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An Intelligent System for Disaster Relief and Management on Roads

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ABSTRACT

This study's objective will be to provide model method for disaster relief and management in order to provide services and distress in a timely manner. The data will be acquired via the sensors. The proposed system is based on the fire and collision sensor and detecting the drivers condition, so in case of an emergency a sound alert will be issued, and the GSM unit will send the distress type to a web server where it is saved in the database, and the appropriate rescue unit is pushed, in addition to an alert message to the accident site for approval On the distress request and the time of arrival of the rescue unit to an incident.

Keywords: Arduino, GPS, Google Map, GSM, Flame Sensor,Ultrasonic Sensor, MQ-3 Sensor.

I. INTRODUCTION

The incidence as a result of increased traffic and careless driving, the number of accidents on roads has risen. The risks of highway and traffic disasters have also risen due to the strong market and delivery of automobiles. Collisions have greatly increased the risk to human life. It is because the greatest crisis services are not easily obtainable. most of these incidents, included the deceased' families, either the police force or the rescue never notified inside a timely manner. It leads to delays inside the survivors' rescue efforts of the accident. It is difficult or almost impossible to find accident locations due limited data concerning the accident's cause and position. [1].

As a result of the overall rise in metropolitan population, many issues have arisen. These difficulties involve emergency response and instability. However, this is important for innovative and successful emergency relief techniques be implemented. [2].

Disasters, whether person or environmental, can significantly harm people's lives, at whatever day and anywhere, technology and the ecology The IFRC has identified result in data catastrophes over the last two decades, including floods, volcanoes, and storm surge. [3].

the newest networking, business, and business intelligence solutions, including Cloud computing, " internet of things ", data storage, and cloud computing, and others, are on the verge of giving disaster management systems access to a variety of obtain the following of evidence, such as quick but also affordable data preparation methods which can be used to strategic planning over all four stages of an accident (i.e., mission, feedback, prevention and adaptation). This same efficacy of such an emergency relief system is measured by useful or sentence using accurate and relevant data during any crisis. [4].

A spacecraft tracking system known as GPS, or "Global Positioning System," employs the geographic coordinates system to pinpoint the precise location of a GPS module. The latitudes and longitudes are included in the GPS coordinates.[5].

Emergency response tied political leaders, academics and professionals have been attempting to improve the emergency relief systems through exploring innovative ideas gathered from different analysis bunches, like as digital technologies, geomatics, biosciences, and earth studies. Our overall objective is to improve the stages of systems of disaster management which obtain, handle, evaluate, and display data for fast and precise choice. Such a concise and instant life choice limits for such systems of disaster management involve the application and inclusion among many government technologies to assist the activities innovatively.[6]. shows the various disasters on the roads figure (1)

Fig.1. The various Disasters on the roads

II. RELATED WORK

Had presented a high - altitude disaster response system, termed EagleEYE, that actually uses cloud technology and deep learning to recognise disaster activities in real. EagleEYE decrease education period through creating an entity processing framework that allows remaking datasets. Additionally, EagleEYE way particular the recognition activities to allow for in-the-moment response. Finally, EagleEYE is reviewed together in on using or the data shows that EagleEYE can minimise the inductive runtime through 90% with a detection rate high precision of 87% [7].

Had suggested a vehicle monitoring system that uses GPS. This hardware for the suggested method includes a GPS receiver, a microprocessor, and a GSM modem for a SIM card. To communicate the necessary data to the other end, where the tracker is located, the equipment was integrated inside the tracked vehicle as a transmitter component. A Matlab-created graphic user interface (GUI) makes up the receiver portion. [8].

Had created a system which might improve the safety of public buses across instant monitoring and surveillance. The Microprocessor is a Software Global positioning sender with GSM and General packet radio service were all used in the system's development. The location is regularly retrieved and its coordinates are compared to the database's known name and inventory. The same procedure is carried out repeatedly until either the school bus comes or a false turn is discovered. When the system detects a problem, it alerts the owners through GSM SMS about the incorrect course of action. [9].

Had introduced intelligent transportation system (ITS) in their work titled smart disaster required to show using Global positioning system, Mobile network modem. The project is simply a proposal about how to find a position data, contact with the server computer, and make the web host find the next vehicle to the disaster scene, but then communicate the precise position of the disaster here to ambulance. The traffic light is regulated by the control unit to pass the ambulance while offering the quickest route to the nearby medical centre via an RF signal, saving time. [10].

Had Proposed tracking system which has used the gps coordinates to pinpoint an object's precise location, user and or asset to something that is connected including using Gsm technology, the said data can be communicated to a wireless device. The GSM/GPS modem's operations were coordinated by an ARM CPU in the design. Sending an SMS to the system can be used to control it. The GSM/GPS provide position data to a remote monitoring system, real-time tracking, the ability to inspect the monitored system's activities, and instantaneous communication are some of the features of this work, however it fails to describe how the crashed is discovered. [12].

Had developed disaster response system utilising techniques such as automotive ad hoc networks (Hetnets) and data storage to concoct town emergency methods. Later, this same concept has been expanded to include deep learning-based traffic control strategies enabling smart buildings. Based on machine learning over massive data along with catastrophe circumstances has high and urgent computing needs that were addressed by in-memory calculations and graphics processing units (GPUs). This study builds on our past work by offering a more thorough examination and system findings. A suggested system architecture uses GPU-based deep learning calculations with in-memory massive data management. We utilised road traffic information that was made accessible to the public according to the UK Ministry of Transport. Similarly outcomes demonstrate how well the deep learning methodology predicts traffic behaviour in emergency and expulsion circumstances. The initial is this catastrophe management method to combine transfer learning, throughout computation calculations, and Graphics card technology. [13].

