1575.42 MHz Frequency Utilization on Intelligent Transportation System in Car Monitoring Distribution Delivery Logistic Using ublox GPS Neo 6M

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Abstract

An Intelligent Transportation System or a smart transportation system with new technology that has been growing in recent years is used as a computing system and communication technology for various purposes, such as traffic management, vehicle and highway security, and emergency services. The current growth of e-commerce is very powerful because people have placed e-commerce as a lifestyle. The high demand for logistics and delivery causes the need for monitoring package cars. This research system is designed to automatically monitor package cars, by utilizing the receiver frequency in the L1 frequency band (1575.42 MHz) which is modulated by the Ublox GPS Neo 6M module. Accelerometer sensors and acoustic data are used in cars as speed gauges and are used to detect and provide brief recordings in the event of an accident and can also monitor the speed of the car's distribution of packages in real-time. It was obtained for 7 trials with the same speed and constantly to avoid the Doppler effect the accuracy of the GPS was quite good with an average distance of 7.3 m compared to GPS on Mobile Phone and the data was successfully uploaded to the web server in real-time.

***Keywords* — Frequency, GPS, ITS, Monitoring**

I. INTRODUCTION

Transportation is one of the important elements in everyday life because almost all activities carried out cannot be separated from the use of transportation, one of which is also in the delivery of goods, both the movement of people or goods from one place to another by using vehicles driven by humans or machines. [1, 2]. The increasing number of users of public transportation has triggered various logistics companies to compete in presenting transportation innovations for those who are reliable in providing services to the community. The existence of online transportation innovations offered such as JNT, JNE, POS Indonesia, TIKI, Lion Parcel and others can answer the community's needs for practical and adequate transportation. Apart from being easy to access, affordable prices are the reason why someone switches to using transportation or a package car, but this certainly does not guarantee that the driver or the goods carried will avoid traffic accidents. The high demand for logistics and delivery causes the need for monitoring package cars.

The growth of e-commerce has increased since the enactment of the global Covid-19 pandemic, causing people to place e-commerce as a lifestyle. An intelligent Transportation System (ITS) or a smart transportation system with new technology that has developed in recent years is used as a computing system and communication technology for various purposes, such as traffic management, routing planning, vehicle, and highway security, and emergency services. ITS uses various kinds of sensing and communication to assist transportation authorities and vehicle drivers in making informed decisions as well as comfort and safety in driving. By utilizing ITS, road and vehicle security systems can be safer, more efficient, and environmentally friendly. The utilization of ITS as a monitoring system has been successfully carried out in several previous studies, with different application categories such as traffic information, vehicles, driver behaviour, and environmental conditions [3-5]. An intelligent Transportation System (ITS) or a smart transportation system with new technology that has developed in recent years is used as a computing system and communication technology for various purposes, such as traffic management, routing planning, vehicle, and highway security, and emergency services [2]. ITS uses various kinds of sensing and communication to assist transportation authorities and vehicle drivers in making informed decisions as well as comfort and safety in driving. By utilizing ITS, road and vehicle security systems can be safer, more efficient, and environmentally friendly. The utilization of ITS as a monitoring system has been successfully carried out in several previous studies, with different application categories such as

traffic information, vehicles, driver behaviour, and environmental conditions [3]. GPS transmits two signals, namely the L1 (1575.42 MHz) and L2 (1227.60 MHz) frequencies. The L1 signal is modulated by two pseudo-random signals, namely the P code (Protected) and the C/A code (coarse/acquisition) and this is modulated by the GPS module in general. The L2 signal carries only the P code. Each satellite transmits a unique code so that the GPS receiver can identify the signal from each satellite [6].

The GPS modules receive system enhancements in low-cost devices by manufacturing low-cost, low-power devices, including the ability to provide L1 satellite data equivalent to geodetic GPS [7].

Most ITS Technologies have used the Global Positioning System (GPS) for localization as well as accelerometers for driver and vehicle safety. in previous studies, some studies apply accelerometers and GPS to monitor driving style and how it performs during the trip [8]. and for the first time, research was conducted using the L1 (1575.42MHz) frequency band at ITS. This research is designed to analyse the result of coordinates in Ublox GPS Neo 6M on ITS system with the capability to automatically detect traffic accidents using accelerometer sensors and acoustic data, then notify the server without time-lapse via emergency messages after an accident, and provide driver situation, GPS coordinates, video channels, and accident data recording. The advantage of this system is that there is a panic button that will be connected to the community service in the event of a suspicious activity or an emergency.

