Optimal USB to Serial Converter and Delphi Software Integration for Emergency Call Handling

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ABSTRACT

This study focuses on evaluating the hardware and software integration performance in the context of an emergency call handling system. The aim is to test the efficiency of two main components, namely the USB to SERIAL converter and Delphi software, with a focus on serial data transmission and the software's ability to process position information from the emergency call sender module.

The research method includes specific testing of both components. The test results indicate that the USB to SERIAL converter successfully transmits serial data without failure. The Delphi software also demonstrates optimal performance in reading, processing, and displaying position information through Google Maps.

These results validate the overall integration of hardware and software, affirming that both function optimally. Reliable, fast, and accurate responses to emergency calls can be ensured, supporting the development of emergency handling technology. In conclusion, this research shows that efficient integration between the USB to SERIAL converter and Delphi software provides a solid foundation for improving the speed and efficiency of responses to emergency situations through the sophisticated combination of hardware and software.

Keywords: Hardware and Software Integration, Emergency Call Handling System, USB To SERIAL Converter

1. INTRODUCTION

People in business and industries engage with modern tools and technology to monitor and control their daily activities. Enterprise Management Associates (EMA) claimed that 98% of businesses would turn to automation within the next few years to build a smart city, smart office, smart home, smart institute, smart industry, and so on. The internet of things (IoT), a core technology to establish the smart systems, has already reached a market value to $745 billion in 2019 [1] The International Data Corporation (IDC) predicts that IoT will maintain globally a double-digit annual growth rate throughout the 2017–2022 forecast period and surpass $1 trillion market in 2022 [2] However, the main limitation of the existing systems is the consumption of high battery power to operate. Therefore, a few key challenges of Industry 4.0 are reducing the power consumption and increasing the range of communication of the smart systems. Considering this, a low power and wide range (LoRa) based automation system using android application is presented in this paper. The growing market of LoRa based automation systems is due to (a) companies building a large industry with colossal area to control processing operations remotely, (b) 45.12% people worldwide [3] with 3.5 billion smart phones willing to control their appliances remotely by the phone, and (c) people interested in monitoring and controlling their appliances at low cost and power, and in an error-free, hazardless way from a long distance. LoRa based automation system offers a cost effective and straightforward solution [4] The LoRa module adopts a modulation technique that is capable of transmitting 300~19,200 bps data on air where transmission consumes 5~20 dBm power with a maximum distance of 12 km. In contrast, the widely used short-range technologies such as Bluetooth, Wi-Fi, and ZigBee are not best suited where LoRa has the ability to cover a wide area while consuming low power and using inexpensive wireless connectivity [5] In this paper, a LoRa based automation system is designed and developed to control appliances such as light, fan, TV, AC, car, and so on. Automation system that is controlled by ESP32 and LoRa with LoRaWAN communication protocol leverages the unlicensed radio spectrum in the Industrial, Scientific and Medical (ISM) band [6] The LoRa based system can overcome the challenge of low power communication. An application has been developed to use a smart phone to control and monitor the target appliances through the LoRa module. Over the last few years, scientists and experts introduced various automation systems for making human life smooth and easy. The earlier systems mainly focused on home automation, automatic irrigation system, robotics in automation for home and industry, and laboratory automation. Automation system that is controlled by LoRa with LoRaWAN communication protocol leverages the unlicensed radio spectrum in the industrial, scientific and medical (ISM) band [7] Furthermore, LoRaWAN can handle the data losses when different nodes are increased to 1000 per gateway [8] An IoT based automation system which can remotely control home appliances using a web server is published in [9] The system provides security for signal interaction using an android application. The system also controls several home appliances remotely through the internet using a microcontroller, sensor, and Wi-Fi module. [10] developed a home automation system using android phone and a Raspberry Pi. Communication was established between a server and a relay module which was connected to appliances for monitoring and controlling. However, the Raspberry Pi is expensive compared with other options such as a microprocessor. In addition, a remotely placed system is constrained by power requirement. Therefore, in wireless communication, high power consumption by the associated devices within the system to operate is a great concern. Modular hardware design and integration of renewable energy sources have been suggested to overcome this power constraint [11] A smart system is presented by [12] for monitoring home equipment where the authors used a Wireless Sensor Network (WSN) and Message Queuing Telemetry Transport (MQTT) protocol to interact between home appliances and user. For some selective sensors, WSN runs out of energy. Another IoT based automation system was proposed in [13] which could control and monitor home via mobile phone through internet connection. Again, this system requires high power consumption. A LoRa based smart home system was proposed by [14] for remote monitoring. The potential of integrating artificial intelligence (AI) with IoT servers and clouds for serving intelligent tasks in home environment were also explored. Other conceptual framework for smart campus was also proposed in [15] An IoT based automatic firming system was implemented by [16] using a raspberry Pi which could monitor through IP camera for short distance. [17] developed smart wireless communication technology for National Chiao Tung University using IoT and LoRa gateway. However, their proposed system was very expensive. The system developed by [18] used Global System for Mobile Communications (GSM) technology to monitor the home devices using a phone. The main advantage of their system was to control home appliances when the homeowner would be travelling outside the country. However, the main challenge of GSM technology is that many users share the identical bandwidth.

[19] proposed an IoT based architecture for a smart home application using LoRa technology. The system was designed to reduce power consumption where Message Queue Telemetry Transfer protocol was used as a domotic middleware to obtain interoperability among different devices in their system. However, the system has not provided clear guideline for controlling appliances through a mobile app. [20] proposed a Low Power Wide Area Network (LPWAN) network across Southampton, UK which supported installing city-scale air quality monitoring. The system was built with a mixture of commercial off-the-shelf gateways and custom gateways. More than 135,000 messages were transmitted through twenty devices. A data server successfully received 72.4% of the messages. Among the received messages, 99% were received within 10 s of transmission. However, packet loss including potential jamming has not been considered in their system. [21] developed LoRa-based low power consumption static and mobile wireless sensors network to attain a wide coverage in an urban environment. The technology was deployed in a mid-size city (Malaga, Spain) where a mobile node was developed by a gateway and sensors. Activation by Personalization (ABP) mode was used for multicasting in urban area for managing the coverage through communicating data between the end devices and the gateways. The data collected from the city was synchronized in an external database. Web mapping service used in the system can monitor data in real time by geolocating data frames. The experiments showed that it can cover 12 km distance during exchanging information with vehicles, objects etc. on the road of Malaga. [22] proposed an emergency light-based smart building solution to reduce system deployment and maintenance cost using LoRa mesh network with one gateway. The system deployed nine types of building including residential and commercial as a case study. The results showed that the proposed system achieved over 97% average packet delivery rate. The system also performed well during changing environment. However, the system could be further improved by a user interface to facilitate remote monitoring of appliances in the building. [23] have proposed LoRa system where large-scale and temporal fading characteristic, coverage, and energy consumption were analysed in four individual buildings for measuring its performance. Different measurement parameters in their study were varied for up to 145 times enabling the LoRa adaptive data rate feature in energy limited applications. However, the proposed system was tested only for indoor application.

