Promoting Excellence in
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D.K.T.E Society's
Textile and Engineering Institute, Ichalkaranji
(An Autonomous Institute Affiliated to Shivaji University Kolhapur)

Department of Electronics and Telecommunication Engineering

A Mini Project Report on

Vehicle Accident Detection and Messaging System

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Academic Year 2018-2019

CERTIFICATE

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of Third Year B.Tech [ETC] has satisfactorily completed mini-project entitled

Vehicle Accident Detection and Messaging System

for partial fulfilment of Under Graduation in Electronics and Telecommunication Engineering at D.K.T.E's Textile and Engineering Institute,Ichalkaranji for Academic Year 2022-2023.

Prof. A. R. Telepatil	Prof. Dr. S.A.Patil	Prof. (Dr.) L.S.Admuthe
Guide	**Head of ETC Department**	**Director**

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Chapter-I

Introduction

The main aim of the project **Vehicle Accident Detection and Messaging System** is to inform the Ambulance and Police of the accident site and arrange for necessary steps to control the situation. This system is not only efficient but also worthy to be implemented. . The Accident Detection and Messaging System can be fitted in the vehicle (Ambulance or the Police) and they are informed about any such untoward incident at the go.

Road accidents and vehicle crashes are a common occurrence, resulting in significant injuries and fatalities each year. Prompt response and medical assistance can be crucial in saving lives and minimizing damage caused by accidents. In recent years, there has been a growing interest in developing technologies to improve road safety and reduce the risks of accidents. One such technology is a crash detection system using a Raspberry Pi Pico, SIM module, and GPS Neo 6 module.

The crash detection system is designed to detect vehicle crashes and automatically send notifications to emergency services or designated contacts. The system is composed of a Raspberry Pi Pico, a SIM module, and a GPS Neo 6 module. These components work together to monitor the location and movement of a vehicle and detect sudden changes in velocity or acceleration that may indicate a crash.

The GPS Neo 6 module provides location data, which is used to track the vehicle's movement and detect any abnormal changes in its speed or direction. The SIM module provides cellular connectivity, allowing the system to send messages to designated contacts or emergency services. The Raspberry Pi Pico serves as the main controller, running a Python script that reads location data from the GPS module and monitors for sudden changes in velocity or acceleration.

When a crash is detected, the Python script sends a message to a designated phone number or emergency services using the SIM module. The message contains the location of the vehicle and a notification that a crash has occurred. This enables emergency services or designated contacts to respond quickly and provide assistance as needed.