Had implemented the emergency relief system like a phone app that used Search Android system. MyDisasterDroid, an Android software for disaster management, finds the best path for volunteers and rescuers to travel along various geographic regions with to reach this same largest number of individuals as well as cover the greatest area in the least amount of time. To find the most ideal path, the technique used for tuning, although variables could also be altered. [14].

Had put in place an IoT system to identify accidents. One of three situations, comprising tilt, vibration, and the separation between the two items, were taken into account by this method. The individual who signed up for the communication receives it right away. Additionally, the GPS antenna aids in providing the police with the precise location of the accident [15].

Had developed an Arduino-based car tracking system that uses GSM and GPS to follow a vehicle's precise location in real time, whether it is moving or still. the position of a vehicle's geographic coordinates as determined by a gadget within the vehicle. It appears that a cell phone was used to access Google Maps and locate the car precisely. [16].

III. THE PROPOSED SYSTEM

The proposed system is designed to provide an effective means of disaster management and monitoring of vital incident data for timely reporting of emergencies. The data will be recorded using the sensors. The proposed system focuses on the fire and collision sensor based on the distance of the obstacle, triggers an audible alarm, detects the condition among drivers, and sent the a message to the server containing a measured values of the degree of fire, gas, obstacle distance, and location of the accident scene to the nearest department, and the department pushes the nearest rescue unit. After arriving at the scene. In addition to sending an alert message to the people at the accident site on the LCD screen by responding to the request and the time of the rescue team's arrival. The proposed system consists of three main stages: measuring the degree of fire, collision based on obstacle distance and alcohol percentage, and sending and receiving notifications via a web server and an LCD screen. People can also send a disaster type SOS through their account profile. The Block Diagram of the suggested system seen in figure (2).

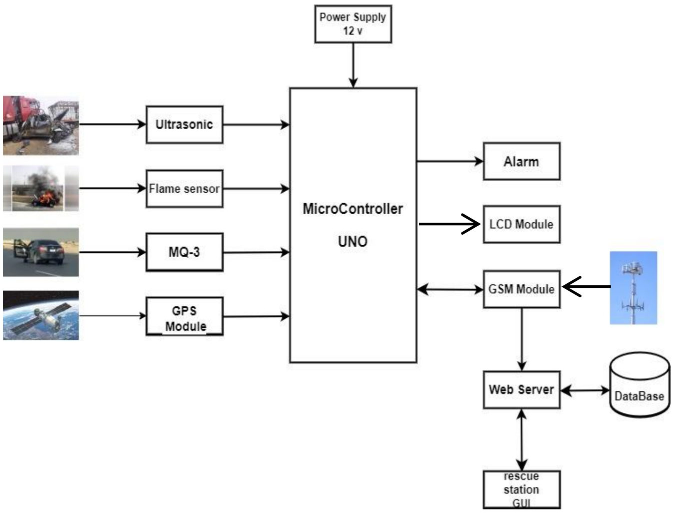

Fig.2.Block diagram of suggested system

Proposed system has three main stages:

1. Measurement of sensors(Disaster detection).
2. Getting the current location for patient using GPS module.
3. Sending and receiving notifications via web server and LCD Module. . Figure (3) depicts the proposed system's flowchart.

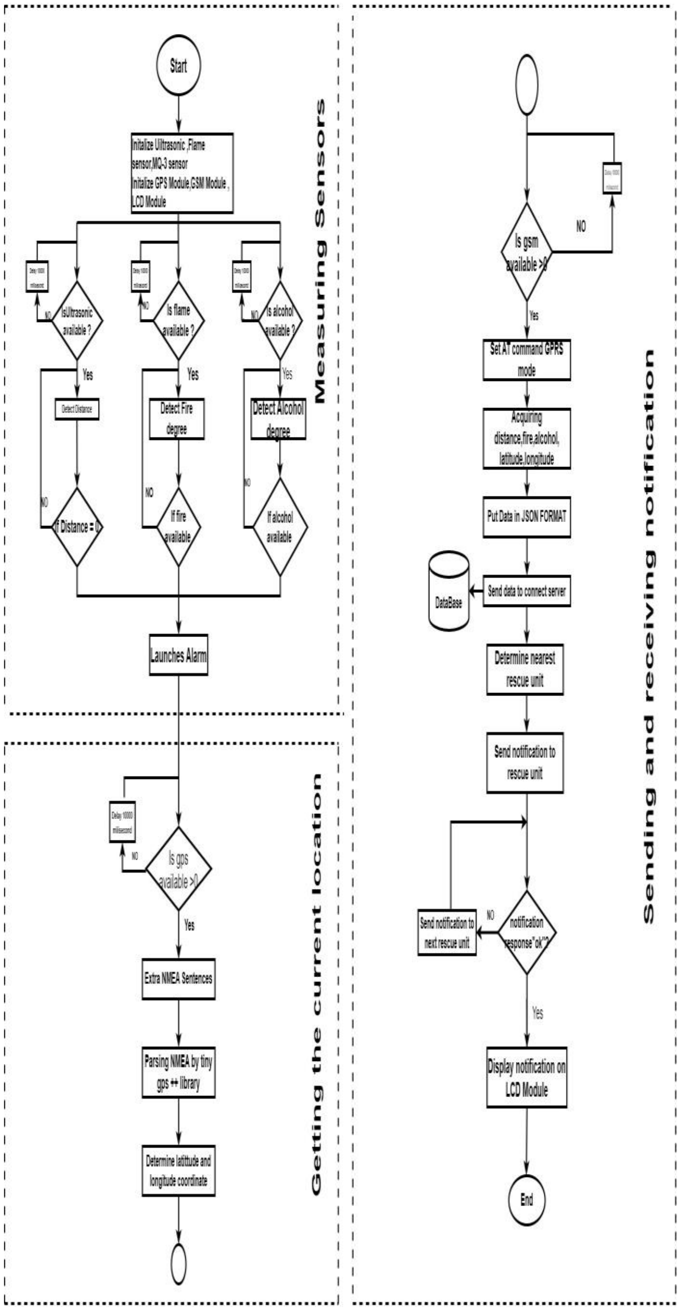

Fig.3.Flow chart of suggested system

Circuit consists of the distress and disaster management method shows that the distress system is made up of eight components, as displayed in Figure (4).

