SAFE ALERT

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report titled "**SAFE ALERT"** is the bonafide work of "**ASMITHA [RA2211032010028], MANEESH [RA2211032010040], HEMANTH[RA2211032010041], S. YAFFIN [RA2211032010053]"**, who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on thisor any other candidate.

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ABSTRACT

The rapid advancement of Internet of Things (IoT) technology has led to the development of innovative solutions across various domains. One critical area that benefits from IoT is road safety, particularly in the context of accident detection and response systems. This paper presents an Intelligent Accident Detection System designed for IoT (AIoT) environments, aiming to enhance emergency response and improve overall road safety.

In the event of an accident, the system employs advanced algorithms to analyze sensor data and detect anomalies indicative of a collision. Upon detection, the system triggers immediate response mechanisms, such as sending distress signals to emergency services and designated contacts. Real-time communication capabilities enable swift coordination between stakeholders, facilitating rapid asInsistance to the accident site.

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I would like to express my deepest gratitude to my guide, Dr.VAISHNAVI MOORTHY her valuable guidance, consistent encouragement, personal caring, timely help and providing me with an excellent atmosphere for doing research. All through the work, in spite of his busy schedule, he has extended cheerful and cordial support to me for completing this research work.

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CHAPTER 1

INTRODUCTION

In today's modern world, road accidents pose significant risks to life and property. To address this issue, advanced technologies like GPS (Global Positioning System) and GSM (Global System for Mobile Communication) modules are being integrated into vehicles to create intelligent systems that can detect accidents and send timely alerts. Our project focuses on developing an Accident Alert System that harnesses the power of GPS and GSM technologies to enhance road safety and emergency response.

By leveraging GPS technology, our system can accurately pinpoint the location of a vehicle in real-time. Coupled with GSM capabilities, the system can transmit alert messages to predefined contacts or emergency services in the event of an accident or collision. This integration enables swift response times and facilitates the deployment of assistance to the precise location of the incident, potentially saving lives and reducing the severity of injuries.

The core components of our system include GPS modules for location tracking, GSM modules for communication, a microcontroller unit for processing data and triggering alerts, accelerometer sensors for impact detection, and a user interface for system feedback. Together, these elements form a comprehensive Accident Alert System that operates autonomously to ensure proactive safety measures on the road.

By implementing such innovative solutions, we aim to contribute to a safer and more secure transportation environment, promoting awareness about road safety and empowering vehicles with intelligent capabilities to mitigate the impact of accidents.

CHAPTER 2

LITERATURE SURVEY

2.1 IOT Based Automatic Vehicle Accident Alert System

Nazia Parveen [1] proposed the model for IOT based smart automatic Vehicle Accident alert system using gsm communication which is an faster mode for communication during emergencies, 2023, IEEE, The feature is faster communication and no internet is required.

2.2 IOT Based Accident Tracking

Misbah A [1] designed IOT based accident detection and tracking system with telegram and SMS notification, 2021, IEEE, The feature is SMS and Telegram notification.

2.3 Accident Alert System Application

G. Suriya Praba Devi [1] propsed Accident Alert System Application using a privacy-preserving Blockchain based incentive mechanism, 2019, IEEE, key feature is an application developed for easy tracking of accidents.

CHAPTER 3

SYSTEM ANALYSIS

1. ARDUINO NANO

Arduino Nano’s compact size and lightweight design make it ideal for integrating into vehicles, ensuring minimal space consumption while providing robust accident detection capabilities.

Its compatibility with a variety of sensors, such as accelerometers, allows for precise monitoring of vehicle dynamics, enabling quick identification of collisions.

Arduino Nano’s communication interfaces (e.g., UART, I2C) seamlessly connect with GPS and GSM modules, facilitating accurate location tracking and immediate communication during emergencies.

The flexibility of Arduino Nano’s programming environment allows developers to customize accident detection algorithms, adjust sensor thresholds, and fine-tune alert mechanisms according to specific safety needs.