II. RESEARCH METHODS

To make it easier to design and understand the work system of this research, it can be seen in the block diagram of the system image below.

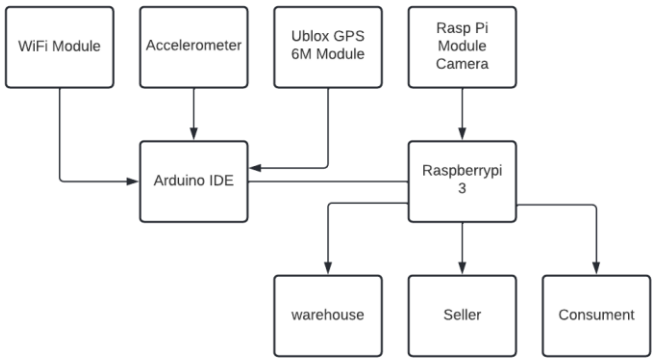


Fig 1 . ITS System Block Diagram

The block diagram owned by ITS (Intelligent Transportation System) in monitoring this logistics delivery distribution car is the Arduino UNO, Raspberry Pi 3, WiFi Module, Accelerometer, GPS Module and Camera Module. First, there is a GPS module that will modulate the signal to the L1 frequency band (1575.42 MHz) and then an accelerometer that works as a reading, this GPS module is also for detecting or reading the coordinates of the actual logistics car. Then the accelerometer to record the actual speed and incline of the car, and the data obtained will be sent by Arduino UNO via the WiFi Module to the Raspberry Pi 3. From the Raspberry Pi 3 it will be sent to the reader via a web server which can later be read by the warehouse, consumers and seller. The function of the camera module is that when a car has an accident, the record will be saved to the database including the last coordinate point.

A. Flowchart

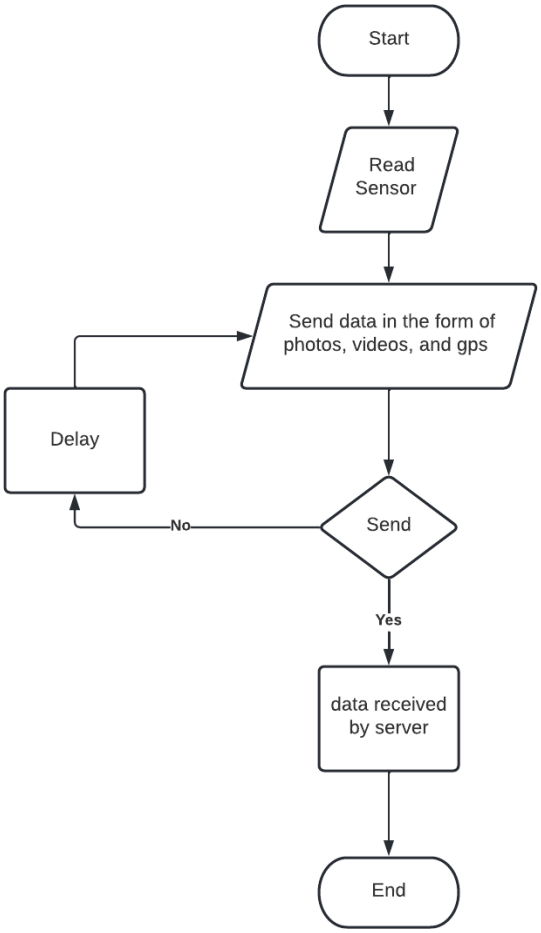


Fig 2 . Flowchart Intelligent Transportation System

The flowchart image above shows the stages of the tool's operation from receiving data in the form of photos, videos, and also coordinates or GPS points to sending data to a web server database. The data displayed on the web shows real-time so that if an accident occurs, the handling will be faster.

B. Electronics Design

Below is an image of the circuit for ITS, which uses serial communication between Arduino Uno and Raspberry Pi along with the sensors used.

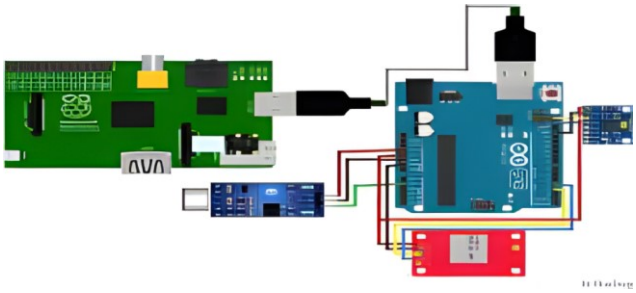


Fig 3 . Electronics Design

In figure 3 it can be seen that the GPS sensor and accelerometer are integrated with the Arduino Uno through the existing pins, which are then connected to the Raspberry PI from the Arduino which is already connected to the camera module via a serial cable and USB port.