This comprehensive discussion covers the design of a wireless sensor system, involving hardware and software design as well as a block diagram of the device. The block diagram provides a detailed explanation of the components, including input, controller, and output, along with the overall working principle of the device. The design of energy converters is crucial, requiring good performance and high conversion efficiency amid changing environmental conditions and inevitable aging effects.

Energy management is a vital aspect that must ensure a stable energy supply throughout the operation, even with fluctuating energy income. Solutions are needed to address the limitation of energy availability, which is not always reliable. The sensor system is designed for low power consumption and adaptable operating modes based on energy availability. This ensures that sensor operation is not disrupted by changes in environmental conditions or periods of low energy availability.

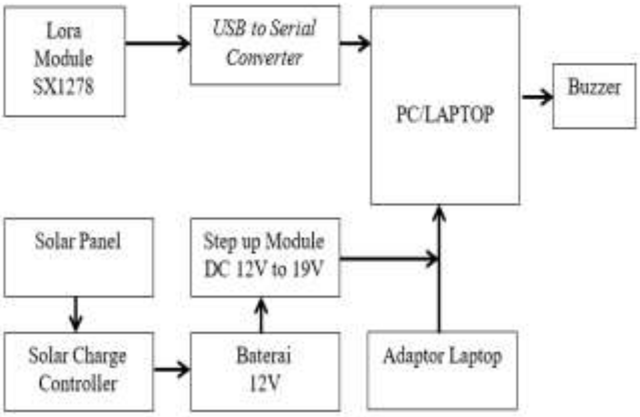
All these aspects are closely related to energy availability and the design of wireless sensor nodes, requiring an interdisciplinary approach. The design of wireless sensor components and modules must consider energy converter efficiency, energy management, and internal communication. Improvement strategies involve the design of converters placed on energy sources considering their characteristics. The use of multiple converters and the development of hybrid converters can enhance the reliability of sensor readings. Similarly, energy savings can be enhanced by strategically dividing it into several storage units, allowing faster availability during restart phases and better power density, especially for node communication.

2. RESEARCH SIGNIFICANCE

From the point of view of location detection, it is very important to identify the location coordinates of people or devices in nature. [24] conducted experiments to assess the feasibility of LoRa for indoor localisation applications in an apartment. The results showed better localisation accuracy of the sensor-integrated robot as evidenced by the results of both line-of-sight (1.6 m) and extreme non-line-of-sight (3.2 m) scenarios, with better than 25 cm accuracy by the LoRa system. However, the opportunity to integrate mobile applications with the system was not explored by the authors. A LoRa-based system was developed and tested for its practical application in smart buildings to facilitate energy management and improve occupant comfort by measuring data related to environmental parameters and equipment [25]. Performance criteria, such as coverage and transmission, were considered during experiments with three LoRa receiver nodes on one floor and eight LoRa receiver nodes on different floors in a 16-storey building. Furthermore, a data acquisition terminal was placed in the centre of the building. The transmit power, communication speed, payload length, and module position were changed following the experiment criteria to measure the round trip time (RTT) and packet delivery ratio (PDR) as indicators of the reliability of the communication system. The suitability of LoRa technology in smart buildings is revealed from the results. Recently, investment in data packet loss research in LoRa systems. [26] used indoor sensor network devices connected via low-power wide area network (LPWAN) technology to monitor the campus indoor environment. Their research focused on identifying the causes of data packet loss, which reached about 8.56% during on-air transmission and within the backbone. Non-uniform distribution of packet transmission, nodes in the network were identified. Seasonal effects on packet transmission and disruptions to network performance were also observed. Previous research shows that most automated systems have limitations in working efficiency for various applications with low battery power consumption. Communication over very short distances, ranging from 10 m to 100 m, such as Bluetooth, Wi-Fi, and Zigbee with ranges of about 10 m, 100 m, and 10-100 m, respectively. The system developed in this research uses the LoRa module, which can overcome the limitations of short-range communication. LoRa technology has attracted research attention, especially for tracking applications in emergency systems, with this paper presenting the design and development of an IoT-based automation system using LoRa technology. This system has the potential to overcome existing limitations with a communication range of up to 2500 m radius, supporting the development of mobile node detection applications in emergencies.

3. METHOD

The system design encompasses both hardware and software, featuring a planning tool diagram and device operation principles. Efficient energy conversion is crucial despite environmental changes and unavoidable aging effects. Merely enhancing energy harvester efficiency or using higher-capacity energy storage units is insufficient for meeting application requirements throughout the operational lifespan. Energy management must ensure stable energy availability despite fluctuating, unstable, and untimely energy income. This safeguards sensor system operations against environmental changes and prolonged periods of low energy availability. Sensor systems should be designed for low power consumption with selectable operating modes based on energy availability. If energy becomes insufficient for the lowest consumption mode, sensors can automatically initiate and return to normal operation after acquiring sufficient energy from the surroundings. All these aspects are closely tied to energy availability and the design of wireless sensor node systems. Therefore, special attention is required during the design of all components and modules in wireless sensor systems by improving energy converter efficiency, energy management, and communication within the sensor. This interdisciplinary design process is crucial to realize a practical system that optimally meets application requirements. Data retrieval from sensor sources is critical due to their limited, unstable, random, and application-relative variable nature. Various techniques have been proposed to enhance LoRa system performance and solar panel array functionality within wireless sensor networks. However, both energy sources and converters have their limitations. Given that converter design significantly influences energy yield, the primary strategy for system improvement is optimizing converter design, considering source characteristics. Further strategies involve using more converters and developing hybrid converters that harvest energy from the same source differently or extract energy from various sources. Similar considerations apply to energy savings, strategically divided into multiple storage units enabling faster availability during restart phases and improved power density, i.e., energy per unit time, particularly for node communication. The design of the mountain climber emergency system using MANET is a wireless network communication designed using the LORA SX1278 long range transceiver module on each system, equipped with GPS and ATMEGA64 controller at the node to read the location and send data. The receiver uses a PC to display digital maps of Google maps and consists of BTS for the communication process between MANET devices so that data can be reached far in mountainous areas. Nodes function as senders of GPS information and information in the form of emergency from users (climbers), BTS as relay stations or repeaters and base stations as information containers displayed on PCs in the form of digital maps, location coordinates and message information in the form of emergency status from nodes.



