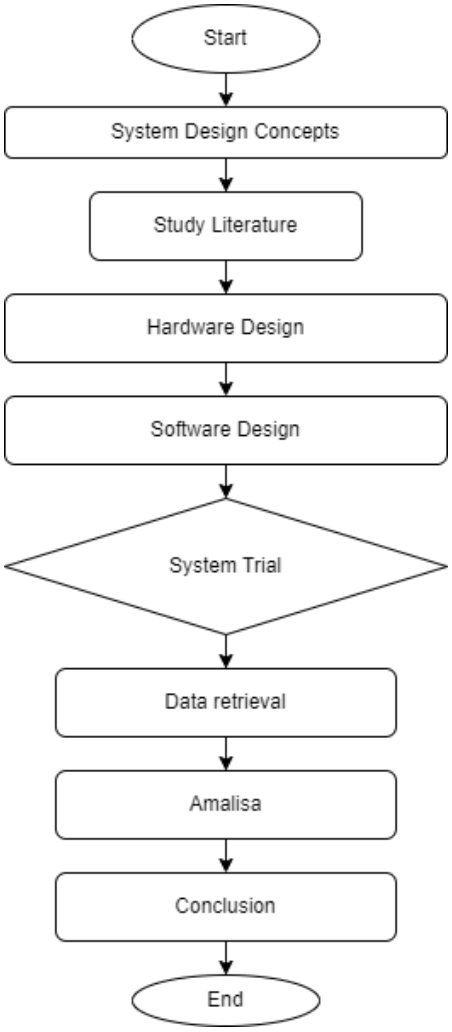


Fig 12. Research Flow DiagramResearch Flow Diagram

From the research flow diagram shown in Figure 2.4, it can be explained that this research began with a literature study. Then proceed to the hardware and software design stage[7]. System Design Trial: If the system being designed meets the specifications, then data can be collected. If the system testing with various predetermined parameters is successful, then analysis will be carried out, and the conclusions obtained from the data analysis will be determined.

2.9 Application Design

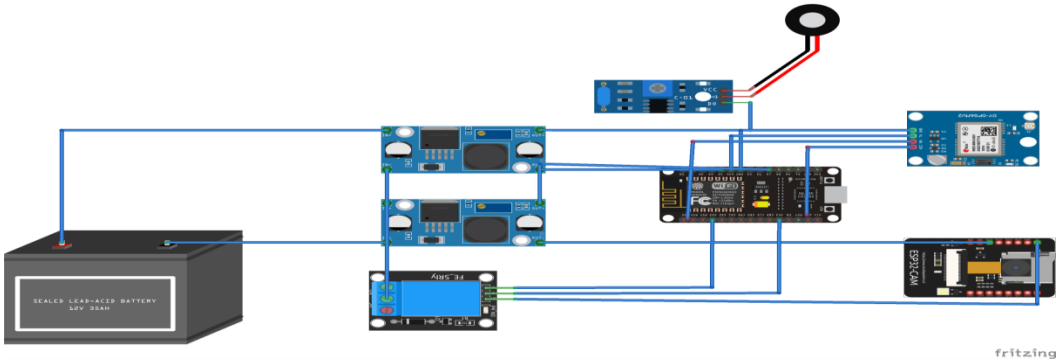
At this stage, an application will be designed for tracking technology and motorcycle vehicle safety. The app interface has been designed with simplicity in mind so that users can easily use it in the future.

Fig 13. Application Display

2.10 Tool Schematic Circuit

This schematic circuit tool is designed through the application of Fritzing software, which will be formed and implemented directly. The following is a schematic image of the tool circuit:

Fig 14. Tool Schematic Circuit



In Figure 2.6, there is a circuit. A tracking and security system will be installed on a motorcycle. The power source used is a 12V DC accumulator. Then, the voltage will be reduced using Step-Down to 5V before being released. divided into two outputs, namely the WiFi network and NodeMcu. NodeMcu is then connected to the GPS module, ESP32-CAM, and relay. This relay is then connected to a standard switch cable as a circuit breaker for the ECM[10].

