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Remote Vehicle Monitoring System Starting and Tracking Using IoT System

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Abstract: Safety in the vehicle is one of the most important factors in the daily life of every vehicle user. This project is more focused on improving vehicle systems to increase vehicle safety systems. The main objective of this project is to study IoT (Internet of Things) safety systems in automotive applications. Next is to design engine start-stop and tracking for motorcycles. In addition, to analyze battery voltage, GPS location data, and engine start-stop system from the motorcycles with safety features. The vehicle used for this project is a Yamaha 135LC version 2 motorcycle, the Blynk app, and a two NodeMCU ESP8266 microcontroller with a Wi-Fi module, a relay, and a GPS module. As a result of the start-stop engine, PicoScope was used to analyze the voltage of the battery after the system had fully functioned when the signal was sent to the relay by Blynk apps. The experiment was carried out from five different locations for the engine start-stop system and seven different locations for the GPS, with the engine start-stop system obtaining motor battery voltage readings using PicoScope and the GPS obtaining vehicle coordinate results by reading the latitude and longitude from the smartphone. The GPS data was then compared between the location of the GPS module and the location of the smartphone's GPS to determine the accuracy of the location.

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Keywords: Blynk application, GPS module, Wi-fi module

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1. Introduction

Technological advancements are accelerating (developing), and businesses are striving for new market share. Nevertheless, all those developments are aiming for the same purpose in which to make the user's life easier, to assure their safety, and to safeguard the environment. These ideas are also applied to automobiles and motorcycles. A car's security system is fitted to deter theft and ensure that the vehicle is always safe and secure. There has been a slew of recent attempts concerning car networking, whether between vehicles or within a vehicle.

This project mainly will be discussing regarding the alternatives offered for extra safety and precaution and further facilitates car and motorcycle use. This smart control is a system used to control the vehicle system by using a mobile phone. Among the system that can be controlled is to turn off and turn on the vehicle engine automatically. These smart controls are intended to facilitate the users to access their own vehicles remotely via the internet. Sometimes, vehicles owner tends to misplace their car key or motorcycle key which caused further problems in their life. Thus, this project aimed to solve and ease the problem. This system incorporates the usage of microcontrollers and electronic devices such as relays. An android smartphone application that connects with the integrated development environment (IoT) platform to communicate with the NodeMCU ESP8266 is developed to control the vehicle system securely via the internet. [1].

Existing vehicle systems are now increasingly sophisticated in the market. But there are some systems that are not available in commercial vehicles but in expensive vehicles. Vehicle theft cases in Malaysia in year 2020 a total of 21,578 cases of vehicle theft were reported and in 2019 a total of 30,868 [1]. According to statistics, Malaysia is in the position of fourteen countries in the world of car theft [2]. Next in the news on vehicle theft cases in 2018 ranking no 1 is from the country of New Zealand [3].

The objective of this project is to study IoT (Internet of Things) safety systems in automotive applications. The second is to design an engine start-stop system and tracking for motorcycles and lastly objective is to analyze battery voltage, GPS location data, and engine start-stop system from the motorcycles with safety futures.

2. Materials and Methods

2.1 Hardware

According to Figure 1, this system employs various components, including two NodeMCU ESP8266, the two-channel relay module, GPS module, and the ignition switch and starter motor wires on the motorcycle. The signal sent from the app via the cloud will be evaluated by the NodeMCU before being delivered to the relay to turn the system on or off. The relay has two channels, one of which will be linked to the ignition switch wire and the other to the motor starter wire. In addition, another ESP8266 will be connected to the GPS module, and the GPS module will receive the latitude and longitude data and send it to the Blynk apps.