Figure 3.1: Arduino NANO

2. ADXL 335 SENSOR

The ADXL335 sensor is essential for detecting accidents in vehicles.

It monitors acceleration in three axes (x, y, z) and provides real-time data.

Customizable sensitivity settings help differentiate normal driving from potential accidents.

Its compact and reliable design ensures seamless integration and dependable accident detection in the system .

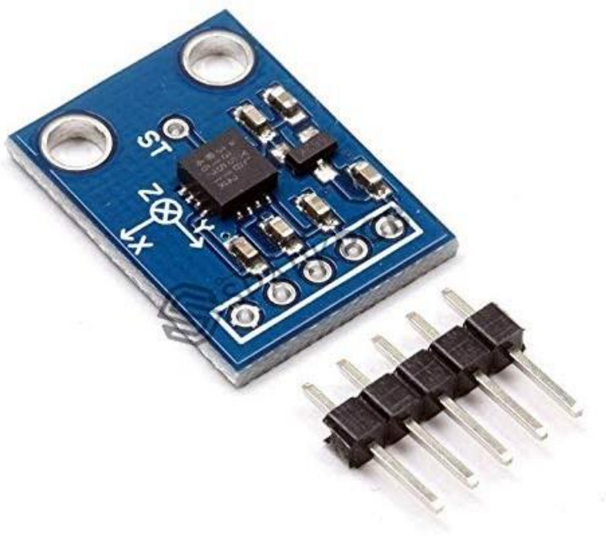

Figure 3.2: ADXL 335

3. SIM 800L MODULE

SIM800L GSM module enables communication in the Accident Alert System.

It facilitates sending SMS alerts or making calls to notify emergency services or contacts.

Compatible with Arduino Nano, it integrates seamlessly into the system for real-time communication.

Provides reliable connectivity, crucial for transmitting accident location data and receiving assistance requests.

Compact and efficient, making it suitable for automotive applications requiring GSM communication capabilities.

Figure 3.3: SIM 800L

4. NEO 6M GPS MODULE

NEO-6M GPS module provides accurate location tracking in the Accident Alert System.

It utilizes satellite signals to determine latitude and longitude coordinates.

Compatible with Arduino Nano, it integrates seamlessly for real-time location data acquisition.

Enables precise accident location detection, crucial for emergency response coordination.

Compact and reliable design ensures consistent GPS performance, enhancing overall system effectiveness in the event of accidents.

Figure 3.5: NEO 6M

CHAPTER 4

SYSTEM DESIGN

4.1 Tables and Figures

1. ADXL335 Accelerometer Sensor:

Voltage Range: Typically operates at 3.3V or 5V, depending on the module.

Output Frequency: Analog output, no specific frequency range like a digital sensor.

Connections with Arduino:

VCC -> 3.3V or 5V

XOUT -> Analog Input A0

YOUT -> Analog Input A1

ZOUT -> Analog Input A2

GND -> GND

The ADXL335 sensor outputs analog voltage signals proportional to the acceleration along the x, y, and z axes. These analog signals are read by the Arduino's analog pins (A0, A1, A2) for processing and interpretation of acceleration data.

2. SIM800L GSM Module:

Voltage Range: Typically operates in the range of 3.4V to 4.4V

Connections with Arduino:

VCC -> 5V (make sure it's provided with external source using battery)

GND -> GND

TX -> Arduino RX (Digital Pin)

RX -> Arduino TX (Digital Pin)

Additional connections may include:

RST -> Arduino digital pin for module reset (optional, if required)

RI -> Arduino digital pin for Ring Indicator (optional, for call/SMS notifications)

DTR -> Arduino digital pin for Data Terminal Ready control (optional)

The SIM800L module communicates with the Arduino using UART (Serial) communication. Connect the TX pin of the module to the RX pin of the Arduino, and vice versa. Ensure proper level shifting since the module operates at 3.3V logic levels.