Chapter 2

System Implementation

2.1 Block Diagram with Explaination

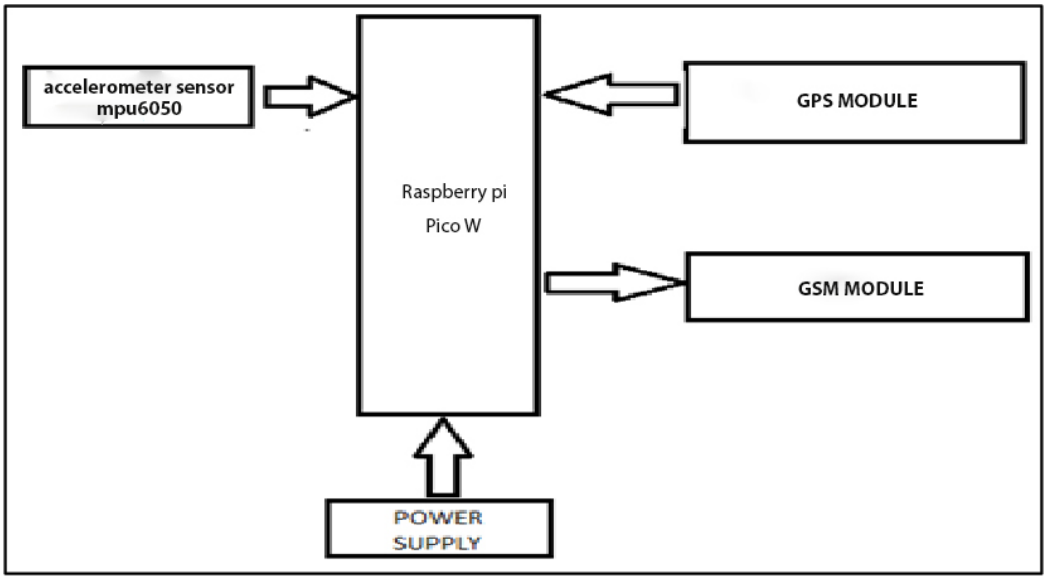

Fig. 1: Block diagram of vehicle unit

The Raspberry Pi Pico communicates with the GPS Neo 6 module via serial communication to obtain location data, which is used to detect vehicle crashes. The SIM module is connected to the Raspberry Pi Pico via GPIO pins, and is used to send notifications to designated contacts or emergency services using AT commands. The system uses an MPU6050 accelerometer sensor to detect the acceleration caused by an accident. The Raspberry Pi Pico reads the sensor data and calculates the resultant acceleration. If the resultant acceleration is above a certain threshold.

The system also uses a GPS module to obtain the location details of the accident. The Raspberry Pi Pico reads the GPS data to get the latitude and longitude of the location.Finally, the system uses a GSM module to send an SMS alert to a predefined mobile number. The SMS alert includes the location details of the accident.

2.2 Circuit Diagram

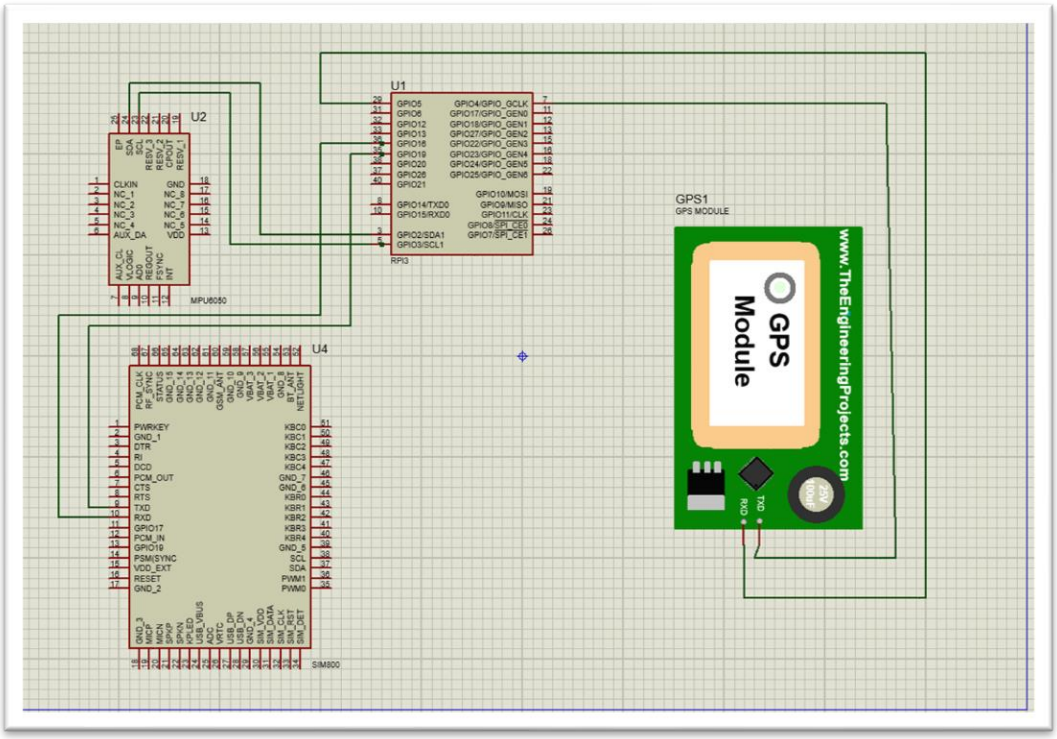

Fig.2 Circuit Diagram

Import necessary libraries: The code starts by importing the necessary libraries - I2C, UART, MPU6050, time and ubinascii. The I2C bus is initialized using the I2C(0) function. The MPU6050 sensor is initialized using the MPU6050(i2c) function. The sensor is connected to the I2C bus.

