INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 06 Issue 10 October 2023

DOI: 10.47191/ijmra/v6-i10-26, Impact Factor: 7.022

Page No. 4741-4747

Transforming Car Accident Detection: An IoT and Cloud-Based Approach

Sabah Khudhair Ali[1], Omar Shakir Hamad[2], Mohammed Ghadhban Ahmed[3], Anmar Aidi Shareef[4], Mohammed Farooq Saber[5]

[1,2,3,4,5] Electronics and Control Engineering Department, Technical Engineering College-Kirkuk, Northern Technical University, Iraq

ABSTRACT: The rise in car accidents and fatalities has led to a growing interest among researchers in the potential of IoT (Internet of Things) and its application in smart transportation technology. In this particular project, we aim to tackle the issue of automatic car accident detection and subsequently alert nearby vehicles within a predefined geographic area. Additionally, our device will send notifications to the driver's family in the unfortunate event of an accident. Within the scope of this project, we are set to develop our own unit for detecting car accidents, which can be easily installed either within the car's dashboard or under the hood. This system relies on components such as the Neo 6m GPS module and the SIM900A GSM module, both integrated with an Arduino. Notably, this GPS-based car accident location tracking system is designed for global use and applicability

INTRODUCTION

In today's world, the frequency of accidents is on the rise. The increased use of vehicles, such as cars and bikes due to employment reasons, often results in accidents caused by overspeeding. People are put at risk due to this overspeeding problem, and the lack of advanced technology has made it challenging to reduce accident rates [1]. To address this issue and work towards decreasing accident rates, this paper presents an innovative solution: an automatic alert system for vehicle accidents. The primary goal is accident prevention by sending instant messages to registered mobile devices using wireless communication techniques [2]. When an accident occurs in a city, a message is promptly dispatched to registered mobile phones via a GSM module. At the core of this system is Arduino, which facilitates the transmission of messages to various devices [1]. A vibration sensor is activated upon an accident, and this information is relayed to the registered numbers through the GSM module. Additionally, the GPS system aids in pinpointing the accident's location [1-3]. The proposed system not only detects accidents but also notifies the nearest medical centers and registered mobile numbers about the accident's location using GSM and GPS modules. The location can be sent through a tracking system, covering geographical coordinates in the area. The vibration sensor plays a crucial role in detecting accidents [1].

Vehicular networking integrates wireless communication, in-vehicle sensing modules, and the Global Positioning System (GPS) to enable various applications in road safety, traffic efficiency, and infotainment domains. There is a significant rise in theft cases and a lack of road safety services [4]. By installing an Arduino equipped with GPRS and GPS (SIM900) in a concealed location within your car and connecting it to GPRS, GSM (Global System for Mobile communication), GPS antennas, and a SIM card, all powered by a battery, you can enhance safety, locate your lost car, or prevent theft. This device can include an SOS button that, when triggered, sends an alarm message to the registered number on the hardware setup. In situations where the exact location of a parked car is unknown, calling the SIM900 can make the car's indicators flash to make it visible to the searcher [6]. This technology can also be beneficial to the police department in locating stolen vehicles.

The board (shield) utilizes the GPRS and GPS Quad-band Module for Arduino (SIM900) and is fully compatible with older Arduino USB models. It can also be implemented using a Raspberry Pi. The shield's LED indicates the status of the GPRS and GPS module [6,8].

When someone calls the module with the correct phone number, the GPS obtains longitude and latitude, sending an SMS with the position and transmitting GPS data through the local network to the SIM card in your cellphone. The code is loaded into the Arduino, and the GPRS and GPS shield is assembled with the antennas, along with the SIM card installation. Once the GPS locks

onto GPS satellites, the GPRS and GPS shield establishes a network connection and sends GPS data through a network request. This allows us to visualize the device's position on Google Maps [6,11].