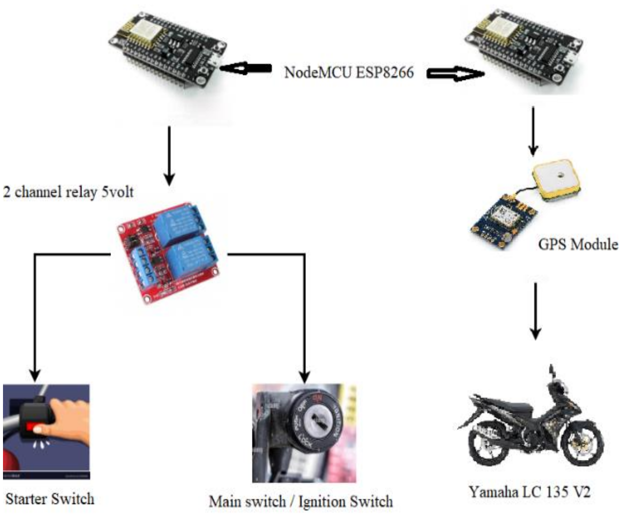

Fig. 1 - Flow Operation Sequences the System start-stop engine

2.2 Blynk Apps

Figure 2 shows the flow of operations with the Blynk application to the hardware. Blynk is a platform that includes Android and iOS apps for controlling Arduino, NodeMCU Raspberry Pi, and other similar devices over the Internet. [4] It is a digital dashboard, and users can create a graphical interface for it by dragging and dropping widgets. To correspond with the project to be produced, this app must employ a few steps to install the app and build in-app content. These apps may be found in the Google Play store for Android phones and the Apple App Store for iPhones. This app will be connected to a wearable microcontroller, such as NodeMCU, which will be supplied by this signal app.

Fig. 2 - Blynk system with hardware

2.3 Flow Sequences Operation of the System

This flow operation shows the flow system that connects smartphones and hardware through the IoT system. This system involves several components such as NodeMCU, motor starter relay, ignition switch, and Blynk apps as in Figure 3. This flow operation process has been divided into two parts, namely for the Smartphone part using Blynk Apps and the second part is the hardware as a place to receive signals and move the system as shown in the Figure 3.

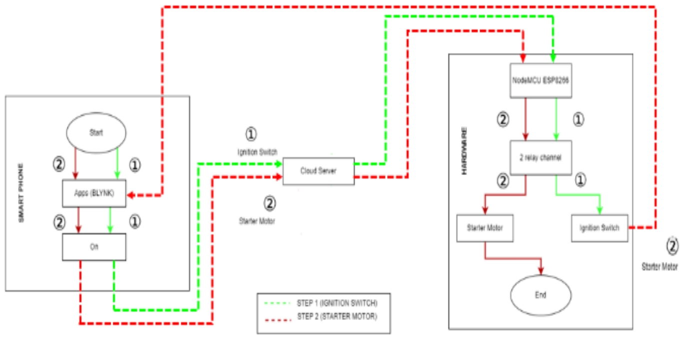

Fig. 3 - Flow Operation Sequences the System start-stop engine

The GPS system is connected to the NodeMCU for use in appropriate Apps such as Blynk apps. Flow operation shown in Figure 4 is the GPS sensor that will provide a location and coordinate data to ESP8266. Next from ESP8266, the location data and coordinates will be sent to the application through the data center or cloud as an intermediate route to obtain data and can be detected via smartphone. [5]

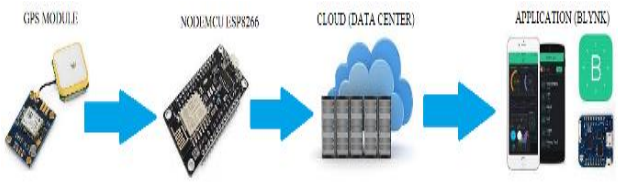

Fig. 4 - Flow operation GPS system

3. Results and Discussion

This section discusses the result and functionality of the overall system and how to control the Startup and Shutdown engine motorcycle and detect location motorcycles via GPS in Blynk Apps. The experiment results for these two systems include several methods, for the engine start and shutdown system, using a PicoScope to obtain data on the battery voltage when the motorcycle is switched on the ignition, start the engine, and engine off. Furthermore, test the GPS system at various locations to determine its accuracy

3.1 Start-Stop Engine

This project used Arduino IDE software to simulate the coding and programmed the two ESP8266 Wi-fi modules, one for the startup and shutdown engine system and one more for the GPS system. The program was also used to check the functionality of the connection between the components by displaying an error box at the bottom of the software window. After each pin was assigned in accordance with the connection between the ESP8266, 2-channel relay, and GPS sensor, Figure 5 displays the successful coding that was uploaded into the ESP8266 coding for the Start-Stop engine system.