- **Flame sensor**
  It is used to determine the fire.
- **Ultrasonic sensor**
  It is used to determine the Distance.
  MQ-3
  It is used to determine Alcohol.
- **Buzzer sensor**

  It is used to determine Alcohol .

- **LCD Module**
  It is used to display the message.
- **Buzzer sensor**
  It is used to sound an alarm for the student in the event of a distreasee in the road.
- **GPS module**
  It is used to get the accident's coordinates.
- **GSM module**
  It is used to send the measured data .
- **Arduino shield**
  It is used to connect and control for all component connect to.

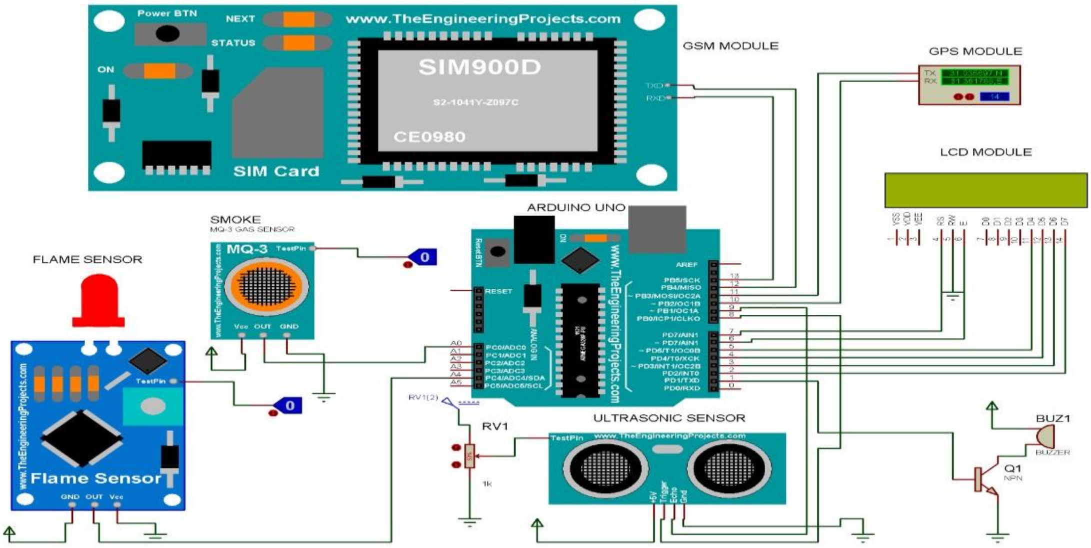

Fig.4. The Schematic for distress and disaster management system.

3.1 Measurement of sensors(Disaster Detection)

The objective of this stage is to measure sensors and detect various disasters. This stage consists of three main sections:

- **Collision Based on Obstacle Distance**

Here ultrasonic sensor is used, the rationale for selecting an ultrasonic sensor It is used to identify an obstruction that is close to the vehicle and is operated without being impacted by direct sun. It also has a high level of precision as well as reliable passages. The range of the sensor in this prototype model is 2 cm to 400 cm. An ultrasonic sensor is made up of four pins: Voltage, Ground, Echoes, and Trigger. The Ground port is linked to the ground of the Node MCU, . A Echo and Trigger connections are linked to the Arduino board's electronic i/o ports. This trig must be put to a high state in order to generate the ultrasound, and the echo pin will pick up the sound. [17].

Fig.5. Ultrasonic Sensor

We can calculate the distance between the two vehicles by using the formula

Distance=(0.034 *time)/2

- **Fire**

Here flame is used, This unit is sensitive to flame and radiation. It can also detect ordinary light source in the wavelength range of 760nm-1100nm. It can be used as a flame alarm or in firefighting robots..

Fig.6. Flame Sensor

- **GAS Sensor**

In this mq3 detector can be used, Because the conductivity of the mq3 sensor increases as alcohol concentration rises and because of its high sensitivity and quick response time, it is particularly useful. Three of the four pins of a gas sensor are typically used. A0 is an analogue pin attached toward the analogue lock of the Micro Controller. Ground pin is attached to GND, and the VCC stock is 3.3 volts. [18].

Fig.7. MQ-3 Sensor

Once a value is obtained from the sensors, the specified threshold is applied.

If the value of the sensors is in the permissible range, then there is no response from the proposed system, and if the value of the sensors is equal to the threshold, there is a transition to the second stage.

3.2 Getting the current location

The aim of this stage is to determine the current location of the accident. This stage is based on the Arduino uno microcontroller and the GPS Neo 6m Module. The schematic for this stage as shown in figure (9).

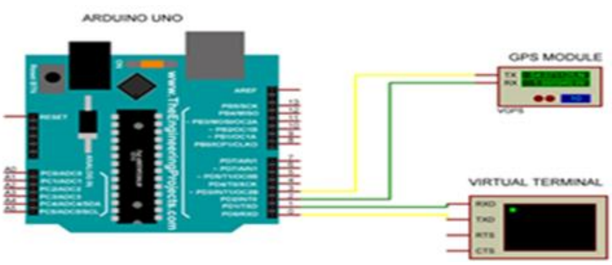

Fig.9. Schematic for getting the current location

The accident's GPS coordinates will be the data to be gathered. A system of devices called the Global Positioning System (GPS) is used to determine in space that transmits precise and error-free locations. It's significant since it has the capability of determining position in three dimensions: longitude dimensions, altitude dimensions, and latitude dimensions..