Arduino Uno

The Arduino/Genuino Uno is a microcontroller board that utilizes the ATmega328P as its core component. This board boasts 14 digital input/output pins, with 6 of them capable of functioning as PWM outputs. Additionally, it offers 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button [2-5,9]. It's essentially a self-contained package that provides all the necessary support for the microcontroller. To get started, you can simply connect it to a computer using a USB cable or power it using an AC-to-DC adapter or battery. The beauty of working with the Uno is that you can experiment with it without the fear of making irreparable mistakes. In the worst-case scenario, you can replace the chip inexpensively and start your project anew.

The name "Uno" is derived from the Italian word for "one" and was chosen to coincide with the release of Arduino Software (IDE) 1.0. The Uno board, along with version 1.0 of Arduino Software (IDE), served as the standard reference for Arduino, although newer versions have since emerged. The Uno board was the inaugural member of a series of USB-based Arduino boards and remains the benchmark model for the entire Arduino platform. For a comprehensive list of current, past, or obsolete boards, you can refer to the Arduino index of boards [10-11].

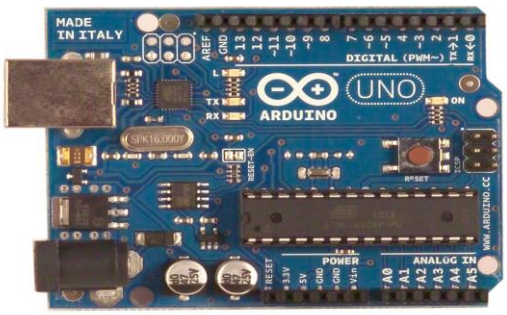

Figure 1. Arduino Ano

SIM900A GSM Module

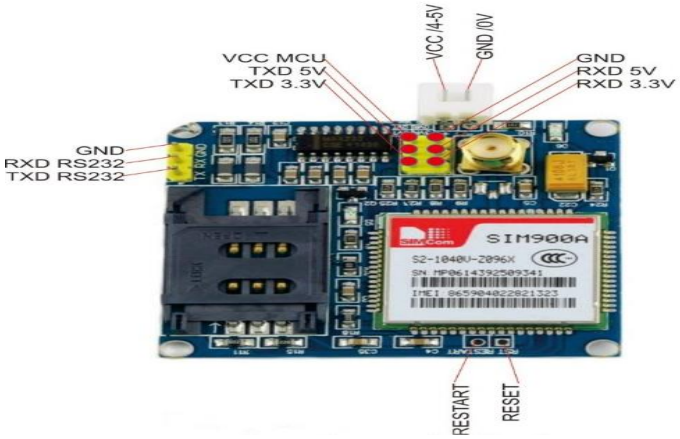

Figure 2. SIM900A Module

We will be using the SIM900A GSM module for this project. It's important to note that this GSM module, as shown on the screen, does not come with an onboard voltage regulator. Therefore, when applying voltage, caution is advised. The ideal voltage range for this GSM module is between 4.7V and 5V, although you can also connect it to a 5V adapter [11]. It's crucial to stay within this voltage range, as voltages higher than 5V can potentially damage the GSM module. If you don't have a regulated 5V adapter, you can alternatively use an LM317T adjustable voltage regulator. There's a comprehensive tutorial available for this, and you can watch the video for more details. While the SIM900A module has numerous pins, we will only be utilizing five of them: the power supply pins, GND, Rxd 5V, and Txd 5V. Specifically, the GND of the GSM SIM900A module will be connected to the Arduino's GND, TXD of the GSM SIM900A will be linked to Arduino pin 7, and finally, the RXD of the GSM SIM900A module will be connected to Arduino pin 8.

Neo 6M GPS Module used in Car accident location tracking

Figure 3. Neo 6M GPS Module

This is the Neo-6M GPS module that we are going to use it in this project. This GPS module can be interfaced with the Arduino using VCC, rx, tx, and gnd. For the easy interfacing, we will need to solder 4 wires with this Neo 6M GPS module.
The Neo 6M GPS module needs 3 to 5v. We will use the Arduino's 5v and its default baud rate is 9600 which we will be using in the programming.