3. NEO-6M GPS Module:

Voltage Range: Typically operates at 3.3V to 5V (check datasheet for specific requirements).

Connections with Arduino:

VCC -> 3.3V or 5V

GND -> GND

TX -> Arduino RX (Digital Pin)

RX -> Arduino TX (Digital Pin)

Additional connections may include:

PPS -> Not typically used in basic setups (optional, for Pulse Per Second output)

SCL -> Not used in basic setups (optional, for I2C communication)

SDA -> Not used in basic setups (optional, for I2C communication)

The NEO-6M GPS module communicates with the Arduino using UART (Serial) communication. Connect the TX pin of the module to the RX pin of the Arduino, and vice versa.

4. LCD with I2C:

Voltage Range: Typically operates at 5V

Connections with Arduino:

VCC -> 5V

GND -> GND

SDA -> A4 (Analog Pin)

SCL -> A5 (Analog Pin)

In the setup() function, the code initializes communication with the LCD display using the lcd.begin() command. This step is crucial for establishing a connection between the Arduino board and the LCD module, enabling data transmission for displaying text and other information. The lcd.backlight() command is then used to turn on the backlight of the LCD display, assuming that the specific LCD module supports backlight control through software commands. This enhances visibility, especially in low-light conditions, making the text on the display more readable.