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Accident coordinates are extracted using the GPS Neo 6m Module. GPS Neo 6m Module as shown in figure (10).

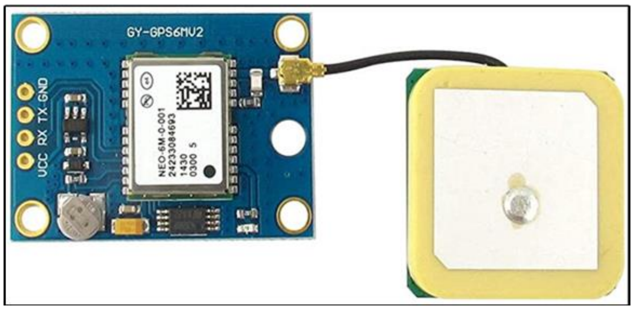

Fig.10. GPS Neo 6m Module

The specifications of GPS module are:

- GPS module receiver that requires a power supply between 2.7 and 3.6 volts.
- This is a u-blox 6 50-channel positioning system with over 2 million effective correlators.
- An EEPROM for saving settings is a crucial feature, as is the 25x25 ceramic antenna.

The GPS Neo 6m Module extracts GPS data in the form of NMEA sentences (National Marine Electronics Association).

NMEA clauses provide specifications that describe the interaction between various electronic equipment. This standard allows computers and other marine equipment to communicate with marine electronic devices. The connection to the GPS receiver is also defined in this specification. NMEA data is understood by the vast majority of computer systems that provide real-time location and navigation. The above NMEA records contains the full location, speed, and current time that is processed either by Gps system. Each National marine electronics statement must initiate to "$ and not be longer than 200 words, such as path endings. The data portions of these statements are separated by commas [19]. The following table (1) shows GPS NMEA sentences.

After getting the GPS NMEA Sentences from the GPS unit utilised in the current stage, an analysis is performed on these sentences using the TinyGPS++ Library to determine the accident's current location.

TinyGPS++ is an Arduino library for processing NMEA data streams, which is provided by GPS modules. It is the direct inheritor of TinyGPS. The library contains methods for quickly and easily obtaining time, location, timeline, rate, direction, and angle from Satnavs. The library can extract all of the data from the two most popular NMEA statements, $GPGGA and $GPRMC.

The Encode () In order for TinyGPS++ to work, this function is utilised to channel characters from the GPS module on a regular basis. Flow chart for extracted coordinate from GPS as shown in figure (11).

Table 1. GPS NMEA sentences extracted from prosed system**.**

S. NO.	Sentence	Description	Value of Proposed System
1	$GPGGA	Global Positioning System Fix Data.	014522.00,3102.70957,N,03124.27719,E,1,05,3.61,19.3,M,17.5,M,,*67
2	$GPGLL	Geographic position, latitude/ longitude.	3102.70957,N,03124.27719,E,014522.00,A,A*6B
3	$GPGSA	GPS DOP and active satellites.	A,3,19,20,17,05,30,,,,,,,,4.76,3.61,3.10*0B
4	$GPGSV	GPS Satellites in view.	3,1,12,05,16,228,16,07,00,101,,12,07,238,20,13,83,259,21*79
5	$GPRMC	Recommended minimum specific GPS/Transit data.	014523.00,A,3102.71121,N,03124.27632,E,6.922,337.86,260621,,,A*6A
6	$GPVTG	Track made good and ground speed.	337.86,T,,M,6.922,N,12.819,K,A*08

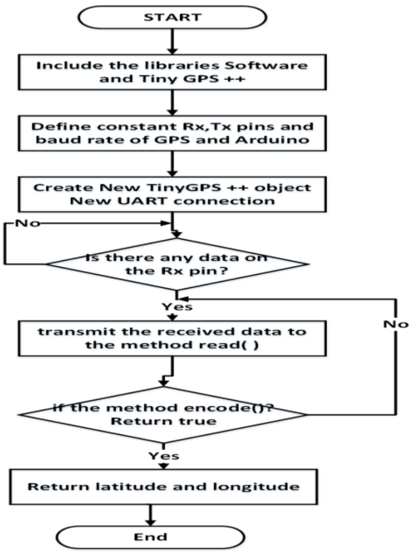

Fig.11.Flow Chart for extracted coordinate from GPS**.**

3.3 Sending and receiving data via server

After determining the type of disaster using the specified sensors (ultrasonic,flame,mq-3) and extracting the coordinates of the incident using the GPS 6M module, it sends a post request as a JOSN object to the server. The JOSN object contains information such as the type of disaster, latitude and longitude, and the chip serial number. The process of sending data to the connected server as shown in the figure (12).

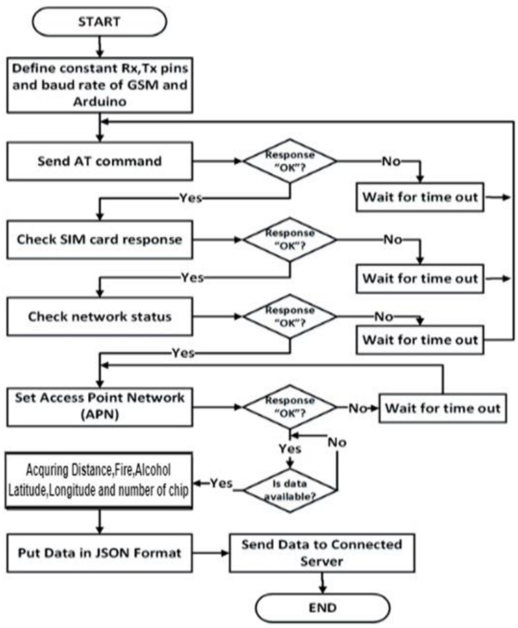

Fig.12. Flow Chart for sending data to a connect server

The data is received from the connected server, then the key value is extracted from the JSON object, the nearest rescue center to the accident is determined based on the rescue center data stored in the database, and finally, a notification is sent to the nearest rescue center . The flow chart for receiving data from a connected server as shown in figure (13).