Here are the functions of each component in the system:

1. **LoRa Module SX1278:** Serves as a wireless data transmitter and receiver.
2. **USB to Serial Converter:** Acts as a medium for serial data transmission between the LoRa SX1278 module and the laptop through USB communication.
3. **Laptop/PC:** Functions as the main data processing device and displays information using software.
4. **Buzzer:** Functions as an emergency indicator by producing a beep sound during emergency situations.
5. **Solar Panel:** Generates electrical power from solar energy.
6. **Solar Charge Controller:** Controls the current and voltage during the battery charging process from the solar panel.
7. **Battery:** Stores DC energy as backup power.
8. **Step-up DC Converter:** Raises the battery voltage to 19V for the laptop's power requirements.
9. **Laptop Adapter:** The main power source for the system, with its output paralleled with the step-up DC converter to maintain power continuity during power outages or when the laptop battery is depleted.

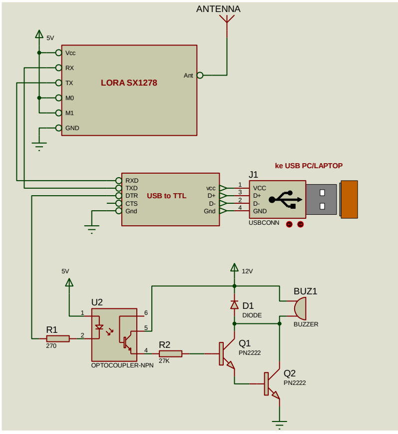
3.3 Principle of Work

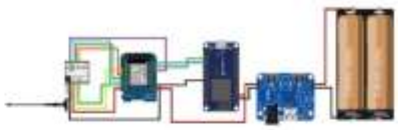
The Lora SX1278 module in the receiver section serves as a receiver of data sent either from nodes directly or serially from BTS in the MANET network. When the data is received, it is sent through the USB to serial controller and then processed through PC software. In the PC software, the data received is a collection of packets consisting of several data as shown in Table 1.

Table 1 Data Protocol Format

1 byte *Syncroune*	3 packet GPS data			1 byte *emergency*	2 byte *Checksum*		1 byte end paket
ID	*Latitude*	*longitude*	*Altitude*	0-3	0 - F	0 - F	0D (heksadesimal)

The system processes received data, separates ID, GPS data, and emergency status, and uses software to display the information on Google Maps. The design includes a backup battery charged by solar panels for uninterrupted operation. The Darlington transistor exhibits higher current than the BJT, advantageous for high-power and high-temperature applications. The system design involves placing sensors on the main road, transmitting data via LoRa to a gateway, and forwarding it to Google Maps. The experiment measures sensor node responsiveness and gateway connectivity. RSSI is evaluated between sensor nodes and the gateway in different locations, demonstrating the system's effectiveness.





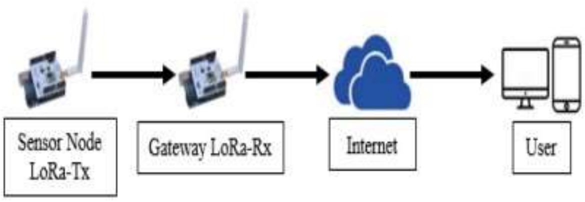


Figure 1 Overall Module Circuit

In order for the data sent on the sending part to be received, a buzzer is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and pagers include alarm devices, timers, and confirmation of user input such as mouse clicks or keystrokes. Buzzers are used as warning indicators to the user in detecting a position. Buzzer as an electronic switch using an NPN transistor, when the buzzer is logic 1 with current from the base to the transistor so that saturation occurs and the collector emittor is short-circuited then the current from vcc to the buzzer and to ground, whereas when the buzzer is logic 0 the base of the transistor occurs cut off and the collector emittor occurs open circuit. and displayed in the form of a map on Google maps, it is necessary to design the data receiver software.

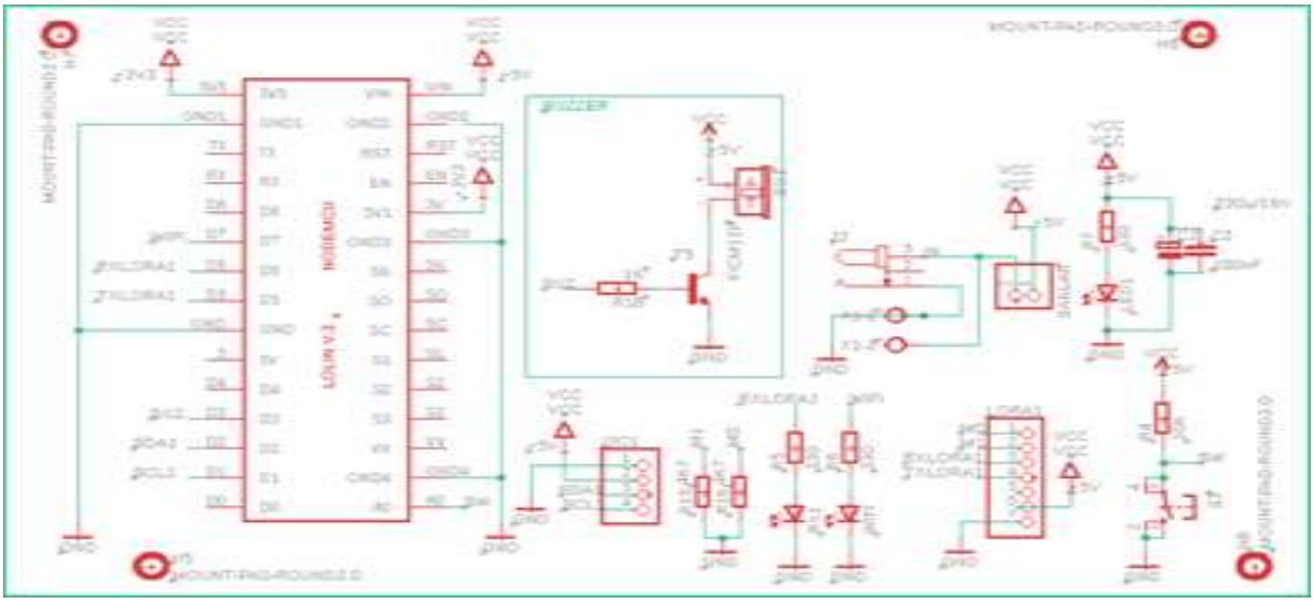


Figure 2 Schematic Wiring Diagram of LoRa Receiver

In Figure 2 is a wiring diagram of the LoRa Receiver circuit with components, namely Adafruit LoRa Feather with each pin, one of which is Vin for the entry of current from the source, pin RX and TX LoRa as a link to send and receive data from LoRa. There is pin D3 which is connected to the buzzer as an electronic switch. Buzzer as an electronic switch in the circuit means using the NPN transistor principle, so when the buzzer is logic 1, there is current from the base to the transistor so that saturation occurs while the collector emitter is short-circuited, then when the buzzer is logic 0, the current from vcc to ground so that the transistor base is cut off while the collector emitter experiences an open circuit. Pin D7 connects to wifi to get a wifi signal so that the Node MCU can forward the data that has been processed and obtained to Blynk as a dashboard.