The UART is initialized using the UART(1, baudrate=9600, tx=0, rx=1) function. The TX and RX pins are connected to GPIO 0 and GPIO 1 respectively. Define the sendsms() function: This function sends an SMS alert to a mobile number using the UART. It takes no parameters.Continuously monitor the accelerometer data: This is done using an infinite loop that runs continuously. Inside the loop, the accelerometer data is obtained using the get_accel_data() function of the MPU6050 sensor.Calculate the resultant acceleration: The resultant acceleration is calculated using the x, y, and z accelerometer data.

2.3 Description of Hardware Components

2.3.1 Raspberry Pi Pico W

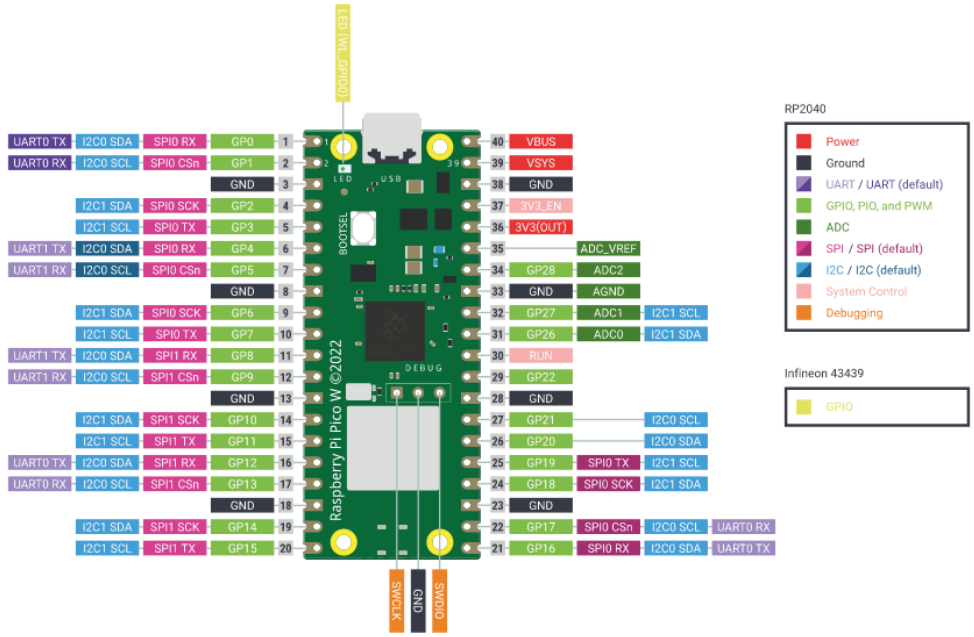

Fig.2.3.1 Raspberry Pi Pico W

Raspberry Pi Pico W adds on-board single-band 2.4GHz wireless interfaces (802.11n) using the Infineon CYW43439 while retaining the Pico form factor. The on-board 2.4GHz wireless interface has the following features:

- Wireless (802.11n), single-band (2.4 GHz)
- WPA3
- Soft access point supporting up to four client

The antenna is an onboard antenna licensed from ABRACON (formerly ProAnt). The wireless interface is connected via SPI to the RP2040 microcontroller.

Due to pin limitations, some of the wireless interface pins are shared. The CLK is shared with VSYS monitor, so only when there isn't an SPI transaction in progress can VSYS be read via the ADC. The Infineon CYW43439 DIN/DOUT and IRQ all share one pin on the RP2040. Only when an SPI transaction isn't in progress is it suitable to check for IRQs. The interface typically runs at 33MHz.

For best wireless performance, the antenna should be in free space. For instance, putting metal under or close by the antenna can reduce its performance both in terms of gain and bandwidth. Adding grounded metal to the sides of the antenna can improve the antenna's bandwidth.