Circuit Diagram of the Car accident location tracking

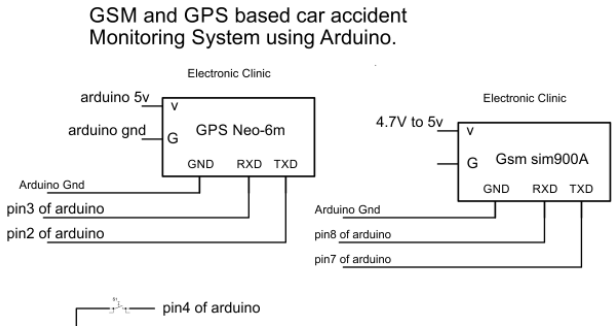

Figure 4. This is the complete circuit diagram of the Arduino GPS car accident location tracking system.

This schematic illustrates how we connected our devices to create a more efficient system. The interfacing of the Neo-6M GPS and GSM SIM900A modules with Arduino is straightforward.
In the circuit diagram, you can observe that the VCC of the GPS module is linked to the 5V supply, Rx is connected to Arduino pin 3, tx is connected to Arduino pin 2, and Gnd is connected to Arduino's GND. For the SIM900A module, tx is connected to Arduino pin 7, Rx is connected to Arduino pin 8, and it is also connected to Arduino's GND. A power supply is linked to the SIM900A, and the ideal voltage range is between 4.7V and 5V. Additionally, a limit switch is attached to Arduino pin 4. When the limit switch is activated, it sends a "0" signal (GND) to Arduino, indicating that the car has been impacted.

RESULTS OF THE PROPOSED WORK

OVERVIEW and WORK EXPLANATION

The proposed project is considered an example for robotic fabrication, aiming to design a sort of Arduino tool and understand how Arduino works.
In this project, Arduino is used for controlling whole the process with a GPS Receiver and GSM module. GPS Receiver is used for detecting coordinates of the vehicle, GSM module is used for sending the alert SMS with the coordinates and the link to Google Map. We have used GPS Module NOE and GSM Module SIM900A.

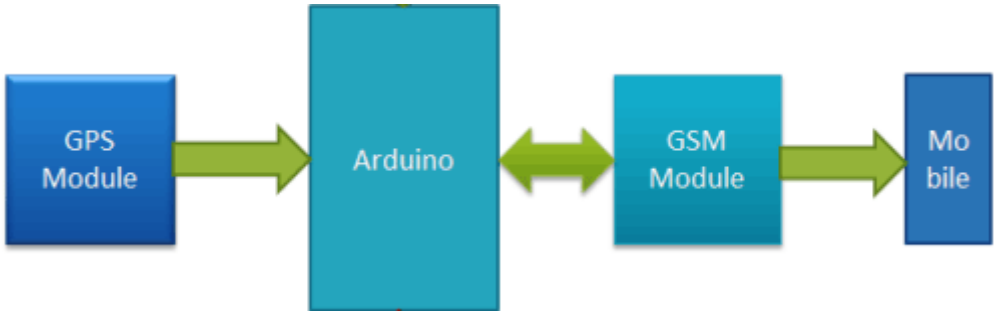

Figure 5. Block diagram of the process

When we are ready with our hardware after programming, we can install it in our vehicle and power it up. Now whenever there is an accident, and the limit switch is pushed.

These values read by Arduino and checks if the value of the limit switch is zero or one. If any change occurs, then Arduino reads String from GPS module data (GPS working explained above) and send SMS to the predefined number to the police or ambulance or family member with the location coordinates of accident place. When we receive the message then we only need to follow the coordinates and we will redirect to the Google map and then we can see the exact location of the vehicle.

The results

After the connection process for all the parts that were mentioned above, we carried out the process of downloading the program to the digital control board that was mentioned above as well, thus we have an integrated system that can now be tried. We charged the SIMCARD with the balance because the car must send messages about the occurrence of accidents and therefore the SIMCARD must have enough balance and also must be activated in order not to have any error during the connection to the network. The following figure represents the car parts that have been mentioned previously, as well as the whole car can be observed.

Figure 6. Limit switch

Figure 5 represent the limit switch that will be used to identify the microcontroller that an accident happened in some area around the area of converge**.** The limit switch is located in front of the car which means that when the car hits something the limit switch will be closed and send a zero signal to the microcontroller and the microcontroller leads to communicate with the GSM and the GPS boards to get the information about the location of the car and sending message to the assigned phone number.