Figure 3 Receiver

The receiver circuit utilizes the Adafruit LoRa 915 MHz module as the data receiver from the transmitter. The data reception process begins with the LoRa Radio Module using an antenna as the transmission medium. The received data is processed by the Adafruit LoRa and displayed on the Blynk dashboard. Proteus 8 software and components such as the 5VDC Voltage Regulator, relay, Arduino Uno, LED lamp, transistor, resistor, and 1N4007 diode are employed in designing the smoke detection system. This system is designed to provide a user's position response in emergency situations.

The design of the application form display contains indicator panels, history, Maps viewer and emergency status and manual setting buttons. The PC form serves as a monitoring centre for events in the form of emergency status, the location of climbers who are being monitored, where in this case the events obtained from data sent by nodes and BTS are then received and sorted by PC software to be displayed in the form of information on the Form. The design of the PC application form display is shown in Figure 4.

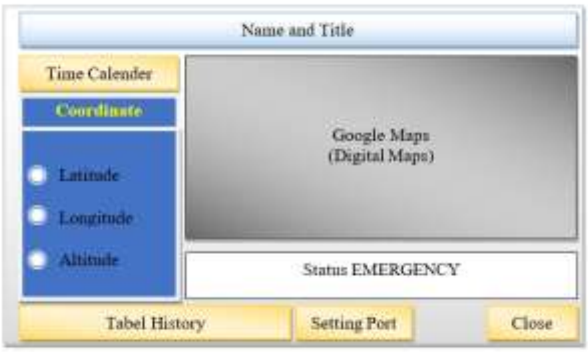


Figure 4 PC Form Design

The application interface features several panels designed to provide comprehensive information and controls for effective system monitoring. The "Google Maps" panel serves as a visual representation of the digital Google Maps, utilizing coordinates from received data to pinpoint locations on the map. In the "Status Emergency" panel, messages from the node module in emergency conditions (EMERGENCY) are displayed as text, indicating the specific mode or request transmitted by the node. The "Table History" panel offers a chronological table documenting recorded events over time, capturing historical and critical system records. For configuring connections, the "Setting Port" panel allows users to view and adjust COM port settings associated with the USB Serial LoRa SX1278 module. The "Time Calendar" panel provides additional temporal context, presenting time information in hours and dates. Additionally, the "Latitude," "Longitude," and "Altitude" panels offer numerical insights derived from GPS data, revealing precise geographical coordinates and altitude information. Collectively, these panels aim to deliver a user-friendly interface for a comprehensive understanding of the status, location, and historical data associated with the LoRa SX1278-based emergency handling system.

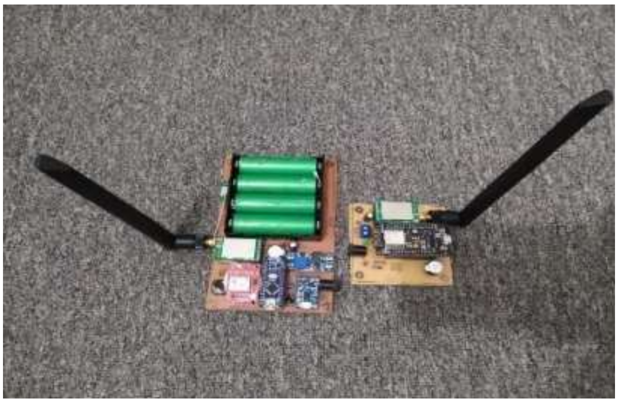


Figure 5 Design of Receiver and Transmitter Box

For the Transmitter section as a data sender requires several components as materials for designing tools such as Arduino Nano functions as a data processor and processor, Adafruit LoRa 915 MHz Module functions as a data sender, Global Positioning System (GPS) functions to detect position and speed as data, Battery functions as a current source, LoRa Radio Module functions as a transmission medium for sending data. The process of sending data (Transmitter) works starting from the Global Positioning System (GPS) working to get data then the data is processed by Arduino Nano sent by Adafruit LoRa using LoRa Radio and antenna as a transmission medium, then all components get a current source from the battery.

4. RESULTS AND DISCUSSION

4.1 USB to SERIAL Converter Testing

The evaluation of the serial converter's functionality in transmitting serial data is conducted through a specific set of procedures and equipment. This testing scenario involves a loop-back configuration, where the serial data transmitted from the converter's TX pin is routed back to its RX pin. The Hyperterminal program on the PC is utilized to observe and document the outcomes of this data transmission. The loop-back setup allows for a controlled and direct evaluation of the converter's ability to transmit serial data effectively. The results recorded during this procedure provide insights into the converter's operational performance and its suitability for the intended application.

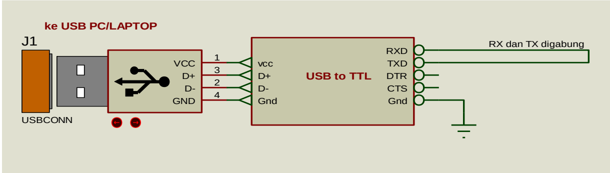


Figure 6 Testing Diagram of USB To TTL Converter

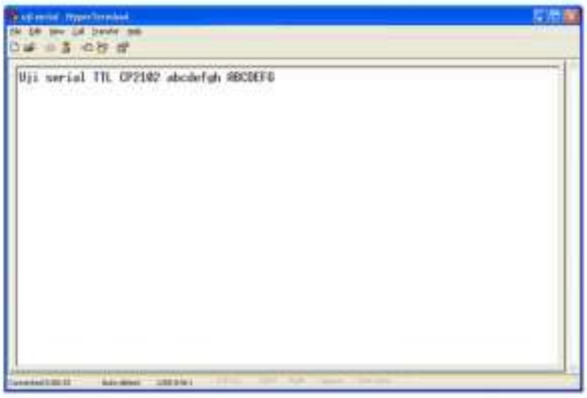


Figure 7 USB To TTL Serial Converter Test Results

In testing Figure 7, it appears that the results of serial transmission of characters typed from the keyboard reappear in the hyperterminal form. This is because the data sent by the hyperterminal is received back by the serial converter so that it appears on the hyperterminal as well (TX to RX). Thus, the sending and receiving of serial data through the converter works as it should. From the system model above, it can be seen that the initial data reception comes from a Personal Computer (PC). In the PC there is an application that connects the user and hardware. Data from the PC is sent via USB to serial to the hardware, in this design a DB9 connector is used. From the DB9 connector, the data enters the RS 232 to TTL module to convert the RS-232 voltage into a transistor-transistor logic (TTL) voltage level so that it can be processed further. From the TTL converter block, enter the amplifier block where there is an IC 2N222 Scmitt Trigger hex inverter as an amplifying device. With this process, the incoming signal will be amplified and noise will be reduced before further processing. From the amplifier block, enter the LED block, as a visible light producer. In this research, a 3-watt High Power LED is used which is arranged in a parallel array, the goal is that when one LED is disconnected, the other LEDs will remain lit. In addition to this, in parallel circuits the lights are brighter than series circuits because the current obtained between LEDs is allocated to each LED instead of being divided for all LEDs in the circuit as in series circuits. The LED light will carry a signal containing information that is sent to the receiver.