2.3.2 GPS Module :

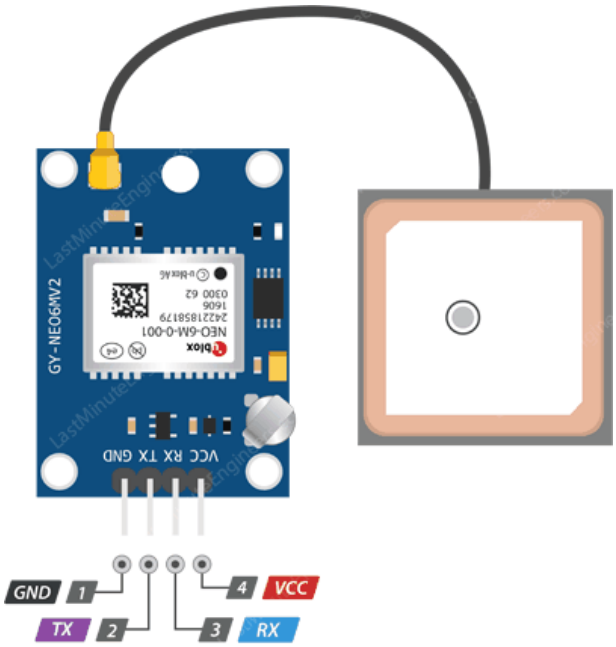

Fig.2.3.2 GPS Module

GPS stands for Global Positioning System and used to detect the Latitude and Longitude of any location on the Earth, with exact UTC time (Universal Time Coordinated). GPS module is used to track the location of accident in our project. This device receives the coordinates from the satellite for each and every second, with time and date. We have previously extracted $GPGGA string in Vehicle Tracking System to find the Latitude and Longitude Coordinates.

GPS module sends the data related to tracking position in real time, and it sends so many data in NMEA format . NMEA format consists several sentences, in which we only need one sentence. This sentence starts from $GPGGA and contains the coordinates, time and other useful information. This GPGGA is referred to Global Positioning System Fix Data. Know more about NMEA sentences and reading GPS data here.

We can extract coordinate from $GPGGA string by counting the commas in the string. Suppose you find $GPGGA string and stores it in an array, then Latitude can be found after two commas and Longitude can be found after four commas. Now, this latitude and longitude can be put in other arrays

2.3.3 GSM Module:

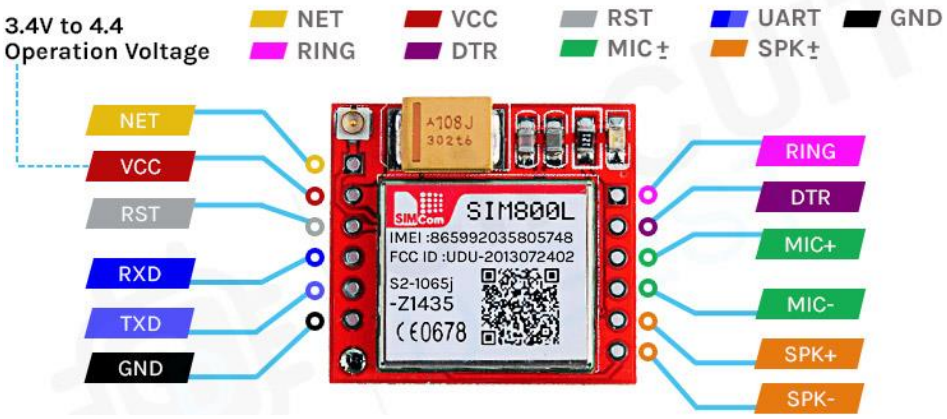

Fig.2.3.3.1 Gsm Module Pinout

NET	a pin where you can solder the helical antenna that comes with the module.
VCC	the Power supply pin of the module and it needs to be powered anywhere from 3.4V to 4.4 volts.
RST	is the hard reset pin of the sim800L module. If you are having trouble communicating with this, pull the pin low for 100ms
RXD	is the RX pin for the module used in serial communication.
TXD	is the TX pin for this module used in Serial communication.
GND	Ground pin for this module; connect this pin to the Ground pin of the pico.
RING	is the ring indicator pin of the module. This pin generally is active high.
DTR	this pin can be used to put the module in sleep mode. Pulling the pin high puts the module in sleep mode and disables the serial
MIC+-	These two pins can be used to connect an external microphone to the module.
SPK+-	these two pins can be used to connect an external speaker to the module.