Fig. 5 - Coding for Start-Stop engine system

After the code was compiled and uploaded to NodeMCU ESP6288, the relay will function if the switch button in the Blynk apps is turned on or off. The Startup and Shutdown engine systems have displays in Blynk apps that have two buttons for the ignition system and the starter motor system. For the ignition system function, turn on the ignition before starting the engine because the motorcycle's system does not have power when the ignition is not already turned on. The main switch in Blynk apps functions similarly to an on/off switch: when the switch is turned on, the system remains on until the switch is turned off. In the Blynk app, there is a button starter for the start motor system. The button functions like a push start button then press the button, the starter on motorcycles will turn

Fig. 6 - Displays Start Motorcycles in Blynk Apps and prototype Start-Stop Engine system

There will be two options based on the relay module, one for switching on and off the ignition system and one for starting the engine system. After pressing the switch button in Blynk apps, the relay 1 will function and turn on the ignition. Following that, as shown in Figure 6, relay no. 2 will activate and the motor will begin cranking the engine.

3.1.1 Battery Voltage Reading For Start-Stop Engine System

Motorcycles' electrical systems use 12 volts to turn on the ignition and power the starter motor. This project is successful with that method, as evidenced by the battery voltage in conditions of engine off, engine start, and idle engine, as shown in Figure 7. With the engine off, the starting voltage will remain around 12.4 volts. And if the switch turned on the ignition, the voltage would slightly drop to 12.3 volts. After that, when they press the switch to turn on the starter, the graph shows the voltage falling fast to around 8 volts because the starter pulls more power from the battery to turn on the starter motor to crank the engine. And, after the engine idles, the voltage will rise to around 13 volts because the motorcycle has a system charger, or, as its technical name implies, a rectifier, which converts the alternating current (AC) produced by the alternator (generator) into direct current (DC), which will be used to charge the battery. This graph is repeated several times to obtain the result voltage when the engine is turned on and started using a smart phone.

Fig. 7 - Voltage graph

Figure 8 depicts the checkpoint location for testing this system. This test is to confirm the system can operate and function successfully when the vehicle is moving and at a different location. From the experiment, the result is fully functioning at all locations after the motorcycle moved to different locations and in these five different locations is that it all works, can restart the motorcycle controlled by a smartphone, and moves normally.

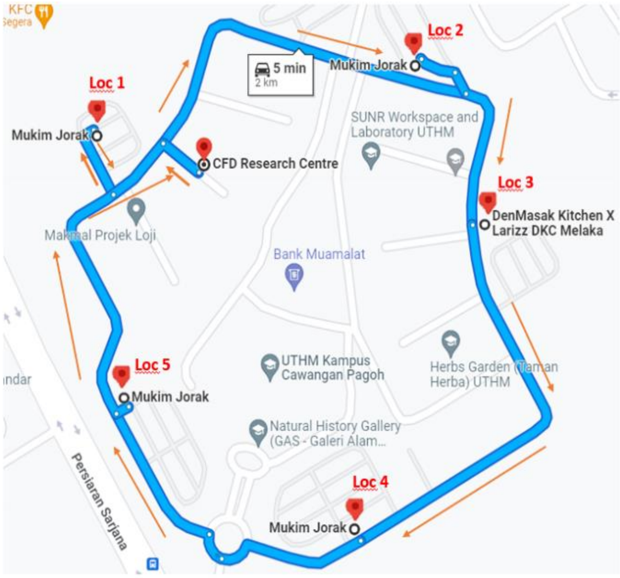

Fig. 8 - Five check point location test

3.2 **GPS System**

The GPS system, still use Arduino IDE software to make and run the coding and programmed ESP8266 with GPS module. This system used a wi-fi module in ESP8266 and automatically connect internet which has been registered in ESP8266. Figure 9 shows the successful coding for GPS system that was uploaded into the ESP8266 after each pin was assigned according to the connection between ESP8266 and GPS module.