The sending process starts from entering data into the interface application. Before sending, it must be ensured that the baud rate between the sender and receiver is the same. On the receiver side, the location used to store the received data must be set before receiving the data. After the applications on the sending and receiving sides are ready, the data is ready to be sent. Data coming from the sender's PC enters the circuit via a USB to serial cable. At the end of the cable there is a connector to connect to the circuit, the connector is a DB9 connector. From the DB9 connector, the signal enters the RS 232 to TTL module, then the module will change the RS 232 voltage to the TTL voltage level so that it can be processed further. Furthermore, the signal will be amplified by an amplifier. From the amplifier, the signal will be sent to the receiver via visible light emitted by the LED. On the receiver side, the light containing the information signal will be received by the phototransistor. Then the information signal will be forwarded to the amplifier for amplification. From the amplifier, the signal enters the RS 232 to TTL module to get a voltage change from TTL voltage to RS 232 voltage. From this module, the information signal goes to the receiving PC through a DB9 connector and USB to serial cable. At the receiver side the interface application will read the data it receives.

4.2 Serial Reading Software Testing on Delphi

The aim is to determine whether the serial data protocol transmitted from the sender module of the emergency call system is received effectively or not. This testing procedure involves the activation of the sender module of the emergency call system. The TX pin of the sender module is connected to the RX pin of the USB Serial circuit. The USB to Serial circuit is then connected to both the laptop and the receiver module. The Delphi serial testing program is run to observe and document the outcomes of the serial data transmission. This test scenario aims to assess the successful reception of the serial data protocol and ensures the effective communication between the sender and receiver modules.

Figure 8 Diagram of Data Acceptance Testing

In this test diagram, it is not tested using the LORA SX1278 transceiver module, because in principle serial testing on delphi aims to see whether the software that has been designed using delphi7 software as a serial data receiver is successful or not. The component used to handle the serial port on the PC/Laptop in delphi 7 uses a serial vacomm with property settings in Figure 9:

Figure 9 Property Setting Serial Vacom Delphi.

The port settings on vacomm in Delphi software are baud rate 9600bps, 1 stop bit, no parity, databit 8 on port COM1. The programme snippet used to retrieve serial data in the buffer is as follows:

```
//----------------------------------------------------------------
procedure TfrmMain.VaComm1RxChar(Sender: TObject;
Count: Integer);
var scan:string;
   i,code:integer;
begin
  buffer:=buffer+vacomm1.ReadText;
  if pos(#13,buffer)>0 then
  begin
    delete(buffer,pos(#13,buffer),1);
    memo1.Lines.Add(buffer);
    buffer:='';
  end;
end;
//----------------------------------------------------------------
```

In the program snippet, the serial reading data is displayed in text memo1 when character 13 (enter) is received by serial in Delphi.

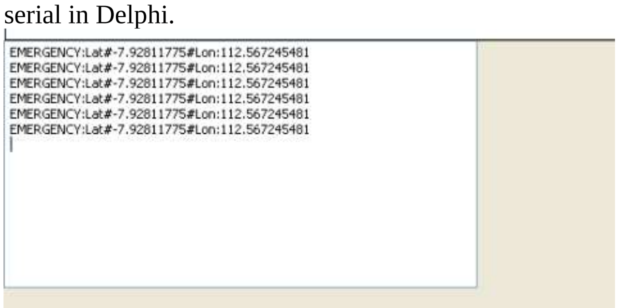


Figure 10 Serial Read Software Testing Results on Delphi Forms

Meanwhile, testing using the built-in windows software (hyperterminal) obtained data as shown in Figure 11 of the following test:

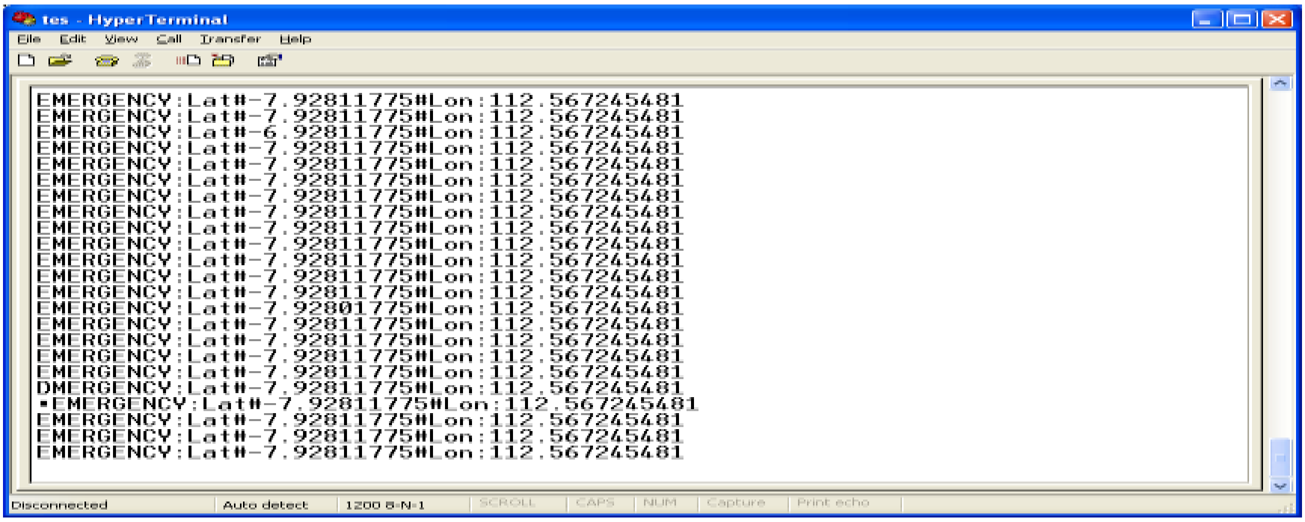


Figure 11 Test Results on Hyperterminal Software

From the data result, the serial data sent by the sender is accommodated in the serial buffer and then called by the "vacomm1.readtext" instruction in the program snippet above. Furthermore, the results of the serial reading are accommodated and displayed in memo text when the enter character is read by the buffer so that it can appear as the test results above. Meanwhile, direct data testing without the intermediary delphi software was tested using hyperterminal (Figure 4.6). The test results have the same protocol sequence as the Delphi program results. Thus the serial reader software in Delphi works well. The results obtained from this research are mobile-based applications for emergency systems and mobile node positions. While the web application is for administrators. The nearest mobile node detection process can be done by opening the Google maps page by pressing the search button from the main page. The detection process does not require a login process. The login process is required if the customer wants to detect the mobile node in an emergency position. Before logging in, mobile node users must first register to get a user name and password or register an email. The mobile node detection process functions to help the user if at any time in an emergency condition and requires assistance. This process starts from searching location data, after finding the last location of the mobile node, the customer can find out the coordinates of that location. After that, Google maps satellite will show the desired mobile location. Furthermore, the GPS signal automatically searches the mobile node to confirm the user is in an emergency. So that users can directly access (offline) without having to contact the administrator first. The detection process is done by email registration and activating the offline Google maps feature. After the registration process is successful, users can access in certain circumstances to determine the location using the location determination feature that is already available.