The SIM800L GSM/GPRS module is a miniature GSM modem that can be used in a variety of IoT projects. You can use this module to do almost anything a normal cell phone can

do, such as sending SMS messages, making phone calls, connecting to the Internet via GPRS, and much more.To top it all off, the module supports quad-band GSM/GPRS networks, which means it will work almost anywhere in the world.

Fig.2.3.3.2 Gsm Module

All the necessary data pins of the SIM800L GSM chip are broken out to a 0.1pitch headers, including the pins required for communication with the microcontroller over the UART. The module supports baud rates ranging from 1200 bps to 115200 bps and features automatic baud rate detection.

The module requires an external antenna in order to connect to the network. So the module usually comes with a helical antenna that can be soldered to it. The board also has a U.FL connector If you wish to keep the antenna at a distance from the board.

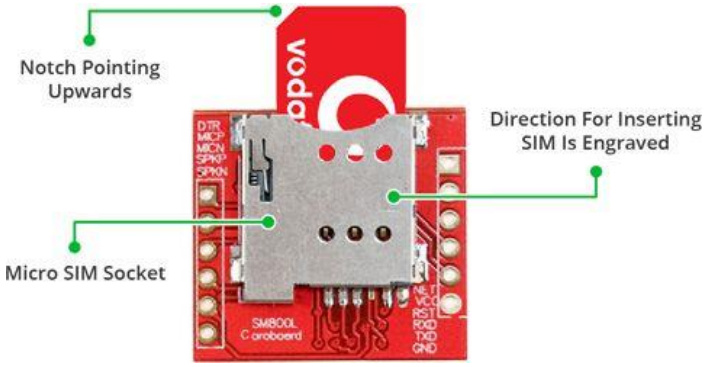

Fig.2.3.3.3 Gsm SIM Socket

There's a SIM socket on the back! Any 2G Micro SIM card will work perfectly. The proper way to insert the SIM card is typically engraved on the surface of the SIM socket.

2.3.4 Accelerometer:

MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor all in small package. Also,

it has additional feature of on-chip Temperature sensor. It has I2C bus interface to communicate with the microcontrollers.

It has Auxiliary I2C bus to communicate with other sensor devices like 3-axis Magnetometer, Pressure sensor etc. If 3-axis Magnetometer is connected to auxiliary I2C bus, then MPU6050 can provide complete 9-axis Motion Fusion output.

Let's see MPU6050 inside sensors. 3-Axis Gyroscope The MPU6050 consist of 3-axis Gyroscope with Micro Electro Mechanical System(MEMS) technology. It is used to detect rotational velocity along the X, Y, Z axes as shown in below figure.

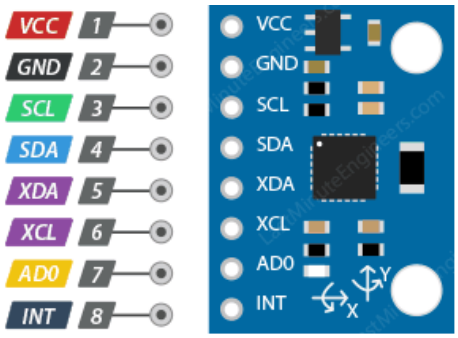

Fig.2.3.4 MPU6050 Module Pinout

MPU6050 Pin Description

INT:	Interrupt digital output pin.
AD0:	I2C Slave Address LSB pin. This is 0th bit in 7-bit slave address of device. If connected to VCC then it is read as logic one and slave address changes.
XCL:	Auxiliary Serial Clock pin. This pin is used to connect other I2C interface enabled sensors SCL pin to MPU-6050.
XDA:	Auxiliary Serial Data pin. This pin is used to connect other I2C interface enabled sensors SDA pin to MPU-6050.
SCL:	Serial Clock pin. Connect this pin to microcontrollers SCL pin.
SDA:	Serial Data pin. Connect this pin to microcontrollers SDA pin.
GND:	Ground pin. Connect this pin to ground connection.
VCC:	Power supply pin. Connect this pin to +5V DC supply.