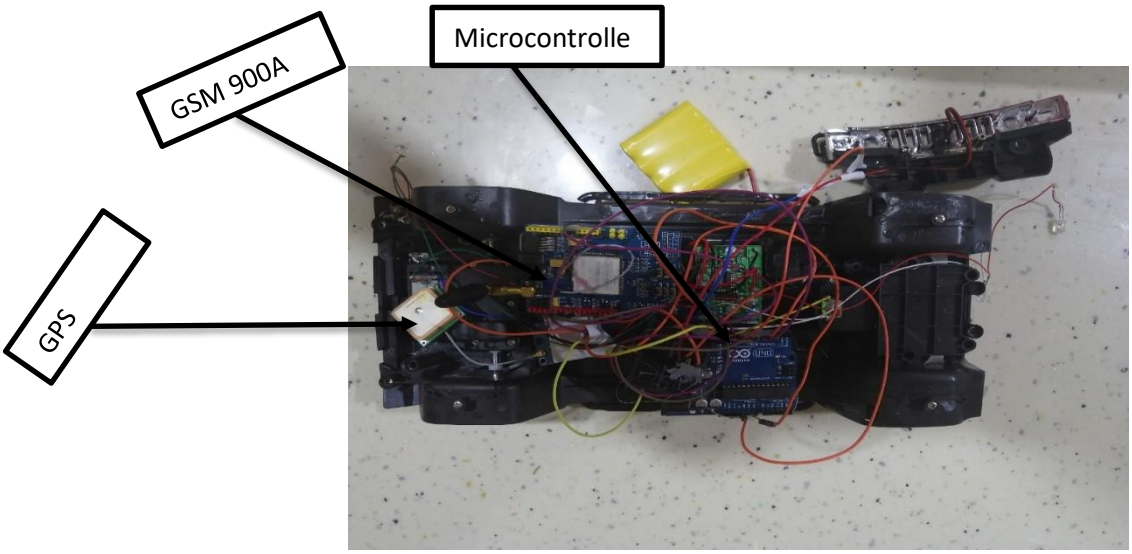

Figure 7. A complete setup of the system

Figure 8. The assembled car

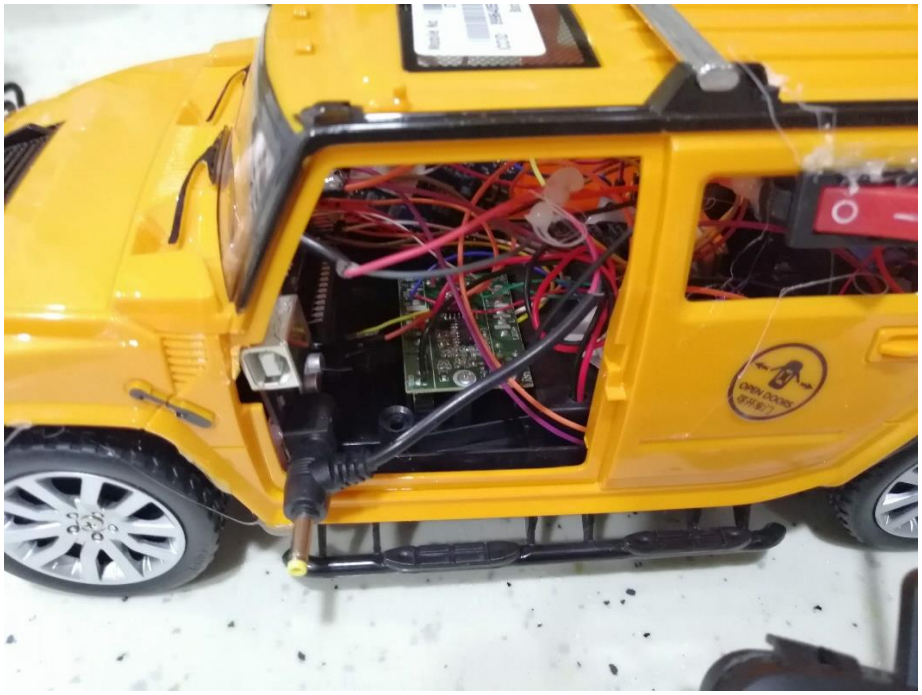

Figure 9. the assembled car from inside

CONCLUSIONS AND FUTURE WORKS

CONCLUSIONS

A GPS module is set, to get position data and also the 3G module, which sends the SMS request with the coordinates of the car. It starts to send the SMS request every hit of the car as the limit switch in front of the car send zero voltage to pin 4 with data of the position (latitude and longitude).