After the coding was uploaded to the ESP8266, the data latitude and longitude does not show at serial monitor which meant there were errors between the connection or the coding. Figure 9 the next figure shows the data GPS did not display on the serial monitor. Then continue with the coding checking and check connection wiring. After checking it was found that the GPS module have a problem and does not function because LED at the GPS sensor not blinking as shown in Table 1 and that's means the GPS module faulty because not function after a few minutes and must change a new GPS module. After all the requirements had been fulfilled, the coding was re-uploaded into the ESP8266 and checking again. The problem was fixed by changing the new GPS module and re-uploaded the coding. The GPS result was displayed as in Figure 10. To obtain an accurate location, the data is updated every 0.05 seconds.

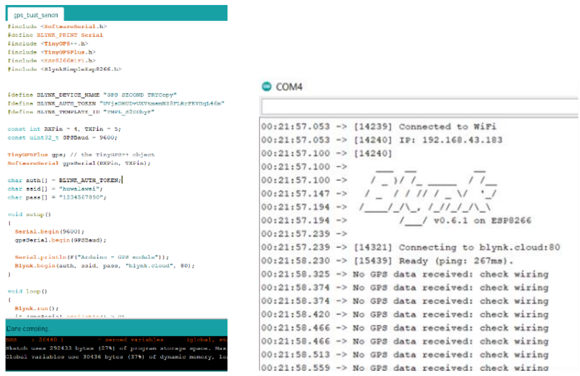

Fig. 9 - Coding GPS system upload in ESP8266 and error GPS data

Table 1 - Condition GPS module

Before (GPS module faulty)	After (GPS module ok)
	

To determine location, the GPS system displays only the latitude and longitude in Blynk apps. Latitude and longitude from form data can be used with the data to detect location; use Google Maps to search for latitude and longitude, and Google Maps will show the exact location. Besides that, this system can read speed in km/h, and if the sensor is attached to a motorcycle or any other vehicle, the sensor will show the speed movement of the vehicle as shown in Figure 10 The sensor's data speed is very sensitive because data speed is constantly changing, and if the sensor moves more than 5 km/h, the data will be accurate, just like in a GPS system on the internet.

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Fig. 10 - Successfully GPS data and displays GPS data in Blynk Apps

3.2.1 **Accuracy Analysis**

GPS testing at various locations to obtain an accurate location is sometimes required because the GPS signal is not accurate for a variety of reasons, including the GPS signal being weak when near building areas and under trees. This test will compare the accuracy of location between the GPS module and the GPS phone. Because GPS module model NEO-6m-001 has a 2.5-metre horizontal position accuracy and GPS-enabled smartphones are typically accurate to within a 4.9-metre (16-foot) radius under an open sky, their accuracy worsens near buildings, bridges, and trees. The GPS module and phone are both located in the same location. This test was conducted at seven different locations in the UTHM Pagoh area, as shown in Figure 11. Locations 1, 2, 5, and 6 are close to buildings, location 3 is in an open space, and locations 4 and 7 are under a tree.