III. RESULTS AND ANALYSIS

In hardware testing, the Arduino Uno microcontroller and the sensors used will be tested. In this test, the Raspberry Pi 3B analysis on the package car monitoring system was also analysed. There are two ways to connect and operate the Raspberry Pi 3B device where the first is to connect the device directly and the other way is to connect the computer after installing the OS software with wifi or internet connection. Arduino UNO will be connected directly because the serial monitor is connected to the Raspberry Pi. If there is a location notification and an accident in the system, it will be reported directly to the authorities through a website that has been created by utilizing the coordinate readings made by the Ublox GPS Neo 6M. This stage is also aimed at ensuring the functionality and performance of the tool.

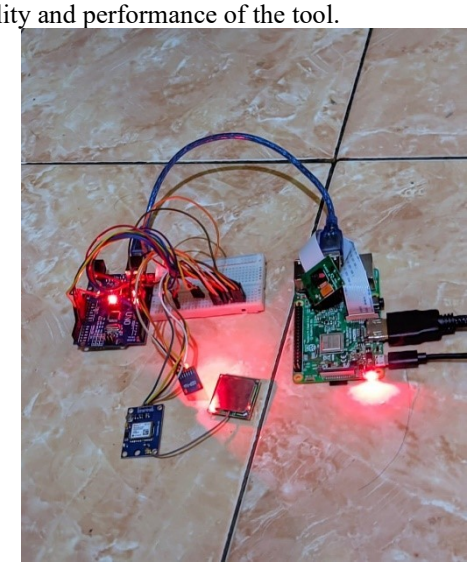


Fig 4 . Protoype ITS

At the time of testing, each sensor takes a reading. The reading results are then sent from the Arduino Uno to the Raspberry Pi using serial communication. The data received by the raspberry pi is then uploaded to the web server. Table 1 shows the overall test results of the tool.

TABEL I
OVERALL TEST RESULTS OF THE TOOL

No	Parameter	Test Result
1	Upload Program to Arduino Uno	Succeed
2	Ublox GPS Neo 6M Module Testing	Succeed
3	MPU 6050 Accelerometer Testing	Succeed
4	The MPU 6050 sensor is able to read the slope of the vehicle's position and changes in speed	Succeed
5	The sound sensor can activate the system when it receives a loud bang	Succeed
6	The system is able to send readings from Arduino Uno to Raspberry Pi via serial communication	Succeed
7	The system is able to send the reading of the results to the local database WEB	Succeed

A. Arduino UNO Microcontroller Testing

Testing is done by connecting Arduino UNO with Raspberry Pi via USB connection. If the LED light flashes once on the Arduino UNO then it indicates that the Arduino UNO is functioning and can be used. after that upload the program that has been made using the Arduino IDE software on the Raspberry Pi.

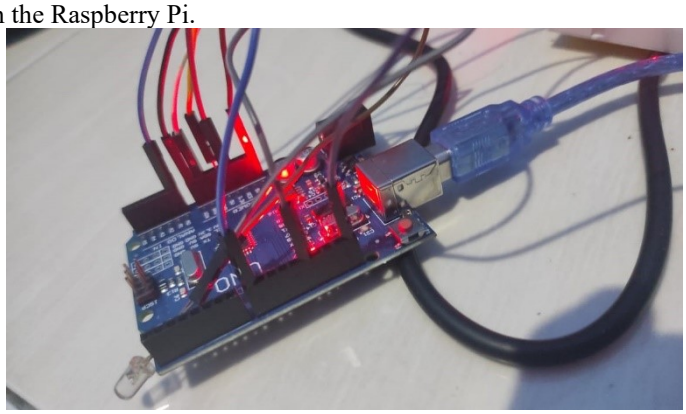


Fig 5 . Arduino Uno Testing

B. GPS Module Testing

Testing is done by connecting the Neo 6M GPS module to the pins on the Arduino UNO. Wait 2 – 5 minutes for the GPS module to pick up the signal from the satellite and modulate it to the L1 frequency band (1575.42 MHz). When the LED is flashing, it indicates that the GPS module is working [9-10]. If the GPS module is functioning, the results of the speed measurement and location coordinates will be displayed on

the Arduino IDE serial monitor and will be stored in a database which allows the website to display data in the database.

