VEHICLE ACCIDENT DETECTION AND ALERT SYSTEM USING GPS AND GSM

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ABSTRACT:

According to the World Health Organization (WHO), over 50% of annual traffic-related fatalities are attributed to road traffic injuries, with a significant portion involving motorcycle riders and head injuries. Delays in rescuing accident victims contribute to the severity of outcomes. To address this issue, this research proposes an automated system for immediate alerting of family members upon detecting an accident. The system integrates an Arduino UNO R3 microcontroller, a GPS receiver, and a GSM module SIM 800L. The GPS module is utilized to obtain the latitude and longitude coordinates of the accident location, while the GSM module facilitates SMS notification to inform designated contacts about the accident type and location using Google Maps. The ADXL335 MEMS Accelerometer sensor captures vehicle X and Y coordinates, while a 16x2 LCD screen displays relevant messages, latitude, and longitude coordinates of the accident site.

KEYWORDS:

Arduino UNO R3, GSM module, GPS module, accident detection, family alert system, emergency rescue.

I. INTRODUCTION:

In India, a densely populated non-industrial nation with nearly 1.35 billion people and an extensive road network spanning 5,897,671 km, the escalating number of accidents poses a

significant concern. Factors such as dense population, lack of awareness about traffic regulations, and limited emergency services exacerbate the situation, especially during peak traffic times and congested roads [1]. In densely populated areas, the presence of emergency services may mitigate some risks, but in remote or less populated regions, the absence of immediate assistance can lead to tragic outcomes [2]. Recognizing the paramount value of human life and the imperative need to expedite emergency response, we propose a project aimed at promptly alerting relatives in the event of an accident occurrence [3].

With the proliferation of vehicles, the incidence of traffic hazards and road accidents has surged, placing lives at heightened risk [4]. Inadequate accident detection systems and other challenges have underscored the need for innovative solutions [5]. This project introduces an automated accident notification system leveraging wireless communication technologies, specifically Arduino, GPS, and GSM modules [6], [7]. Drawing upon relevant research from IEEE journals, we have formulated a novel approach that streamlines the accident detection process and promptly notifies family members, providing them with precise accident location details [8].

The proposed system revolves around three core modules:

1. Accident Detection
2. Vehicle Location Tracking
3. Alert Message Dispatch to Family Members

II. EXISTING SYSTEM:

Despite the increasing number of fatalities due to road accidents, existing systems have failed to provide a comprehensive solution that continuously tracks a vehicle's location and promptly sends alert messages upon an accident occurrence. To address this critical gap and save lives, we have developed a model that emphasizes real-time location tracking and immediate notification in the event of an accident . Road accidents in India remain a significant cause of death, injury, and loss of life annually, with recent incidents demonstrating the severity of the issue [9]. The lack of timely rescue during emergencies exacerbates the situation, particularly in remote areas where access to assistance is limited [10]. While accidents in busy areas may receive prompt attention from bystanders [11], those in remote locations often result in significant delays, leading to tragic outcomes.

Various researchers have proposed alternative systems to address this challenge. Varsha introduced a system leveraging ARM controllers and ultrasonic sensors, offering cost-effectiveness but potentially hampered by execution challenges [12]. MI Ahmed suggested a Smart Cities-oriented framework using software-defined networking (SDN), but its implementation complexities, security concerns, and latency issues present significant obstacles [13]. Harsha Vardhan proposed a system based on RFID vehicle tag recognition, but it faces limitations regarding range and security [14]. In contrast, our model integrates advanced technologies, including Arduino, GPS, and GSM modules, to deliver a robust and efficient solution for accident detection and alerting. By overcoming the limitations of existing systems, our approach aims to enhance road safety and emergency response effectiveness, ultimately saving lives and reducing the impact of road accidents.

III. PROPOSED METHODOLOGY:

To enhance driver safety across all accident scenarios, we propose a vehicle alert system project utilizing Arduino technology. Our model integrates Arduino UNO R3 with a GPS NEO-7M receiver and GSM module SIM 800L. The ADXL335 Accelerometer captures the vehicle's X, Y axis coordinates, while the GSM SIM 800L sends a notification message to pre-registered family contacts. Continuously, the GPS module tracks the vehicle's latitude and longitude coordinates. In instances of minor accidents where emergency notification to family members isn't necessary, we've incorporated a reset button to halt notification transmission. This feature ensures that emergency alerts are only triggered when genuinely required, thereby safeguarding lives in critical situations and potentially reducing accident-related fatalities.