4.3 Protocol Sorting Software Testing

The goal is to determine whether the software can parse the protocol to extract latitude and longitude data sent by the emergency call sender module. This testing procedure involves the use of a protocol parsing software designed to process the data received from the sender module of the emergency call system. The Delphi program is initiated, and the protocol text, formatted according to the received data, is entered. The parsing process is then executed by pressing the designated button, and the outcomes of the testing are observed and documented. The objective is to verify the software's capability to effectively extract latitude and longitude data from the received protocol.

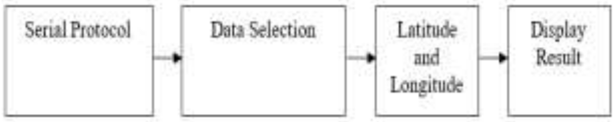


Figure 12 Flowchart of Data Sorting Software Testing

The program snippet used to retrieve serial data and sort the data into latitude and longitude is as follows:

```
//--------------------------------------------------------------
procedure TfrmMain.proses_protokol(protokol:string);
var scan,latitude,longitude:string;
 i,code:integer;
begin
 scan:=copy(protokol,1,pos(':',protokol)-1);          //baca header
 if scan='EMERGENCY' then
 begin
  delete(protokol,1,pos(':',protokol));
  scan:=copy(protokol,1,pos('#',protokol)-1);  //baca text lat
  if scan='Lat' then
  begin
   delete(protokol,1,pos('#',protokol));
   latitude:=copy(protokol,1,pos('#',protokol)-1);
   delete(protokol,1,pos('#',protokol));      //hapus nilai latitude
   scan:=copy(protokol,1,pos(':',protokol)-1);       //baca header
   if scan='Lon' then
   begin
    delete(protokol,1,pos(':',protokol));
    longitude:=protokol;

showmessage('Latiude:'+latitude+#13+#10+'Longitude:'+longitude);
   end;
```

```
    end;
  end;
end;
//-------------------------------------------------------------
```

In the program snippet, the results of reading the data are displayed in the message box on the Delphi form.

Figure 13 Test Results of Data Sorter Software Testing

From the data result, when the button is clicked, the protocol data in the editor is then sorted. Sorting is done by matching the data in the header containing "EMERGENCY", if this word search is found at the beginning of the protocol, then the system further sorts the data and searches for lat and lon data characters to access the latitude and longitude position values included in the protocol. Furthermore, the search results are displayed in the message editor on the Delphi form. In this test the software works well.

4.4 Overall Software Testing

The aim is to determine whether the Delphi browser software can display Google Maps based on the latitude and longitude sent from the node. This testing procedure involves verifying whether the Delphi browser software, equipped with the necessary components, can effectively display Google Maps based on the latitude and longitude coordinates sent from the node. The Delphi program is executed, and the sender's coordinates are activated. The sender's HT is then turned on, and the coordinates are sent. The HT receiver is connected to the FSK receiver module, and the USB to serial is connected to the PC to activate the Delphi receiver program. The results of the testing are observed to assess the software's capability to display Google Maps accurately. The following test diagram is the flow of the Google Maps map viewer software in delphi with the help of the delphi browser. This device can be run only when there is a connection to the internet network. The stages are in the form of a flow chart as shown in Figure 14