2.11 Tool Design

This motorbike vehicle security system design uses the NodeMCU ESP8266 V3, ESP32-CAM module, GPS Neo 6M module, relays, vibration sensors, and other supporting components. This technology consists of two main components, namely hardware that will be installed on motorcycles and software[5][15].

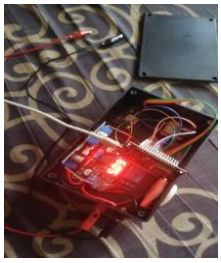


Fig 15. Tool Design

3 Result and Discussion

3.1 Result

3.1.1 Tool Design Results

This chapter discusses the results of the design of the Tracking Technology platform and motorbike vehicle safety, which have been adapted to the tools and materials. Figure 3.1 below is physical evidence of the results of the tool design.

Fig 16. Motorcycle tracking and safety device

3.1.2 U-BLOX 6M GPS Test Results

U-BLOX 6M GPS testing was carried out to evaluate location accuracy by comparing it with location data stored in Firebase[6]. This test was carried out twice by comparing the location in Firebase and the location in the Android application by carrying out 10 measurements, which can be seen in tables 3.1 and 3.2 as follows:

Table 8. GPS Testing with Firebase

No	GPS With Firebase		Distance
	Latitude	longitude	
1	-5.38145	105.25641	3,6 km
2	-5.38301	105.25680	1,51 km
3	-5.38301	105.29182	3,83 km
4	-5.38525	105.24540	7,1 km
5	-5.36931	105.24420	3,9 km
6	-5.36959	105.24160	4,2 km
7	-5.36986	105.30894	7,5 km

8	-5.38718	105.24047	9,3 km
9	-5.36953	105.24394	4,4 km
10	-5.37377	105.23401	4,5 km

Table 9. GPS Testing with Android Applications

No	GPS With Android Application		Distance
	Starting Location	Final Location	
1	Labuhan Ratu,kec.Kedaton ,kota Bandar lampung 35132	Jl.Beringin No.51C,labuhan ratu,kec.kedaton ,kota Bandar lampung 35142	1,51 km
2	Labuhan Ratu,kec.Kedaton ,kota Bandar lampung 35132	Rajabasa Raya,kec.Rajabasa,Kota Bandar Lampung 35142	3,6 km
3	Sukarame, kec. Sukarame , Kota Bandar lampung 35131	Gg. Cemara, Rajabasa Raya, Kec. Rajabasa, Kota Bandar Lampung 35142	3,83 km
4	Labuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132, Indonesia	Sukarame, Kec. Sukarame, Kota Bandar Lampung, Lampung 35131, Indonesia	7,1 km
5	Labuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132, Indonesia	Gedong Meneng, Kec. Rajabasa, Kota Bandar Lampung, Lampung 35141, Indonesia	3,9 km
6	abuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132, Indonesia	Jl. H. Komarudin No.10, Rajabasa Raya, Kec. Rajabasa, Kota Bandar Lampung, Lampung 35142, Indonesia	4,2 km
7	Labuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132, Indonesia	Perumahan Taman Prashanti 2, JI. Pulau Sebesi No.14, Sukarame, Kec. Sukarame, Kota Bandar Lampung, Lampung 35131, Indonesia	7,5 km
8	JI. H. Ismail, Rajabasa Raya, Kec. Rajabasa, Kota Bandar Lampung, Lampung 35142, Indonesia	Jl. Ryacudu, Harapan Jaya, Kec. Sukarame, Kota Bandar Lampung, Lampung 35131, Indonesia	9,3 km

9	Labuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132, Indonesia	Tugu Air Mancur Universitas Lampung, Gedong Meneng, Kec. Rajabasa, Kota Bandar Lampung, Lampung 35141, Indonesia	4,4 km
10	JI. ZA. Pagar Alam, Gedong Meneng, Kec. Rajabasa, Kota Bandar Lampung, Lampung, Indonesia	Jl. Gatam 1 No.5, Hajimena, Kec. Natar, Kabupaten Lampung Selatan, Lampung 35143, Indonesia	4,5 km

From GPS testing with the application and Firebase, the results can be seen: testing via Firebase to test the IP location and testing on the Android application to see the results of the IP location.