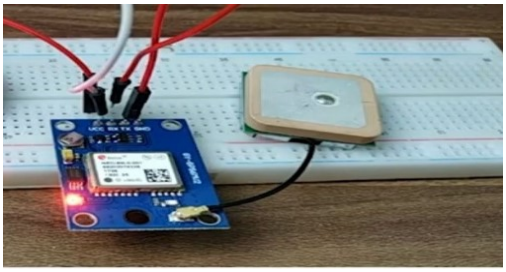


Fig 6 . Module GPS Testing

C. *Accelerometer Test*

The test is done by connecting the pins on the MPU 6050 accelerometer to the pins on the Arduino UNO. The accelerometer itself takes analog data, so it uses analog pins on the Arduino. This sensor includes two functions, namely as an accelerometer and also a gyroscope.

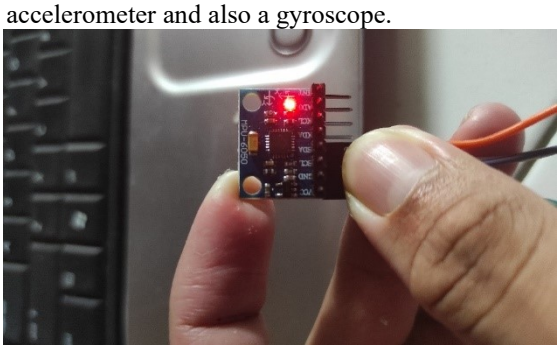


Fig 7 . Accelerometer Test

D. *Raspberry Pi Camera Module Testing*

Testing camera module using a 5MP REV 1.3 camera module which is connected directly to a Raspberry Pi 3 that has the Raspbian operating system installed [5]. At the time of testing, this module is capable of recording up to 1080 resolution at 30fps.

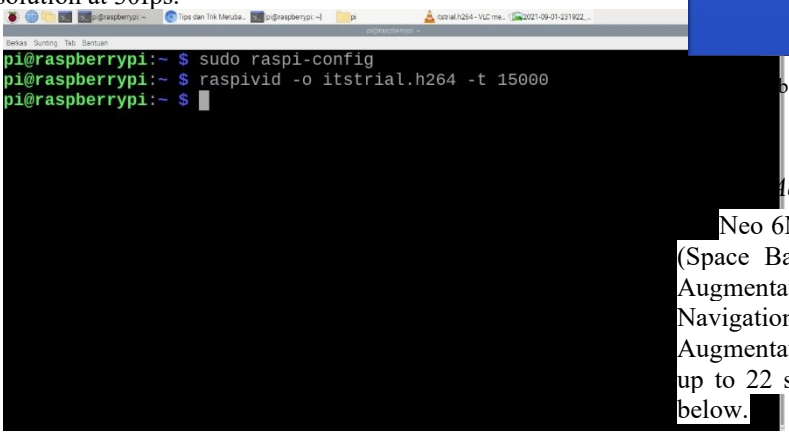


Fig 8 . Terminal Display for video recording

In order to be able to record video on a raspberry pi 3B+, it takes a command written on the CLI (Command Line Interface) or terminal so that the camera module can start recording video [11] as shown in figure 8. camera module, raw data can be seen in Figure 9.

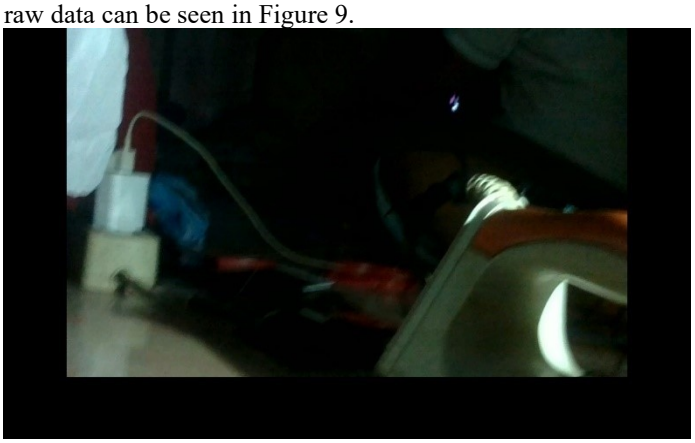
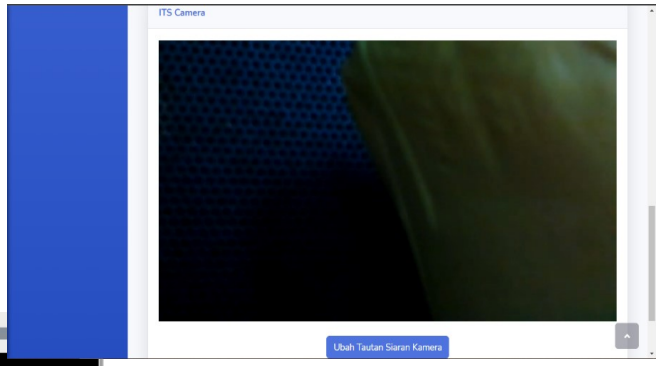