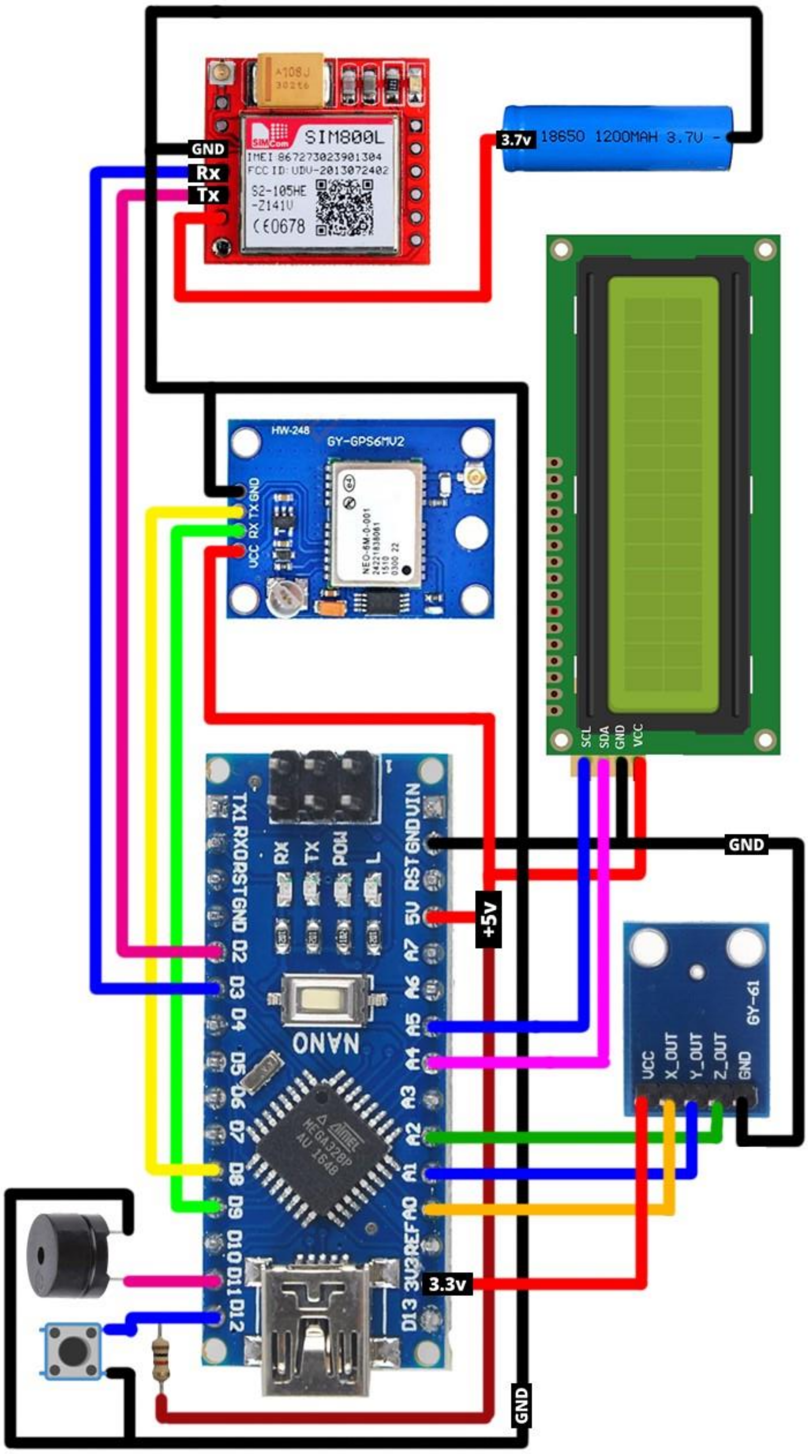

Figure 4.1: Fig 4.1 Wiring

CHAPTER 5

EMBEDDING WITH AI

5.1 NEED FOR AI

The Kalman Filter algorithm, a cornerstone of modern control and estimation theory, holds significant relevance in my project for vehicle tracking using an accelerometer sensor like the ADXL335. By seamlessly blending predictive modeling and statistical analysis, the Kalman Filter intelligently processes noisy sensor data, providing a refined and accurate estimation of the vehicle's position or velocity. Its adaptive nature allows for dynamic adjustment of filter parameters, optimizing tracking performance in real-time and enhancing the system's overall reliability and responsiveness. This algorithmic prowess not only filters out disturbances but also predicts future states, making it an indispensable tool for ensuring precise and efficient vehicle tracking in diverse environmental conditions.

5.2 USE OF KALMAN FILTER ML TECHNIQUE

Data Filtering with AI: The Kalman Filter, as a part of your AI-driven system, acts as a sophisticated data filtering mechanism. It employs predictive models and statistical techniques to intelligently filter out noise from the raw accelerometer sensor data. This AI-driven data filtering ensures that the system focuses on relevant signals while reducing the impact of random variations or disturbances, thereby improving the accuracy of vehicle tracking.

State Estimation and Prediction: AI-powered state estimation techniques, such as the Kalman Filter, leverage historical sensor data and dynamic system models to estimate the current state of the vehicle (e.g., position or velocity). By continuously updating and refining these estimations based on new sensor inputs, the AI-driven system can predict the future state of the vehicle with higher accuracy. This predictive capability is crucial for anticipating vehicle movements, enabling proactive decision-making in real-time.

Noise Reduction through AI: AI algorithms embedded within the Kalman Filter dynamically adapt to the noise characteristics of the sensor data. By learning from patterns and trends in the data, AI helps the Kalman Filter distinguish between meaningful signals and noise. This AI-driven noise reduction process ensures that the vehicle tracking system operates robustly even in challenging environments with varying levels of sensor noise, enhancing overall system reliability and performance.

Optimized Tracking with AI: Integrating AI techniques into the Kalman Filter allows for optimized tracking strategies. AI algorithms can adjust the filter's parameters (such as process noise covariance and measurement noise covariance) autonomously based on real-time data analysis and environmental conditions. This adaptive behavior ensures that the tracking system remains agile and responsive to dynamic changes, providing precise and reliable tracking of the vehicle's motion.

