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A Search and Rescue System for Alive Human in Disasters Management

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ABSTRACT:Technology evolves day to day to make life easy and relaxed. Due to advances in technology, information about various natural disasters can be predicted in advance. But man cannot stop natural disasters from happening. During these incidents, many people lose their lives instantly while some people die by being trapped under obstacles for a longer period of time and are not identified by the rescue team or due to delay in identifying. This delay is caused by the fact that the rescue team is unable to identify the exact location and health status of the person trapped at the point of time. So, even the alive person dies while the rescue team searches from person to person.In this paper, we have proposed a system which communicates a victim's pulse rate using heartbeat sensor to the rescue team along with the Global Positioning System (GPS) location. The Vibrations sensor is also integrated into the system to detect the frequency of vibrations in the accident-prone area. In our system we have developed two communication models between the victim and the rescue team. In which one model uses Global System for Mobile Communications (GSM) to transfer the victim's status in a Uniform Resource Locator (URL) link format to the rescue team and the other model uses the Radio Frequency (RF) technology. The transmitter section which lies with the victim's designed using Arduino Mega microcontroller while receiver section which is hold by the rescue team unit with Arduino Uno. An emergency switch is used to manually activate the system, transfer the information and which also prompts the buzzer to generate alarming signal.

KEYWORDS: Heartbeat sensor, Global System for Mobile Communications (GSM), Uniform Resource Locator (URL), Radio Frequency (RF) technology, Buzzer, Global Positioning System (GPS).

I.INTRODUCTION

Nature has elegance of its own, but when it comes to disasters it is the most dangerous and devastating. Many people lose their lives, families get destroyed, and a lot of other losses occur. Especially places like the Philippines, China, Japan, Bangladesh natural disasters such as floods, volcanoes, earthquakes, etc are common where people lose their lives trapped under collapsed buildings and monuments. It is a tough task for the rescue team to rescue people in affective conditions because at that moment it is difficult to look where people are caught and what their health status is. The first 48 hours of every tragedy are critical for rescuing the defectors. The below fig1 shows the natural disaster report analysis. On June 3, 2018 the volcanic eruption takes place in Guatemala. On June 9, the dust-storms claimed 26 lives in UP adding to tens of deaths from weather events this year. In 2017, natural disasters and conflicts created more than 30m new internally displaced people. A review of the destruction of homes and livelihoods left in the wake of disasters and conflicts around the world.

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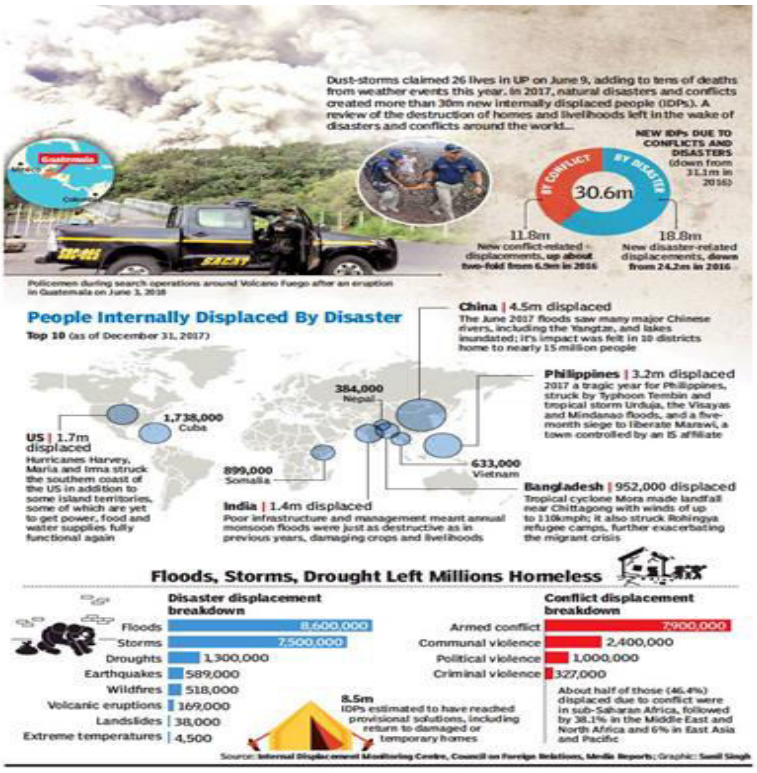

Figure.1 Natural disaster report analysis

Zia Uddin and Mojaharul Islam [1], have proposed a robot it detects alive human being using (PIR) sensor and Internet Protocol (IP). The robot is controlled by the rescue team using RF technology. Bhandari Prachi et. al [2] have found a new model, which can automatically detect the accident by means of sensors installed in it. The GPS module determines the vehicle's position, i.e., latitude & longitude and sends data to GSM module and this information is carried out to the main server of the emergency rescue unit. Purnima G et al. [3] have developed used GSM based effective wireless communication system. The victim's information will be communicated by GSM module, if the microcontroller device gets the signal about the movement of the human body and along with the GPS positioning information.