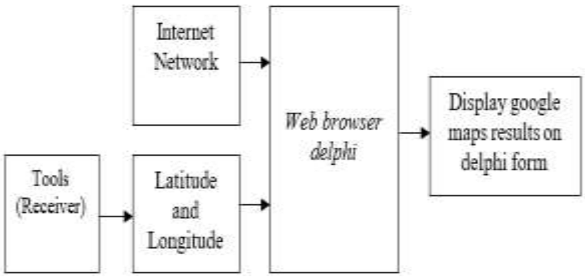


Figure 14 Receiver Section Testing Diagram

The program pieces used in this test are using Java Script which is executed on delphi software to be able to run the browser as the following program listing:

```
//-------------------------------------------------------------------
-----------------------
procedure TfrmMain.FormCreate(Sender: TObject);
var
  aStream     : TMemoryStream;
begin
    loading:=1;
    flagled:=false;

    griddatabase.ColWidths[0]:=22;
    griddatabase.ColWidths[1]:=195;
    griddatabase.ColWidths[2]:=30;
    griddatabase.ColWidths[3]:=80;
    griddatabase.ColWidths[4]:=135;

    griddatabase.Cells[0,0]:='No.';
    griddatabase.Cells[1,0]:='Tanggal ';
    griddatabase.Cells[2,0]:='ID';
    griddatabase.Cells[3,0]:='Status Alarm ';
    griddatabase.Cells[4,0]:='Kordinat ';
    kedip:=false;
end;


procedure TfrmMain.Timer2Timer(Sender: TObject);
var reg:tregistry;
    I:INTEGER;
    DATAPORT:STRING;
begin
    reg:=tregistry.Create;
    reg.RootKey:=HKEY_LOCAL_MACHINE;
    if
reg.OpenKeyReadOnly('HARDWARE\DEVICEMAP\SERI
ALCOMM')=true then
    begin
      FOR i:=0 to 100 do
      begin

dataport:=(REG.ReadString('\DEVICE\ProlificSerial'+int
tostr(i)));
        if dataport<>'' then combobox1.Items.add(dataport);

dataport:=(REG.ReadString('\DEVICE\SERIAL'+inttostr(
i)));
        if dataport<>'' then combobox1.Items.add(dataport);

dataport:=(REG.ReadString('\DEVICE\Silabser'+inttostr
(i)));
        if dataport<>'' then combobox1.Items.add(dataport);
      end;
        reg.CloseKey;
    end;
    timer2.Enabled:=false;
end;

procedure              TfrmMain.ComboBox1Change(Sender:
TObject);
var numport,i:integer;
    port:string;
begin
  port:=combobox1.Items.Strings[combobox1.itemindex];
  if port<>'' then
  begin
```

```
    vacomm1.Close;
    vacomm1.DeviceName:=port;
    delete(port,1,3);
    val(port,numport,i);
    vacomm1.PortNum:=numport;
    vacomm1.Open;
    timer1.Enabled:=true;
  end;
end;

procedure TfrmMain.SpeedButton2Click(Sender: TObject);
begin
  combobox1.Clear;
  timer2.Enabled:=true;
end;

procedure TfrmMain.scan_serial;
begin
  //:1|N2|2|1|-7.26544|112.789123|1|
  if pos(#13#10,buffer)>0 then
  begin
    delete(buffer,pos(#13,buffer),1);
    delete(buffer,pos(#10,buffer),1);
    memo1.Lines.Add(buffer);

    if length(buffer)>0 then
    begin
      if buffer[1]=':' then
      begin
        delete(buffer,1,pos(':',buffer));

        mode:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        ID:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        destination:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        status_data:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        mylatitude:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        mylongitude:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        status:=copy(buffer,1,pos('|',buffer)-1);
        delete(buffer,1,pos('|',buffer));

        if (mode='1') and (destination='2') then
        begin
            //showmessage(status);
          panelx.Caption:=ID;
          latitude.Text:=mylatitude;
          longitude.Text:=mylongitude;
          if status='0' then
          begin
            panely.Caption:='NAVIGASI';
          end else
          if status='1' then
          begin
            panely.Caption:='DARURAT 1';
            label5.Caption:='User '+ID+' mengirim EMERGENCY 1';
            label8.Caption:='Pendaki Membutuhkan Perlengkapan / Makanan';
            labelkordinat.Caption:='Kordinat: '+latitude.Text+', '+longitude.text;
            griddatabase.Cells[0,griddatabase.RowCount-1]:=inttostr(griddatabase.RowCount-1);
            griddatabase.Cells[1,griddatabase.RowCount-1]:=label10.Caption+' '+label9.Caption;
            griddatabase.Cells[2,griddatabase.RowCount-1]:=ID;
            griddatabase.Cells[3,griddatabase.RowCount-1]:='DARURAT 1';
            griddatabase.Cells[4,griddatabase.RowCount-1]:=latitude.Text+','+longitude.text;

griddatabase.RowCount:=griddatabase.RowCount+1;
            label7.Visible:=true;
            label5.Visible:=true;
            label8.Visible:=true;
            labelkordinat.Visible:=true;
            suibutton2.Visible:=true;
            kedip:=true;
          end else
          if status='2' then
          begin
            panely.Caption:='DARURAT 2';
            label5.Caption:='User '+ID+' mengirim EMERGENCY 2';
            label8.Caption:='Pendaki KECELEKAAN, Butuh pertolongan medis dan TIM SAR';
            labelkordinat.Caption:='Kordinat: '+latitude.Text+', '+longitude.text;
            griddatabase.Cells[0,griddatabase.RowCount-1]:=inttostr(griddatabase.RowCount-1);
            griddatabase.Cells[1,griddatabase.RowCount-1]:=label10.Caption+' '+label9.Caption;
            griddatabase.Cells[2,griddatabase.RowCount-1]:=ID;
            griddatabase.Cells[3,griddatabase.RowCount-1]:='DARURAT 2';
            griddatabase.Cells[4,griddatabase.RowCount-1]:=latitude.Text+','+longitude.text;

griddatabase.RowCount:=griddatabase.RowCount+1;
            label7.Visible:=true;
            label5.Visible:=true;
            label8.Visible:=true;
            labelkordinat.Visible:=true;
            suibutton2.Visible:=true;
            kedip:=true;
          end else
          if status='3' then
```

```
        begin
          panely.Caption:='DARURAT 3';
          label5.Caption:='User '+ID+' mengirim EMERGENCY 3';
          label8.Caption:='Pendaki TERSESAT, Butuh pertolongan TIM SAR';

          labelkordinat.Caption:='Kordinat: '+latitude.Text+', '+longitude.text;
          griddatabase.Cells[0,griddatabase.RowCount-1]:=inttostr(griddatabase.RowCount-1);
          griddatabase.Cells[1,griddatabase.RowCount-1]:=label10.Caption+' '+label9.Caption;
          griddatabase.Cells[2,griddatabase.RowCount-1]:=ID;
          griddatabase.Cells[3,griddatabase.RowCount-1]:='DARURAT 3';
          griddatabase.Cells[4,griddatabase.RowCount-1]:=latitude.Text+','+longitude.text;

griddatabase.RowCount:=griddatabase.RowCount+1;
          label7.Visible:=true;
          label5.Visible:=true;
          label8.Visible:=true;
          labelkordinat.Visible:=true;
          suibutton2.Visible:=true;
          kedip:=true;
        end;
      end;
    end;
  end;
  buffer:='';
 end;
end;

procedure TfrmMain.VaComm1RxChar(Sender: TObject; Count: Integer);
var scan,strlatitude,strlongitude,straltitude:string;
  i,code1,code2:integer;
  cekval:real;
begin
 buffer:=buffer+vacomm1.ReadText;
 scan_serial;
end;

procedure TfrmMain.suiButton1Click(Sender: TObject);
begin
 flagled:=false;
 tiled1.Caption:='';
 labelstatus.Caption:='Scan................';
 labelinfo.Caption:='';
 label7.Visible:=false;
          label5.Visible:=false;
          label8.Visible:=false;
          labelkordinat.Visible:=false;
          suibutton2.Visible:=false;
          kedip:=false;


 edit1.show;
 edit2.show;
 bitbtn1.show;
end;

procedure TfrmMain.suiButton2Click(Sender: TObject);
var s: PAnsiChar;
begin
s := PAnsiChar(AnsiString('http://maps.google.com/maps?q='+latitude.text+','+longitude.text));
    shellexecute(frmMain.Handle,'open','C:\Program Files\Mozilla Firefox\firefox.exe',s,'C:\Program Files\Mozilla Firefox\',sw_show);
end;
//-----------------------------------------------------------------------------------------
```

In this test, the sender system is turned on at a place which in this test was tested on Jl. Soekarno-Hatta and waited for some time until the earth coordinates from the GPS reading appeared on the LCD, then the emergency button on the node was pressed until the data was sent using LORA SX1278 to be displayed on the Google Maps map through the help of Delphi software as shown in Figure 15:

Figure 15 Delphi Form Initial Display Result

The form above is the initial appearance of the Delphi form when run. In this condition the user must select a USB port connection in order to read serial data from the receiver module. After the connection is made, the form will be in standby mode and here the system waits for data submissions from the node or BTS as the sender of the information. When the information is sent, the form will display the emergency mode and sender coordinates on the form as shown in Figure 16:

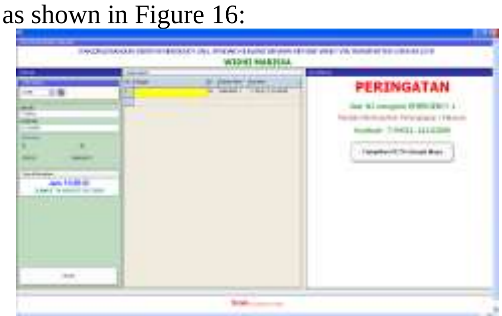


Figure 16 Display Results When Receiving Data from Nodes

In the form above the device is tested in the area of Jl. Soekarno - Hatta, where when the button is pressed and the data is sent from the node, the form displays the latitude and longitude coordinates and the emergency mode selected as the emergency request mode. The form also includes a map viewer button from the coordinates obtained so that it can be seen based on the Google Maps map. After the button is pressed, Delphi opens the Mozilla browser and displays the Google Maps map. according to the coordinates obtained in the data reading results from the sender (node). The results are shown in Figure 17.