CHAPTER 6

CODING, TESTING

6.1 Code for SET UP FUNCTION

The below code ensure that the sensor ADXL 335, NEO 6M and SIM800L are set upped properly.

```
void setup()
//——————————————————————————————
//Serial.println("Arduino serial initialize");
Serial.begin(9600);
//——————————————————————————————
//Serial.println("SIM800L serial initialize");
sim800.begin(9600);
//——————————————————————————————
//Serial.println("NEO6M serial initialize");
neogps.begin(9600);
//————————————————————————————
pinMode(BUZZER, OUTPUT);
pinMode(BUTTON, INPUT_PULLUP);
//——————————————————————————————
//initialize lcd screen
lcd.begin();
// turn on the backlight
lcd.backlight();
lcd.clear();
//——————————————————————————————
sms_status = "";
sender_number = "";
received_date = "";
```

```
msg="";
//————————————————————————————————
sim800.println("AT"); //Check GSM Module
delay(1000);
//SendAT("AT", "OK", 2000); //Check GSM Module
sim800.println("ATE1"); //Echo ON
delay(1000);
//SendAT("ATE1", "OK", 2000); //Echo ON
sim800.println("AT+CPIN?"); //Check SIM ready
delay(1000);
//SendAT("AT+CPIN?", "READY", 2000); //Check SIM ready
sim800.println("AT+CMGF=1"); //SMS text mode
delay(1000);
//SendAT("AT+CMGF=1", "OK", 2000); //SMS text mode
sim800.println("AT+CNMI=1,1,0,0,0"); /// Decides how newly arrived SMS handled
delay(1000);
//SendAT("AT+CNMI=1,1,0,0,0", "OK", 2000); //set sms received format
//AT +CNMI = 2,1,0,0,0 - AT +CNMI = 2,2,0,0,0 (both are same)
//————————————————————————————————
time1 = micros();
//Serial.print("time1 = "); Serial.println(time1);
//————————————————————————————————
//read calibrated values. otherwise false impact will trigger
//when you reset your Arduino. (By pressing reset button)
xaxis = analogRead(xPin);
yaxis = analogRead(yPin);
zaxis = analogRead(zPin); //————————————————————————————————
```

6.2 Code for IMPACT FUNCTION

An impact algorithm is set up in which sensitivity can be changed based on the vehicle type.

void Impact()

//————————————————————————

time1 = micros(); // resets time value

//————————————————————————

int oldx = xaxis; //store previous axis readings for comparison

int oldy = yaxis;

int oldz = zaxis;

xaxis = analogRead(xPin);

yaxis = analogRead(yPin);

zaxis = analogRead(zPin);

//————————————————————————

//loop counter prevents false triggering. Vibration resets if there is an impact. Don’t detect new changes until that "time" has passed.

vibration–;

//Serial.print("Vibration = "); Serial.println(vibration);

if(vibration < 0) vibration = 0;

//Serial.println("Vibration Reset!");

if(vibration > 0) return; //———————————————————————— deltx = xaxis - oldx;

delty = yaxis - oldy;

deltz = zaxis - oldz;

//Magnitude to calculate force of impact.

magnitude = sqrt(sq(deltx) + sq(delty) + sq(deltz));

//NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN

if (magnitude >= sensitivity) //impact detected

updateflag=1;

// reset anti-vibration counter

vibration = devibrate;

//NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN

else

//if (magnitude > 15)

//Serial.println(magnitude);

//reset magnitude of impact to 0

magnitude=0;

//NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN

6.3 Code for SEND SMS FUNCTION

The below code triggers the GSM module which in turn send SMS to the Emergency contact number.

void sendAlert()

String sms$_{d}ata;$

sms$_{d}ata = ''AccidentAlert!!\Sigma;$

sms$_{d}ata+ = ''http : //maps.google.com/maps?q = loc : '';$

sms$_{d}ata+ = latitude + '', '' + longitude;$

sendSms(sms$_{d}ata);$

6.4 Code to MAKE CALL FUNCTION

The below code triggers the GSM module to make call to the emergency contact number.