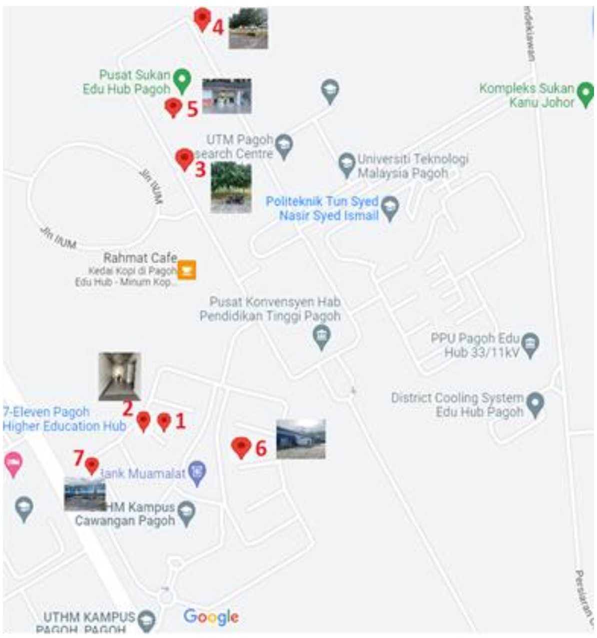

Fig. 11 - Location test GPS

The speed data at the GPS module is very sensitive in Table 2, which shows data from the GPS module and GPS phone, because the speed always changes and is not fixed, even though the GPS module does not move. Based on this data, the difference in accuracy between a GPS module and a GPS phone is less than 40 meters at each location. This is because location no. 1 and location no. 5 has the most displacement compared to the other locations. Locations 1 and 5 are on the inside of the building. The accuracy of each location has been shown to change because the GPS signal is disturbed and weak due to the presence of nearby buildings. The location at number 4 is one of the closest distances among the other locations because it is an open area with a small tree that does not interfere with the GPS signal. Figure 12 show an example of how to measure displacement between two locations.

Table 2 - Data from Location GPS module and GPS phone

location	GPS Module			GPS Phone			Different displacement between GPS module and GPS phone (meter)
	latitude	longitude	Speed (km/h)	latitude	longitude	Speed (km/h)	
1	2.15014	102.73050	1.574	2.150106	102.730365	0.00	37.0
2	2.15014	102.72987	2.222	2.150007	102.729707	0.00	23.0
3	2.15541	102.73052	0.185	2.155472	102.730690	0.00	20.0
4	2.15739	102.73108	0.000	2.157362	102.731137	0.00	6.70
5	2.15592	102.73061	0.426	2.156094	102.730877	0.00	35.0
6	2.14957	102.73206	0.148	2.149490	102.731993	0.00	10.0
7	2.14926	102.72913	0.463	2.149092	102.729228	0.00	22.0

Fig. 12 - Example of how to measure displacement between two locations

4. Conclusion

In conclusion, the first objective of the remote vehicle monitoring system starting and tracking using IoT system is to study IoT (Internet of Things) safety systems in automotive applications. The literature analysis in the article highlights the different components, software, and sensors that are available for IoT systems. It also presents several articles on how IoT systems have been implemented in vehicles such as buses and cars. The article goes on to describe the processes, methods, and outcomes of projects that make use of IoT systems. The IoT systems bring many benefits

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to the automotive industry, as they can help to develop and advance it. The circuit for the engine stop-start system described in the article was developed based on the study of IoT systems. As a result, the first objective is achieved.

Next second objective, to design engine start-stop system and tracking for motorcycles is achieved. The project is created with the help of specialized software and components such as IDE software, which is responsible for coding and uploading the coding to the microcontroller. Furthermore, the ESP8266, which can receive signals, transmit signals and receive data, is an important component for the success of this project. Then a 5-volt relay to enable the engine start-stop system and the GPS module to be used in the vehicle tracking system by reading the latitude and longitude data from the vehicle. The system was then installed on a Yamaha 135 LC motorcycle-type vehicle and tested several times to make sure it worked properly. After conducting several tests, it was found that the system works well, thus achieving the second objective.

Finally, to analyze battery voltage, GPS location data, and engine start-stop system from the motorcycles with safety futures. After some investigation, it was discovered that PicoScope is the ideal tool to capture the changing voltage data when trying to start the motorcycle to prove the success of this system when executing the start-stop engine system experiment. The data was read using a PicoScope, and the results were successful. Aside from that, GPS data was successfully obtained by employing a GPS module and precise microcontrollers, as well as obtaining the vehicle's latitude and longitude data via Blynk apps on a smartphone. Finally, all experimental data for both systems was successfully extracted.

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