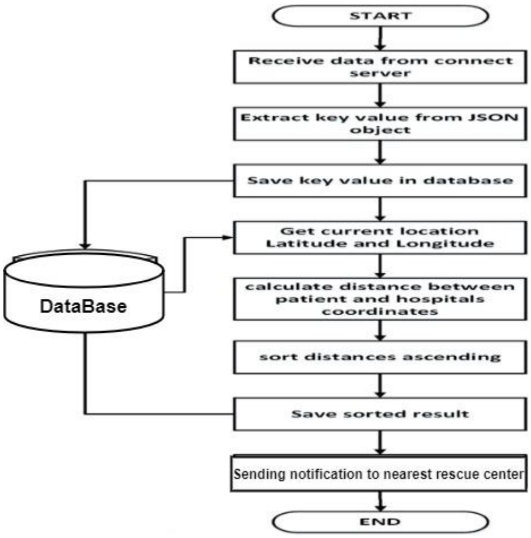

Fig.13.Receiving data from connected server

The notification contains the type of disaster, the time of the disaster, and the serial ID of the device.

After the request is sent to the server a request is sent to the web of the nearest rescue unit with a delay time of 10,000ms. The message sent contains the type of distress and the current location of the incident. If the response from the rescue unit was with the keyword “OK”, an alert message is sent to the LCD located at the scene of the accident containing the time of arrival of the rescue unit, and in the event that the rescue unit rejects the request by sending the word “No”, the first message is sent to the next nearest rescue unit, Disaster management is handled in this manner until the request is accepted.

The distance is calculated by the following equation [20] and the following table (2) shows the coordinates of the rescue units and calculates the distance to the nearest rescue unit.

$$d = 2r\ arcsin\sqrt{sin^2\left(\frac{\varphi2-\varphi1}{2}\right)+cos(\varphi1).cos(\text{Ø}2).sin^2\left(\frac{\psi2-\psi1}{2}\right)}$$

Where :

d : the Distance (km).

r : the earth's radius, which is 6371 (km).

φ : the Latitude.

ψ : the Longitude.

This stage is based on the Arduino uno microcontroller and the GSM SIM800L Module. Schematic for sending data to a connected server as shown in figure (14).

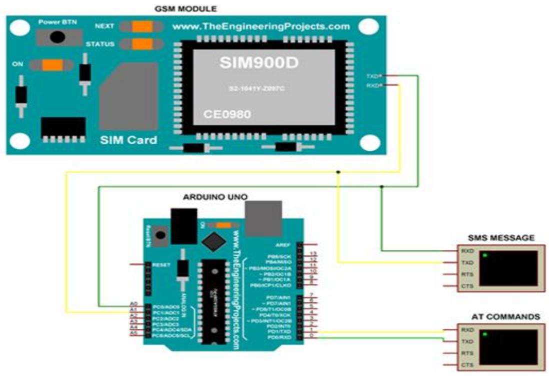

Fig.14. Schematic for sending data to connected server

A post request will be sent at this stage using the GSM SIM800L Module. The GSM SIM800L Module as shown in figure (15).

Fig.15.GSM SIM800L Module

Approach Global System for Mobile Communications is referred to as GSM. It is produced through the European Telecommunication services Issue Of high (ETSI). It is a small cellular module called A SIM800L. Its compact size and affordable price are the distinguishing features of the GSM Sim800L.The specifications of the GSM SIM800L Module are:

- Voltage range: 3.8 to 4.2.
- Module dimensions are 25 x 23 cm.
- The temperature range of -40 to + 85 ° C.
- Micro-SIM is the type of SIM card that may be used and AT instructions are used as the interface.
- Frequencies supported 850/950/ 1800/1900 MHz .

This GSM SIM800L Module is operated by the AT Command. AT commands are control instructions for GSM modems. The letters "AT" are the first part of every command. The GSM modem is indicated at the beginning of the command line by the prefix AT.. The AT commands are used in the proposed system to send data to the connected server are shows in Table (3).

Table 3. AT Commands**.**

AT Commands	Description
AT	Check the status of the modem
AT+HTTPINIT	Start HTTP service
AT+HTTPTERM	Stop HTTP Service
AT+HTTPPARA	Set HTTP Parameters value
AT+HTTPACTN	HTTP Method Action
AT+HTTPHEAD	Read the HTTP Header Information of Server
AT+HTTPREAD	Read the response information of HTTP Server
AT+HTTPDATA	Input HTTP Data

IV. APPLICATIONS AND OUTCOMES

The primary objective of the suggested system will be to send an SOS in the event of a disaster (fire / collision / an abnormal condition for drivers), transfer the information obtained from the scene of the accident using sensors, obtain the current position of the disaster, send a notification toward the nearest relief unit, as well as finally send an alert to the scene of the accident At the time of arrival of the rescue team, The suggested system is represented in Figure. (16).

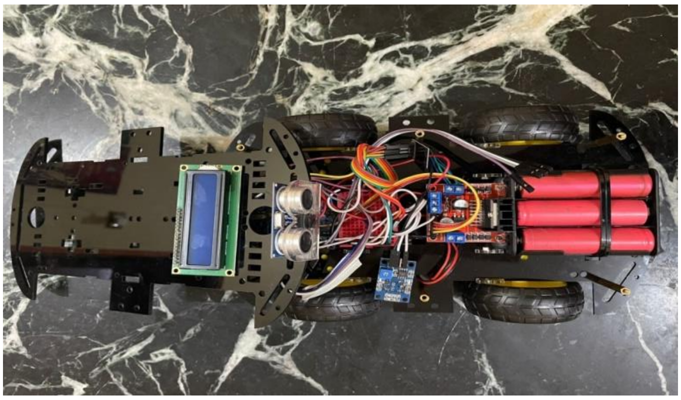

Fig.16. Implementation of the suggested system.