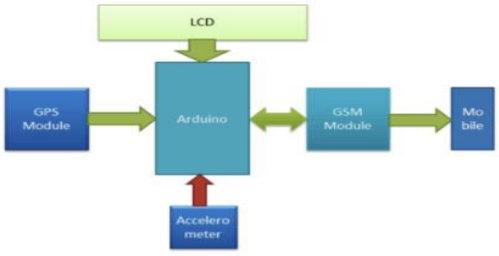

Fig 1: Block diagram of accident alert system

Figure 1 illustrates the accident alert system comprising the GPS module, GSM modem, and MEMS Accelerometer connected to the Arduino microcontroller. The GPS module precisely identifies the accident location in terms of latitude and longitude coordinates. Meanwhile, the MEMS Accelerometer monitors the vehicle's movement, activating the SIM

800L GSM module upon detecting threshold-exceeding movements. Subsequently, notification messages are promptly dispatched to designated relatives, facilitating swift assistance in emergency situations.

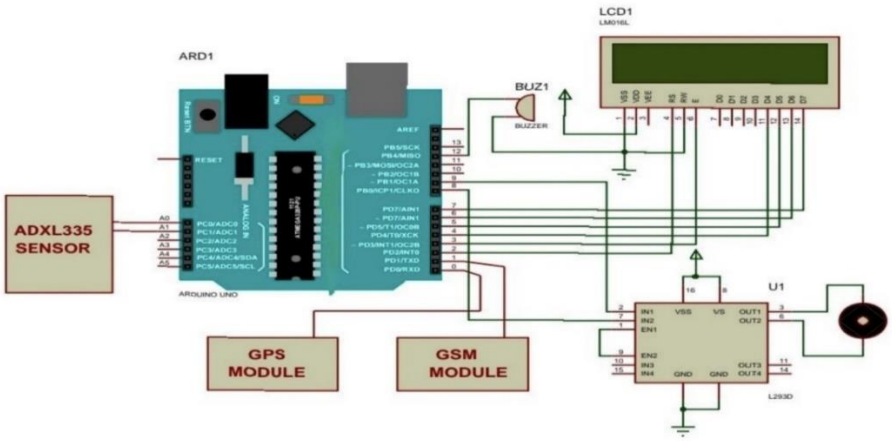

Fig 2: representation of accident alert system

Figure 2 depicts the proposed system, which integrates an Arduino UNO R3 microcontroller, a GPS NEO-7M receiver, and a GSM module SIM 800L. The GPS module captures the latitude and longitude coordinates of the accident location, while the GSM module sends alert SMS messages, detailing the accident type and providing the location via Google Maps. The ADXL335 MEMS Accelerometer sensor captures the vehicle's X and Y coordinates. Additionally, a 16x2 LCD screen is utilized to display messages and the accident location coordinates. A reset button is incorporated into the proposed model to address minor accidents. In the event of a minor accident, the driver can press the reset button, halting the circuit from immediately sending messages to family members. The system includes a brief waiting period, allowing the driver to press the reset button if necessary. If the reset button remains unpressed within the designated timeframe, the system interprets it as a serious accident and proceeds to dispatch alerts to family members.

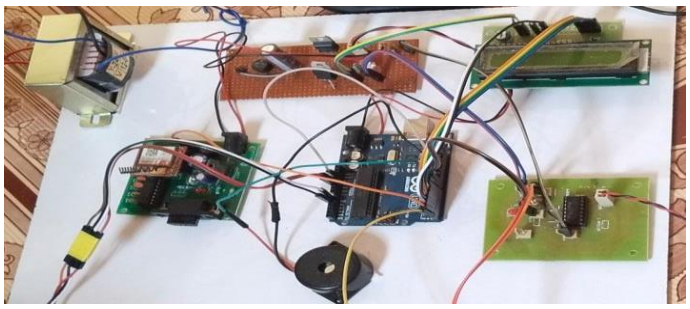

Fig 3: hardware model for accident alert system

Figure 3 illustrates the operational model of the proposed system, titled " Arduino-Based Vehicle Collision Detection and Alert System with ADXL335 Accelerometer, GPS, and GSM Integration". This model demonstrates the practical implementation and functioning of the system components to enhance driver safety and facilitate prompt emergency response.