3.1.3 SW-420 Sensor and Buzzer Test Results

This test aims to check the accuracy of the SW-420 sensor and buzzer and whether the sensor and buzzer can be connected to each other by carrying out five experiments, which can be seen in Table 3.3 as follows:

Table 10. Testing of the SW-420 Sensor and Buzzer

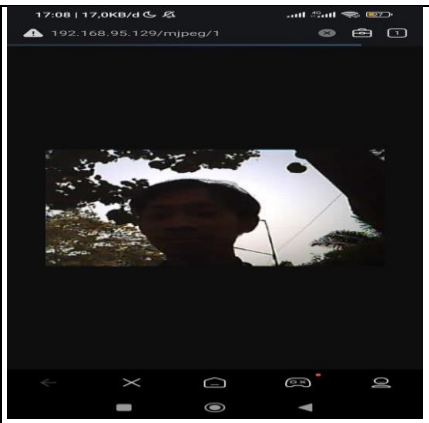
No	Censorship	Sensor Value	Buzzer
1	SW-420 sensors	Detected	sounds
2	SW-420 sensors	Detected	sounds
3	SW-420 sensors	Not detected	No sound
4	SW-420 sensors	Detected	sounds
5	SW-420 sensors	Not detected	No sound

Testing the buzzer to respond to detection results from the SW-420 sensor when it detects vibrations on the SW-420 sensor When the situation is like that, the buzzer will sound. After the sensor has detected a vibration, the buzzer will stop sounding.

3.1.4 ESP32-CAM Test Results

Tabel 11. ESP32-CAM Test Results

No	Time	GPS coordinates	Image Results
1	15:00	-5.36953,105.24394	

2	16;00	-5.38301, 105.25680	

From the test results in Table 3.4, the camera used is a 2 MegaPixel resolution camera. In the morning, afternoon, and evening conditions, the results look quite good, but at night the camera does not display very clear images.

3.2 Discussion

Based on the test results that have been evaluated on the parts of the device used, both those that act as input, processing, and action output, the result data is obtained in accordance with the system creation plan. The results obtained from testing are in accordance with the function of the security system applied to motorcycle vehicles. The suitability of test results is based on several things, namely:

1. The system allows communication via the internet network between motorcycle vehicles and their owners by utilizing Android application software.
2. The system can activate an alarm for the vehicle owner if the motorbike is started and produces vibrations that are read by the SW-420 sensor and then sent to the buzzer.
3. The system can show the exact location of the motorbike on the map on the owner's cellphone.
4. The system is able to capture images of motorbikes via the Android application.

Data obtained from testing the entire system showed that there were factors that could influence performance; these factors were distance, signal, and GPS sensor.

4. Comclusion

4.1 Conclusions

Based on the research analysis that has been carried out, it can be concluded as follows:

1. On the creation of this motorbike tracking and safety technology device. An additional advantage of this research is that it is relatively cheap to implement, making it an accessible option for most motorbike owners.
2. In making this motorbike tracking and safety technology tool, durable and weather-resistant materials are used, which is a key factor in the safety of the tool. Strong and weather-resistant components can guarantee the durability of the tool.

4.2 Suggestions

Based on the results of the research that has been carried out, which provides the basis for this content to be shown, here are some suggestions that the author can provide for further research:

3. Use a high-speed internet network (5G) or a SIM card module because if the internet network is disrupted, it will be difficult for motorcycle users to get information.
4. The tool technology is designed to be more flexible so that it can guarantee the tool's resistance to sabotage attempts and uses a higher GPS version because collecting data from the GPS NEO 6M takes quite a long time.

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