Nearest rescue unit received a distress notification from the proposed distress device that includes the type of disaster, the time and date of the disaster, as shown in the figure (17).

Fig.17. nearest rescue center received notification on the webpage.

To confirm the response to the distress request, a notification page containing the type of disaster as well as its current location and navigation through directions on Google Maps is entered, as shown in Figure (18).

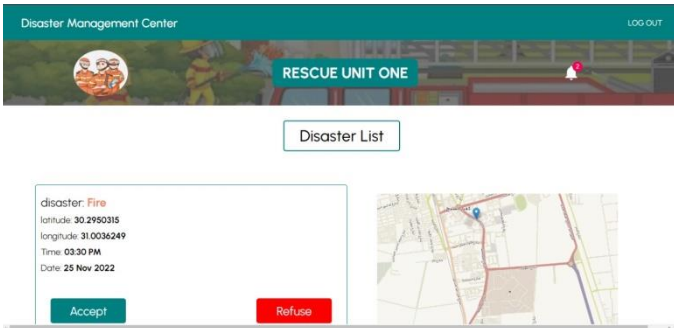

Fig.18. webpage of confirm response to distress request.

If the nearest rescue unit is not ready to receive the accident, the notification is automatically sent to the next rescue unit in terms of the nearest distance as shown in Figure (19).

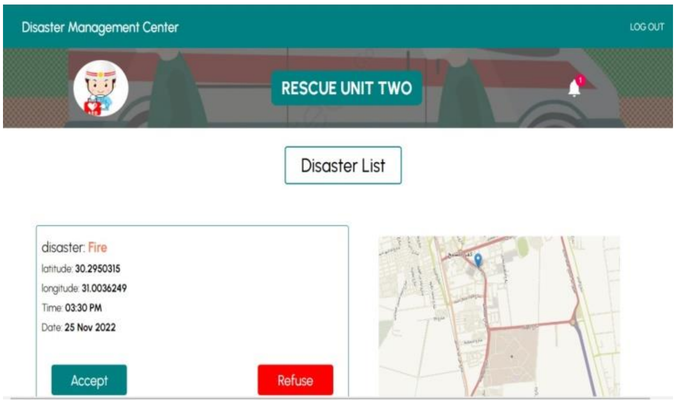

Fig. 19. Next nearest rescue .

After sending a communication to the nearest rescue unit, and its approval of this request, a notification will be sent to the scene of the accident on the LCD, including the response, and the arrival time of the rescue center. of demand as shown in Figure (20).

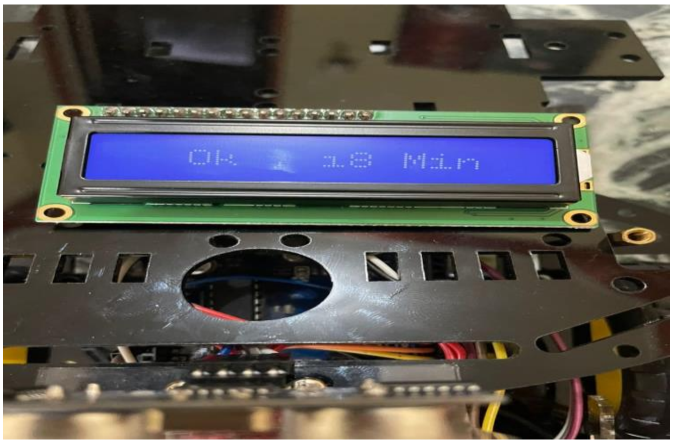

Fig:20. Display notification on the LCD screen.

In the event that someone wants to report a disaster in the current location. If he does not have an account, he registers.as show in Figure (21)

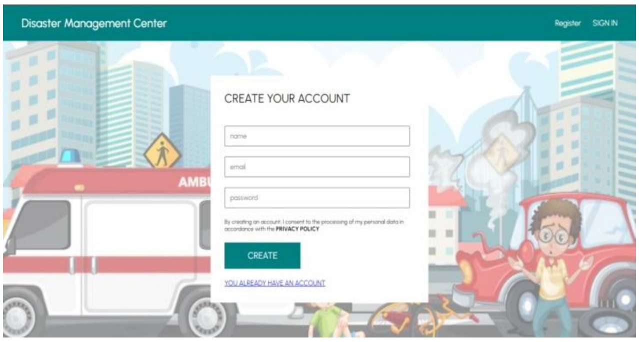

Fig:21. Create an account

In the event that the person has an account, he logs in and reports the problem. as show in Figure (22)

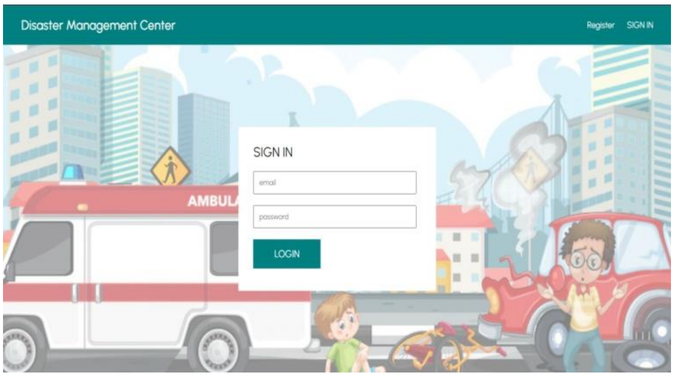

Fig:22. Login screen

After entering the person's account, he starts by determining the type of problem and confirming it. The request is sent to the rescue unit, along with the type of disaster, the current location, and the time and date of the disaster. as show in Figure (23),(24),(25)