2.4 Algorithm of implemented work

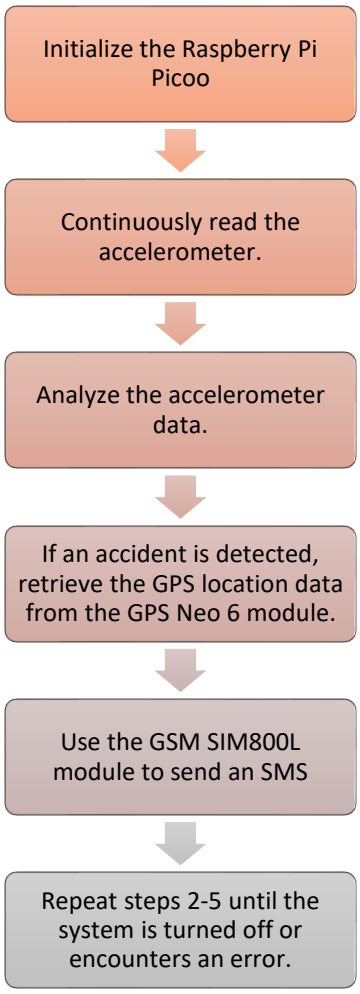

Fig 2.4 Flowchart of implementation

Chapter 3

Results

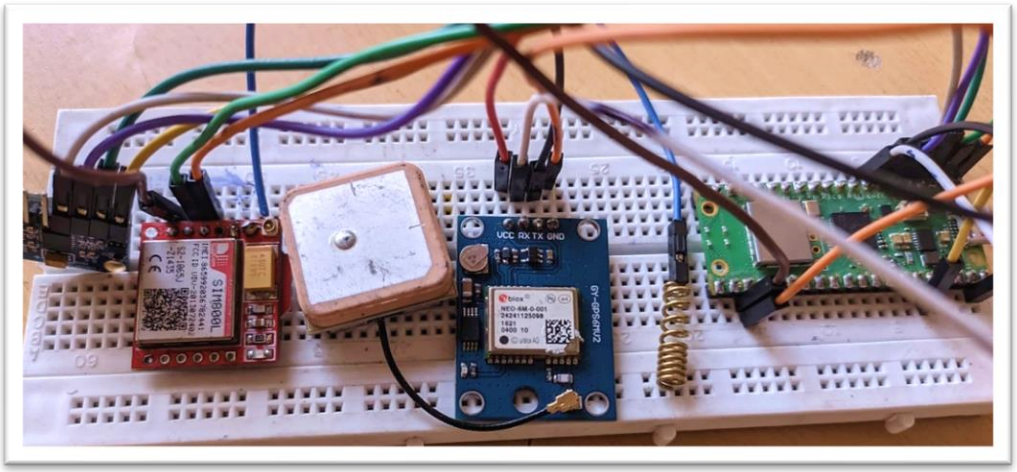

Fig.3.1 Implemented Circuit

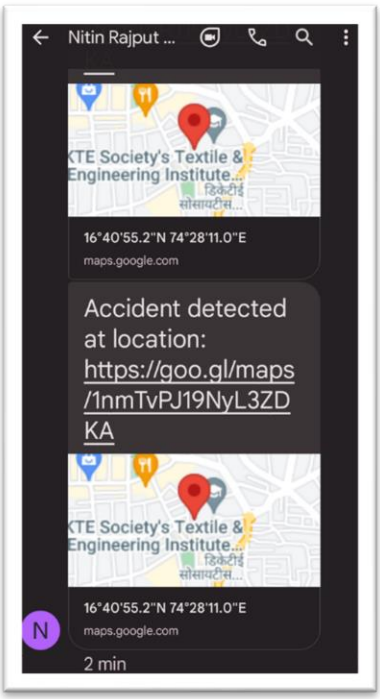

Fig.3.2 Output

The result of the vehicle accident detection system project will be a fully functional system that can accurately detect vehicle accidents in real-time and alert emergency services and/or designated contacts with the location of the accident. The system will utilize a Raspberry Pi Pico, GPS Neo 6 module, and GSM SIM800L module, along with an accelerometer sensor to detect sudden changes in motion indicative of an accident.

Overall, the project will make a valuable contribution towards improving road safety and reducing the severity of injuries resulting from vehicle accidents.

Chapter 4

Conclusion

4.1 The crash detection system using Raspberry Pi Pico, SIM module, and GPS Neo 6 module is effective and reliable for detecting vehicle crashes and notifying emergency services or designated contacts.

4.2 The system uses GPS location data and accelerometers to detect sudden changes in velocity or acceleration indicating a possible crash.

4.3 The system is cost-effective and can be easily installed in any vehicle and function in various environments.

4.4 The system has several benefits, including potentially saving lives, preventing injuries, and providing fast and efficient response to accidents.

4.5 Future improvements to the system could include integrating additional sensors such as cameras or microphones and real-time monitoring of vehicle data.

4.6 The crash detection system using Raspberry Pi Pico, SIM module, and GPS Neo 6 module is a valuable tool for promoting road safety and reducing the impact of vehicle crashes.

4.7 The system's SMS notification feature ensures that emergency services or designated contacts are promptly notified of a crash, enabling faster response times and potentially saving lives.

4.8 The use of a Raspberry Pi Pico microcontroller makes the system low-cost and easily customizable, allowing users to modify or add features as needed.

4.9 The GPS Neo 6 module provides accurate location data, ensuring that emergency services or designated contacts can quickly locate the accident scene.

Chapter 5

Applications with Advantages and Limitations

5.1 Applications