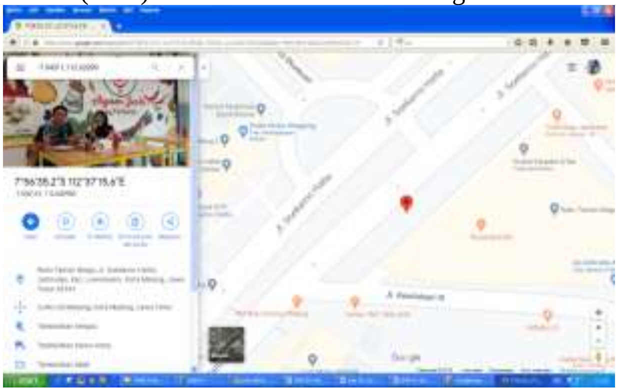


Figure 17 Google Maps Map Coordinates

As for the test results of the coordinates of other places to determine the tolerance of errors, then in this test an android smartphone is used by activating the Google Maps application as a comparison, it can be seen in table 2

Table 2 Latitude and Longitude Testing

No	Regional	Tools		Google Maps (android)		% error	
		Latitude	*Longitude*	*Latitude*	*Longitude*	*Latitude*	*Longitude*
1	UMM *Inn*	-7.92040	112.59416	-7.92031	112.59412	2%	1%
2	Landungsari Bus Station	-7.92410	112.59883	-7.92412	112.59877	1%	2%
3	Tlogomas Gas Station	-7.93117	112.60281	-7.93127	112.60271	1%	3%
4	Water Recervoir	-7.93576	112.60519	-7.93572	112.60515	1%	1%
5	Jl. Soekarno-Hatta	-7.94311	112.62099	-7.94310	112.62095	1%	2%
6	Jl. Dau	-7.92272	112.56651	-7.92266	112.56641	2%	2%

Tests carried out to observe the tool response when the emergency feature is activated on the tool test when not connected to an internet signal but already registered in Google Maps offline. In testing the tool response in an emergency, it is simulated when there is no internet network available and it is assumed that in a place where there is no cellular signal available because the signal does not change, then the user is simulated to activate the emergency feature on the tool so that the tool will respond and send a signal to notify the monitor on Blynk (dashboard) that the user is in an emergency.

Figure 18 Monitoring Incoming Data on Laptop

In Figure 18 it is shown that when the tool test is carried out by the user, the transmitter section is taken up into the bus to simulate an emergency at several locations according to Jl. Soekarno-Hatta to the Tlogomas bus stop with a distance of approximately 2500 meters (2.5 km) by activating the emergency button every 200 meters. The receiver part is monitored from Jl. Soekarno-Hatta to observe the incoming data on the laptop from receiving the data sent in the form of the position of the device using the latitude and longitude of the user's position so that it can be known that the user is in an emergency, the signal monitoring distance can also be measured. The emergency in question is that there is no adequate signal or internet network available, it is known when the user activates the emergency feature so that there is an incoming warning on the dashboard and there is an interval of time for the bus position to stop on the monitoring map for 1 - 5 minutes. In the tool test also observed the delay in the tool response when the emergency feature is active.

Figure 19 Emergency Alert Display on LORA

Figure 19 shows that there is an incoming notification in the form of the words "Emergency" as well as an emergency indicator (warning) that lights up for the monitor on Blynk as a monitoring dashboard. The distance data from the position of the device and the user that can be monitored for emergencies is no more than 2500 meters just like and simultaneously like the previous test on the serial monitor every 5 seconds, namely latitude and longitude and the number of emergency notifications (warning). Delays in sending and receiving data occur every time the data entered on the serial monitor is different.

From testing the tool for emergency areas, data from the serial monitor is obtained as above that there is location data that can be monitored by the tool. Detection of the location measured by the tool when it exceeds the safe state set on the tool, there will be a warning that appears on the transmitter part, namely the buzzer will sound as a reminder that it exceeds the speed limit and there is an incoming notification in the form of writing "Emergency" as well as a speed limit indicator that lights up for monitors on Blynk as a monitoring dashboard. Speed data is displayed the same as and simultaneously as the previous test on the serial monitor every 5 seconds, namely the loudness of the signal measured by the device and the number of signal limit warnings that appear. The maximum signal data that can be measured on the device is 9600 at the position -7.054317, 110.444194, this is due to obstacles in the form of quite a lot of trees, a fairly dense telecommunications network, causing the data transmission strength to decrease and the speed measurement is less accurate. Delays in sending and receiving data occur every time the data entered on the serial monitor is different - different from 0.8; 5.8; 5; 10; on the input data every 5 seconds, if the delay is 10 seconds it means that the input data is still the same as before. from 0.8; 5.8; 5; 10. Delays and limitations of monitoring distance as far as 2500 meters are caused by obstacles in the form of quite a lot of trees, telecommunications networks that are quite dense, as well as signal slowdown causing reduced data transmission strength and less accurate speed measurements. The longer the distance is directly proportional to the obstacles that will affect the transmission of signals for sending and receiving data so that it causes delay due to obstruction for signal propagation.

5. CONCLUSIONS

The evaluation of the emergency call system, encompassing the serial converter, sender module, and protocol sorting software in Delphi, yielded positive outcomes. The serial converter demonstrated effective transmission and reception in a loop-back configuration, confirming its suitability for the intended application. Furthermore, the Delphi software successfully parsed protocols, extracted crucial latitude and longitude data, and seamlessly integrated with Google Maps for precise location visualization. The tool's adept handling of emergency alerts and speed limit warnings, as demonstrated in Figure 18 and 19, underscores its reliability. However, it's crucial to acknowledge limitations in monitoring distance and occasional delays caused by signal obstacles, emphasizing the need for optimal signal conditions in real-world scenarios.

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7. AUTHOR CONTRIBUTIONS

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