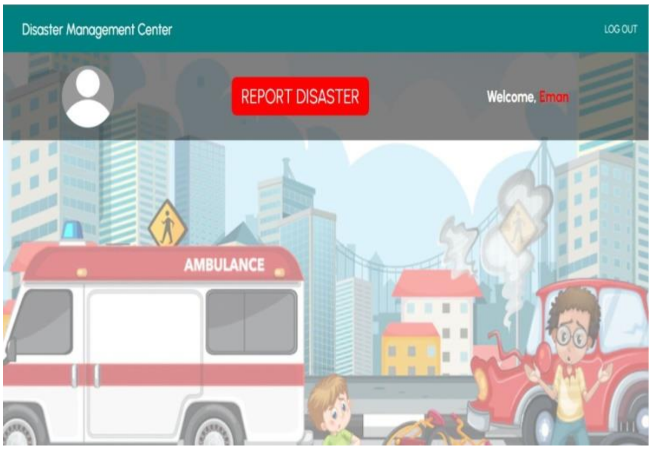

Fig.23. Profile screen

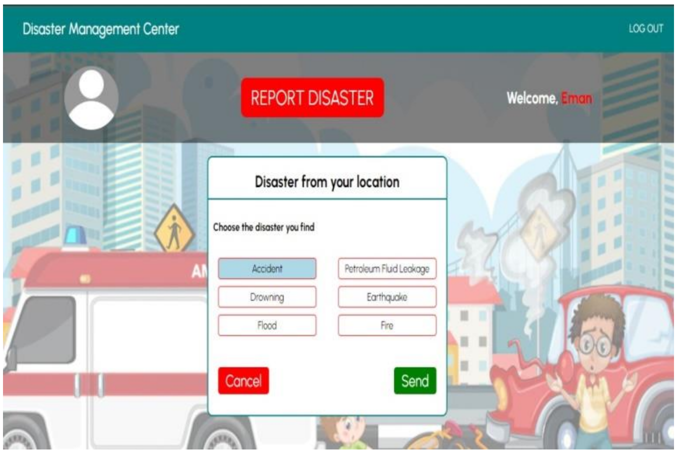

Fig:24. Choose the type of disaster

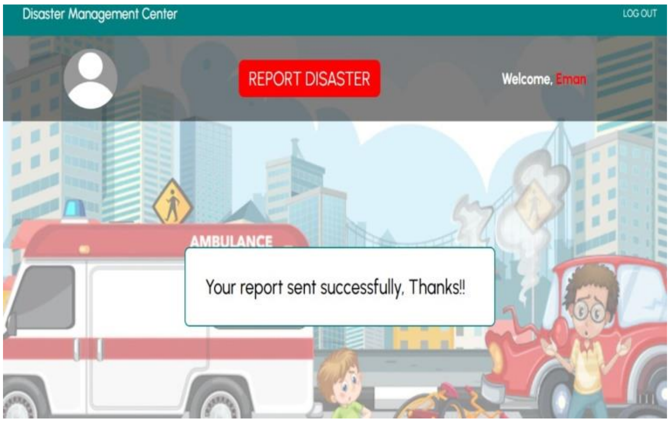

Fig:25. Confirm and send the type of disaster

Table 2. Rescue Center coordinate and calculate distance to nearest rescue center.

NO	Rescue Center	Latitude	Longitude	D
1	Rescue Unit 1	31.041676	31.376746	8.02
2	Rescue Unit 2	31.055096	31.380351	16.6
3	Rescue Unit 3	30.884375	31.461521	16.97
4	Rescue Unit 4	30.715572	31.260711	17.56
5	Rescue Unit 5	31.215113	31.364485	25.26
6	Rescue Unit 6	30.969610	31.166945	26.71
7	Rescue Unit 7	31.196885	31.521303	30.41
8	Rescue Unit 8	31.085872	31.588890	32.2
9	Rescue Unit 9	31.114613	31.221597	36.56
10	Rescue Unit 10	31.114613	30.938618	39.12
11	Rescue Unit 11	31.311555	31.145352	39.49
12	Rescue Unit 12	30.786547	30.999872	39.89
13	Rescue Unit 13	30.576107	31.503799	50.44
14	Rescue Unit 14	30.464831	31.184646	54.04

The reliability of the location provided either by Global Positioning system was measured by comparing the location supplied by the Gps receiver toward the real location supplied by Google Map and noting the distance distinction.

The GPS module (Neo-6m GPS) used has a stated accuracy of 0.50m, and measurement of coordinate accuracy is calculated using the following equation [21]. Table (3) presents the results obtained and figure (26).

$$\text{Position Accuracy (\%)} = 100\% - \frac{\text{Actual Variation} - \text{Stated Variation}}{\text{Actual Variation}} * 100$$

Table 3. Measuring the Accuracy of the Coordinates.

Position	Actual Coordinates (Latitude, Longitude)	GPS Module Coordinates (Latitude, Longitude)	Variation in Distance (m)	Percentage Accuracy (%)
1	30.962118, 31.241217	30.962121, 31.241219	0.58	85.7
2	31.165955, 30.755309	31.165955, 30.755313	0.55	90.9
3	31.385035, 31.358789	31.385039, 31.358789	0.53	94.4
4	30.934284, 31.699526	30.934280, 31.699530	0.56	89.3
5	31.090780, 31.241871	31.090782, 31.241868	0.58	85.7

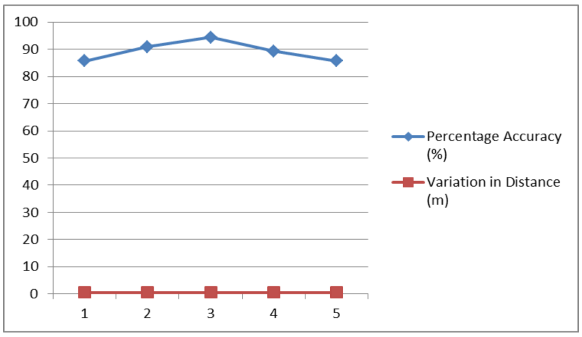

Fig.26. Variations in Distance and percentage for Accuracy GPS Coordinates

V. CONCLUSIONS AND FUTURE WORK

This paper proposes an intelligent distress and disaster management system based on the proposed techniques. Sensors are used to determine the detection of the disaster. The device starts transmitting as soon as a disaster occurs, the system determines the current location of the accident, and then notifications are sent through the web server containing the type of disaster, the location of the accident, and the chip serial ID of the nearest rescue center. The results can be modified in future work by applying the proposed system to different parameters such as earthquakes, floods and epidemics. The system can be developed to work on mobile phones.