1.1.1 **Emergency services:** The system can be used by emergency services to respond quickly and efficiently to vehicle accidents, especially in remote areas where there may not be any witnesses.

1.1.2 **Road Safety:** The primary application of the system is to improve road safety by detecting accidents in real-time and notifying emergency services and/or designated contacts with the location of the accident. This can help reduce the severity of injuries resulting from accidents and potentially save lives.

1.1.3 **Fleet management:** Companies that operate large fleets of vehicles can use the system to monitor the safety of their drivers and reduce the risk of accidents.

1.1.4 **Public transportation:** The system can be used in public transportation vehicles, such as buses and trains, to alert emergency services and/or designated contacts in the event of an accident.

5.2 Advantages

5.2.1 **Improved Road Safety:** The system can quickly detect accidents and notify emergency services, potentially saving lives and reducing the severity of injuries.

5.2.2 **Cost-Effective:** The system is built using affordable and readily available components, making it a cost-effective solution for vehicle accident detection.

5.2.3 **Easy to Install:** The system can be easily installed in different types of vehicles with clear instructions and a user-friendly interface.

5.2.4 **Real-Time Location Data:** The system provides real-time location data, making it easier for emergency services to respond quickly to the accident scene.

5.3 Limitations

5.3.1 **Limited Detection:** The system is designed to detect accidents based on changes in motion detected by the accelerometer, which may not be sufficient for detecting all types of accidents.

5.3.2 **Limited Range:** The system relies on the GSM network to send SMS notifications, which may not be available in all areas or may have limited coverage.

5.3.3 **Power Supply:** The system requires a stable power supply to function correctly, and a sudden power failure can lead to inaccurate readings or system failure.

5.3.4 **GPS Accuracy:** The GPS Neo 6 module used in the system has a limited accuracy of about 2.5 meters, which may not be sufficient for pinpointing the exact location of the accident.

5.3.5 **Installation Limitations:** The system may not be suitable for installation in all types of vehicles, and some modifications may be required.

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