void makeCall()

Serial.println("calling... ");

sim800.println("ATD"+EMERGENCY$_{P}HONE + ''; '');$

delay(20000); //20 sec delay

sim800.println("ATH");

delay(1000); //1 sec delay

6.5 Code for KALMAN FILTER ALGORITHM

include <KalmanFilter.h>

// Define Kalman Filter variables

float x$_{e}st = 0.0; //Initialestimatedposition$

float P = 1.0; // Initial estimate uncertainty

float Q = 0.01; // Process noise covariance float R = 0.1; // Measurement noise covariance

// Define sensor and measurement variables float $z_m eas = 0.0$;

void setup()

Serial.begin(9600); // Initialize serial communication

void loop()

// Simulate sensor measurement

$z_m eas = simulateSensor()$; $//Functiontosimulateaccelerometerdata$

// Kalman Filter prediction step

float $x_p red = x_e st$; $//Predictedstateestimate$

float $P_p red = P + Q$; $//Predictedestimateuncertainty$

// Kalman Filter correction step

float K = $P_p red/(P_p red + R)$; $//Kalmangain$

$x_e st = x_p red + K * (z_m eas - x_p red)$; $//Correctedstateestimate$

P = (1 - K) * $P_p red$; $//Correctedestimateuncertainty$

// Output results

Serial.print("Measured: ");

Serial.print($z_m eas$);

Serial.print("Êstimated: ");

Serial.println($x_e st$);

delay(1000); // Delay for demonstration (adjust as needed)

// Function to simulate sensor data (replace with actual sensor readings)

float simulateSensor()

// Simulate noisy accelerometer data

float noise = random(-2, 2) / 10.0; // Add random noise between -0.2 and 0.2

float $true_v alue = 1.0$; $//Truevalue(replacewithactualsensorreadings)$

float $measured_v alue = true_v alue + noise$; $//Simulatednoisymeasurement$

return $measured_v alue$;

CHAPTER 7

CONCLUSION

In conclusion, the Accident Alert System project demonstrates the integration of various components such as sensors, communication modules, and microcontrollers to enhance road safety. The use of sensors like the ADXL335 for detecting accelerations indicative of accidents, along with modules like the SIM800L for GSM communication and the NEO-6M GPS module for accurate location tracking, forms a robust system capable of timely accident detection and emergency response.

The compact size and efficient operation of Arduino Nano microcontroller boards make them suitable for embedding within vehicles, enabling real-time data processing and communication. Additionally, the system's customization capabilities, such as adjustable sensor thresholds and alert mechanisms, allow for adaptation to specific safety requirements.

By leveraging these technologies, the Accident Alert System not only provides critical alerts to emergency services or contacts but also contributes to overall road safety by reducing response times and facilitating swift assistance in case of accidents. Continued development and refinement of such systems hold promise for further advancements in automotive safety and emergency response mechanisms.

CHAPTER 8

FUTURE ENHANCEMENT

For future enhancements to the Accident Alert System project, several avenues can be explored to further bolster its capabilities and effectiveness. One key area of improvement could involve the integration of advanced sensor technologies and machine learning algorithms. For instance, incorporating more sophisticated sensors such as LiDAR or computer vision cameras can provide richer environmental data, enabling the system to not only detect accidents but also identify specific hazards or obstacles on the road. By leveraging machine learning algorithms like convolutional neural networks (CNNs) or recurrent neural networks (RNNs), the system can analyze complex sensor data patterns in real-time, enhancing its predictive capabilities and reducing false alarms.

Moreover, enhancing the system's communication and response capabilities can significantly impact its effectiveness. Integration with emerging communication technologies such as 5G networks or vehicle-to-vehicle (V2V) communication protocols can enable faster and more reliable transmission of accident alerts and emergency information. Collaborating with emergency services and leveraging geospatial data platforms can further streamline response coordination, ensuring timely and accurate assistance during critical situations.

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