IV. REFERENCES

[1] Abdulwaheed Musa et al., (2019) ,“ Vehicle Tracking and Accident Alert System Using GPS and GSM Modules”, ABUAD Journal of Engineering Research and Development (AJERD).

[2] Joel Poncha Lemayian and Jehad M. Hamamreh,(2020), “Autonomous First Response Drone-Based Smart Rescue System for Critical Situation Management in Future Wireless Networks”, RS Open Journal on ICT.

[3] D. Fisher, K. Hagon, C. Lattimer, S. O'Callaghan, S. Swithern, and L. Walmsley, “Executive summary world disasters report: Leaving no one behind”, Int. Fed. Red Cross, Geneva, Switzerland,Tech. Rep., 2018. [Online]. Available:https://media.ifrc.org/ifrc/wpcontent/uploads/sites/5/2018/10/B-WDR-2018-EXECSUM-EN.pdf.

[4] V. Hristidis, S.-C. Chen, T. Li, S. Luis, and Y. Deng, “Survey of data management and analysis in disaster situations”, J. Syst. Softw., vol. 83,no. 10, pp. 17011714, 2010.

[5] Muhammad Waleed et al. ,(May 2020), “ Determining the Precise Work Area of Agriculture Machinery Using Internet of Things and Artificial Intelligence ” , MDPI AG in Applied Sciences , Vol.10, Issue 10 , pp.1-12.

[6] V. Hristidis, S.-C. Chen, T. Li, S. Luis, and Y. Deng, ‘‘Survey of data management and analysis in disaster situations”, J. Syst. Softw., vol. 83, no. 10, pp. 1701–1714, 2010.

[7] Ardiansyah, M.F., William, T., Abdullaziz, O.I., Wang, L.-C., Tien, P.-L. and Yuang, M.C. (2020). “EagleEYE: Aerial edge-enabled disaster relief response system”. [online] scholar.nycu.edu.tw.

[8] S. Almishari, N. Ababtein, P. Dash, and K. Naik (2017). “An Energy Efficient Real-time Vehicle Tracking System”. IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PACRIM).

[9] P. A. Shinde and Y. B. Mane (2015). “Advanced vehicle monitoring and tracking system based on Raspberry Pi”. Proceedings of 2015 IEEE 9th International Conference on Intelligent Systems and Control, ISCO.

[10] S. Sonika, K. Sathiyasekar, and S. Jaishree. “Intelligent accident identification system using GPS, GSM modem”. International Journal of advanced research in computer and communication engineering, vol. 2: Feb, 2014.

[11] A. Khan and R. Mishra. “ GPS-GSM based tracking system”. International Journal of Engineering trends & technology. Volume 3: 2012.

[12] Jung, D., Tran Tuan, V., Quoc Tran, D., Park, M. and Park, S. (2020). “Conceptual Framework of an Intelligent Decision Support System for Smart City Disaster Management”. Applied Sciences, 10(2), p.666.

[13] Aqib, M., Mehmood, R., Alzahrani, A. and Katib, I. (2019). “ In-Memory Deep Learning Computations on GPUs for Prediction of Road Traffic Incidents Using Big Data Fusion”. Smart Infrastructure and Applications, pp.79–114.

[14] Fajardo, J.T. and Oppus, C. (2010). “A mobile disaster management system using theandroidtechnology”.WSEASTRANSACTIOnonCOMMUNICATIONS,[online]Availableat:https://archium.ateneo.edu/discsfaculty-pubs/201/ [Accessed 25 Oct. 2022].

[15] Sasi Kumar, Soumyalatha and Shruti G Hegde., ―“IoT Approach to Save Life using GPS for the Traveller during Accident”, IEEE International Conference on Power, Control, Signals and Instrumentation Engineering, pp.2424-2428, 2017.

[16] Marufi Rahman, et al., ―“Real Time Google Map and Arduino BasedVehicle Tracking System‖”, 2nd International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE), pp.1-4, 8-10 December 2016 .

[17] Boddapati Venkata sai Padmaja, Venkata Ratnam Kolluru and Syam Sai Kota,(April 2019), “IoT based Implementation of Vehicle Monitoring and Tracking system using Node MCU” International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-8 Issue-6.

[18] Mohd Shoab, Kamal Jain, M Anulhaq and M Shashi., (February 2012), “Development and implementation of NMEA interpreter for real time GPS data Logging”, 3rd IEEE International Advance Computing Conference (IACC), pp.143-144.

[19] M.Basyir, M.Nasir, Suryati and Widdha Mellyssa.,(December 2017), “Determination of Nearest Emergency Service Office using Haversine Formula Based on Android Platform”, EMITTER International Journal of Engineering Technology, Vol.5, No.2, pp.272-276.

[20] Bernard Akindade Adaramola et al., (2020), “Development and Performance analysis of a GPSGSM Guided System for Vehicle Tracking”, International Conference on Computation,

Automation and Knowledge Management (ICCAKM) Amity-University,pp.287-290.