When you find your car, you only have to reset your Arduino and it is ready to work again.

In this project we have related one of the application of vehicular networking using Arduino the important components that are used are briefed. This model of car tracking exists in real time which uses gps. The new innovation here is using the same in cabs for safety issues and also using this connection to link to the indicators of the car so as to blink on calling the SIM900. This model will sound the alarm which is produced in the form of a button.

FUTURE WORKS

The future works to this project is by applying a call alarm addition to SMS alarm. Also, we can connect with internet HTTP along with the GSM services.

REFERENCES

1) Prabha, M., Seema, M., & Saraswathi, P. (2015). Distance based accident avoidance system using Arduino. International Research Journal of Engineering and Technology (IRJET), 2(07), 777-780.
2) Vairavan, R., Kumar, S. A., Ashiff, L. S., & Jose, C. G. (2018). Obstacle avoidance robotic vehicle using ultrasonic sensor, Arduino controller. International Research Journal of Engineering and Technology (IRJET), 5(02).
3) Mahamud, M. S., Monsur, M., & Zishan, M. S. R. (2017, December). An arduino based accident prevention and identification system for vehicles. In 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC) (pp. 555-559). IEEE.
4) Kaur, P., Das, A., Borah, M. P., & Dey, S. (2019). Smart vehicle system using arduino. ADBU Journal of Electrical and Electronics Engineering (AJEEE), 3(1), 20-25.
5) Yadav, V., Teli, A., Darvesh, G., Baraskar, R., & Kumar, M. (2020). Smart Road Safety and Vehicle Accident Prevention System for Mountain Roads. International Research Journal of Engineering and Technology, 7(2), 2916-2919.
6) Rana, S., Faysal, M. R. H., Saha, S. C., Noman, A. A., & Shikder, K. (2021, January). Road accident prevention by detecting drowsiness & ensure safety issues. In 2021 2nd international conference on robotics, electrical and signal processing techniques (ICREST) (pp. 348-352). IEEE.

7) Sharif, M. A. (2022). PVC gel smart sensor for robotics sensing applications: an experimental and finite element simulation study. Engineering Research Express, 4(3), 035029.
8) Yadav, H., Varshney, M., Gupta, H., & Pal, H. C. (2019). Design and Implementation of Advance Accident Prevention System for Reducing the Cause of Death. International Journal of Radio Frequency Design, 5(1), 1-5.
9) Lei, H., Sharif, M. A., Paley, D. A., McHenry, M. J., & Tan, X. (2016, April). Performance improvement of IPMC flow sensors with a biologically-inspired cupula structure. In Electroactive Polymer Actuators and Devices (EAPAD) 2016 (Vol. 9798, pp. 418-426). SPIE.
10) Islam, M. H., Khandoker, A. A., Sami, T. S., Talukder, T. I., Rahman, M. I., & Sarkar, P. K. (2021, August). Car Accident Prevention And Health Monitoring System For Drivers. In 2021 IEEE Region 10 Symposium (TENSYMP) (pp. 1-6). IEEE.
11) Sharif, M. A., & Tan, X. (2018, March). IPMC flow sensor exploiting self-generated vortices. In Electroactive Polymer Actuators and Devices (EAPAD) XX (Vol. 10594, pp. 269-277). SPIE.
12) Jadhav, S., Nair, S., Vidhrani, S., & Roychowdhury, S. (2020). IOT based Accident Prevention and Detection System using GSM-GPS Eye blink and Alcohol Sensor. Int. J. Res. Appl. Sci. Eng. Technol, 8(5), 771-776.