The proposed system integrates a GSM SIM 800L modem, a GPS module NEO-7M, and a ADXL335 Accelerometer sensor, complemented by a 16x2 display for message presentation alongside latitude and longitude details of the accident site. The GPS module functions to capture the latitude and longitude coordinates, transmitting this data to the Arduino board. Upon detection of X and Y coordinates surpassing predetermined thresholds, the ADXL335 Accelerometer sensor signals the Arduino board. Subsequently, the GSM modem is activated, facilitating the transmission of alert messages to designated family members. These messages include precise location information conveyed through Google Maps links, ensuring prompt assistance and accurate localization in case of an accident.

IV. RESULT AND ANALYSIS:

FRONT ACCIDENT: When our vehicle experiences a frontal collision with another vehicle, it is classified as a front accident.

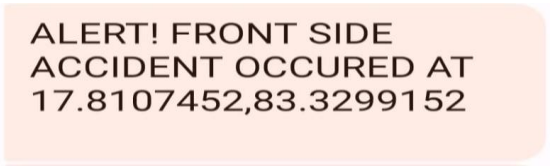

Fig 4: Output of GSM Module When Front Accident Occurs

Figure 4 illustrates the output message sent by the GSM Modem to the registered contact numbers when a front accident occurs.

LEFT ACCIDENT: When our vehicle is impacted by another vehicle from the left side, it constitutes a left-side accident. Figure 5 illustrates the output message sent by the GSM Modem to the registered contact numbers when a left-side accident occurs.

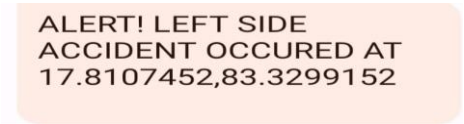

Fig 5: Output of GSM Module When Left Accident Occurs

RIGHT ACCIDENT: When our vehicle experiences an impact from another vehicle on the right side, it is categorized as a right-side accident.

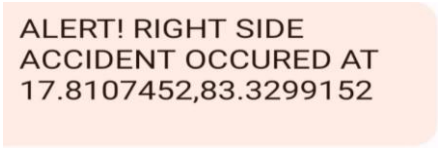

Fig 6: Output of GSM Module When Right Accident Occurs

Figure 6 illustrates the output message that will be sent by the GSM Modem to the registered contact numbers when a right-side accident occurs.

BACK ACCIDENT: When our vehicle experiences an impact from another vehicle from the rear, it is classified as a rear or back accident.

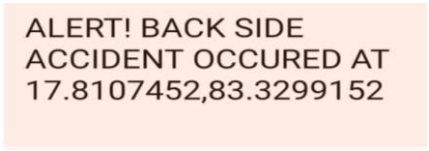

Fig 7: Output of GSM Module When Back Accident Occurs

Figure 7 illustrates the output message that will be sent by the GSM Modem to the registered contact numbers when a rear accident occurs. In the event of an accident, categorized into one of the four types previously specified, if the driver fails to press the reset button within the designated time frame, the accident is considered critical. Subsequently, an alert message will be promptly dispatched to the family members.

V. CONCLUSION:

The surge in vehicle ownership has also heightened the risks of traffic accidents, posing significant threats to people's lives. The inadequate availability of emergency services further exacerbates this issue in our country. To mitigate the occurrence of accidents, we have devised a system aimed at alerting the family members of individuals involved in accidents. This system employs a GSM module to transmit alert messages, coupled with a GPS modem that continuously tracks and relays the latitude and longitude coordinates of the accident location. Additionally, we have integrated a ADXL335 Accelerometer, which detects changes in axes upon impact with another vehicle. By monitoring the values of the X and Y axes, the ADXL335 Accelerometer can discern the type of accident that has occurred.

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