Fig 9 . Video results on the camera module

E. *Web Server Test*

Web server testing uses a web that is already hosted where the raspberry pi is connected to the internet and sends data retrieved by the arduino uno in real time. In Figure 10, it can be seen that the content of the web used in the form of coordinate points and video from the tool can appear clearly and in real time with the condition of the tool. Apart from that, this website also displays data that can be inputted, such as data on the vehicle used.



b Server Test

ccuracy

Neo 6M GPS have 50 channel receiver and support SBAS (Space Based Augmentation System), WAAS (Wide Area Augmentation System), EGNOS (European Geostationary Navigation Overlay Service), MSAS (MTSAT Satellite Augmentation System) [12]. Neo 6M GPS Module can track up to 22 satelites. It can be seen in the datasheet in table 2 below.

TABEL III
NEO 6M GPS MODULE DATASHEET

No	Parameter	Specification
1	Receiver type	50 Channels GPS L1 (1575.42 MHz)
2	Capture time (TTFF)	Cool start : 27s Hot start : 1s
3	Horizontal position accuracy	GPS, SBAS, SBAS + PPP
4	Navigation Update Rate	1Hz
5	Operating Voltage	2.7V ~ 3.6V
6	Operating Current	45mA

Fig 11 .GPS Test on Mobile Phone

The figure above is a test carried out on a mobile phone. So according to the analysis according to data, Neo 6M has little change, because the mobile phone is not a dedicated GPS device, so it allows the data provided to be less than optimal, Neo 6M has a fairly large antenna. GPS on mobile phones also does not support SBAS, WAAS, EGNOS, and MSAS, unlike the Neo 6M which is a dedicated GPS device. Neo 6M and mobile phones already use AGPS (Assisted GPS) which can help reduce or speed up TTFF (Time to First Fix) which has the advantage of getting a faster signal, saving power, and getting location data when GPS doesn't get a signal. But mobile phones from time to time will develop and maybe GPS on mobile phones will have a higher level of accuracy. According to the Official U.S. government information about the Global Positioning System (GPS), GPS on mobile phones typically has an accuracy of up to 4.9 m in the open sky [13].

TABEL IIIII
Testing Comparison of Ublox Neo 6M GPS and GPS Mobile Phone Accuracy

No	Ublox GPS Neo 6M Coordinate		Mobile Phone GPS Coordinate	
	Latitude	Longitude	Latitude	Longitude
1	-6.323455	107.306476	-6.323374	107.306503
2	-6.323672	107.305039	-6.323713	107.305087
3	-6.323644	107.304391	-6.323646	107.304334
4	-6.323523	107.303568	-6.323530	107.303521
5	-6.323654	107.299905	-6.323749	107.299925
6	-6.325160	107.299849	-6.325167	107.299808

The table above is a table of coordinate accuracy testing obtained by Ublox GPS and Mobile Phone GPS. Tests were carried out in 6 different places by turning on ITS and turning on GPS on the Mobile Phone. Where the difference in the distance between the coordinates of Ublox and Mobile Phone GPS with the actual average distance is quite large, which is 7.3 m. Accuracy on Mobile Phone GPS is more accurate because of the help of the internet network while Ublox GPS does not use the internet at all to detect the location

IV. CONCLUSION

Based on the results of the ITS (Intelligent Transportation System) research in monitoring logistics delivery distribution cars, it can be concluded that:

1. Testing the accuracy of the tool in this study was carried out on a straight road and at a constant speed, so that if there was a significant change in speed in a short period
2. GPS speed data by utilizing the L1 (1575.42 MHz) frequency band in the actual speed data coordinates will be detected and can be monitored directly using a Raspberry Pi 3B and in the event of an accident the sound sensor will

immediately send sound data to Arduino and then sent to the Raspberry Pi automatically real-time. By doing an accuracy test by comparing it with Mobile Phone GPS, there is a difference where the accuracy of the GPS module is about 7.3 m. The use of a dedicated GPS device such as the Neo 6M is very appropriate to use.

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