Jinu Sebastianet al. [4] has proposed an alive human detection system for rescue operations in hazardous areas. Some people die by being trapped under obstacles for longer period of time and impossible to detect them. They have also built a robotic vehicle that travels through the disaster prone region and helps to locate the people alive to undertake rescue operations. ARM7 microcontroller unit and a wireless camera with microphone are integrated with the system. GPS module is used to find the positional co-ordinates of the victim in which the disaster takes place. Manjesh N, Sudarshan Raj [5] has proposed a working model of helmet which communicates with the emergency unit, when the rider met with an accident. The vibration sensor senses the vibration of the vehicle and transmits to the microcontroller. The control unit transfers the information using the GSM module when it identifies the range beyond normal vibration level.

In this our prototype helps the rescue team by knowing the exact position and the health condition of the victim, thereby decreasing the time for identification. The GSM and RF technology are made use to communicate wirelessly and location of the victim is identified using GPS. This model can be used by other civilians at times of any danger to send their location to the concerned people or department. There is a buzzer integrated into the system which keeps alarming to indicate the person is in need of help. We organize the rest of the paper as follows. Section 2, delivers the detailed view of system architecture. Section 3 discusses about the design and implementation of the system. Section 4, presents overall functioning of the system with necessary figures and Section 5 concludes about the proposed system in this article.

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II.SYSTEM ARCHITECTURE

1) Transmitter Section

The Arduino Mega2560 microcontroller is used in transmitter section as it is capable to support all the components connected to it and also serves as a great development platform for 8-bit microcontroller [6]. The 16x2 LCD, buzzer which is connected to the output port of the microcontroller whereas power supply, GPS module, heartbeat sensor, vibration sensor and emergency switch is connected to the input of microcontroller. The GSM and RF module is bidirectional components that are connected to microcontroller for exchange of data. The power supply of 5V is given to activate the microcontroller and the components connected to it. The GPS module is connected to the input port of microcontroller to give the co-ordinates of the person. Therefore, the microcontroller takes the GPS co-ordinates as input and displays the latitude & longitude co-ordinates on 16x2LCD device [7].The vibration and heartbeat sensors are activated and the measurements are displayed on 16x2 LCD. This information is transferred to receiver through RF and

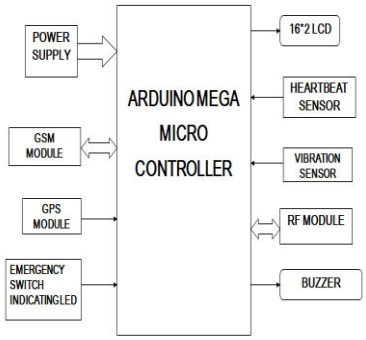

Figure.1 Block diagram of Transmitter section

GSM module since we have developed two communication modes in order to reach the information to the rescue team if even one mode fails. The emergency switch is an additional feature which will be activated by the victim to transfer the information directly to the receiver indicating he/she is in danger and needs help [8]. In turn it activates the buzzer to alter the people around victim that there is someone is the surroundings who are in danger. In the below figure 1 represents the transmitter section.

2) Receiver Section

The receiver section is held with the rescue unit. Arduino Uno microcontroller is used in receiver section for its flexibility and low cost. It is capable of performing multiple operations. The power supply, emergency switch is connected to input ports of the microcontroller and 16x2 LCD is connected to the output port of the microcontroller and GSM and RF module is bidirectional as shown in figure 2. The 5V of power supply is given as input to microcontroller to activate the controller and components connected to it.

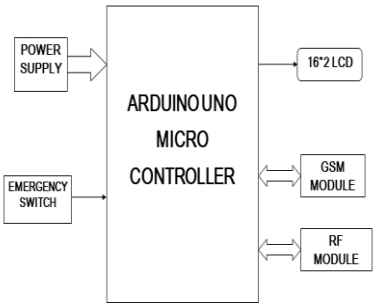

Figure.2 Block diagram of Receiver section

The information from the transmitter is received by the receiver through RF and GSM module which will be displayed on 16x2 LCD. The emergency switch in the receiver section which communicates with the victim about their location or any precautionary information. The data is transferred from receiver to transmitter through RF and GSM technology and also activates the buzzer to notify the victim about their presence.

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a) Arduino Mega microcontroller

The Arduino Mega is an ATmega2560 based microcontroller module. It has 54 digital input/output pins of which 14 pins are used as Pulse Width Modulation (PWM) outputs, 16 pins are used as analog inputs, 4 Universal asynchronous receiver-transmitter (UARTS) ports [9]. The input voltage is 7-12V, DC current per I/O pin is 40mA and the clock speed is 16 MHz.

Figure.3 Arduino Mega microcontroller

The microcontroller is therefore simple and easy to connect to or power an AC-to-DC adapter or a battery on a computer with a USB cable. The microcontroller board can be powered via USB connection or with an external power supply. The power source is selected automatically. The board can operate on an external supply of 6 to 20 volts. It is supplied with less than 7V in this system.

b) Arduino Uno microcontroller

The Arduino Uno is an ATmega328 based microcontroller module. It has 14 digital input/output pins, 6 of which can be used as Pulse Width Modulation (PWM) outputs, 6 analog inputs and 16MHz crystal oscillator, a USB port, a power jack, an ICSP header and a reset key. It is simply connect it to a computer with a USB cable, or power it to get started with an AC-to-DC adapter or battery.

Figure.4 Arduino Uno microcontroller

It can operate on an external supply of 6 to 20 V. It supplied with less than 7V, however the 5V pin may supply less than five volts and the board may be unstable. The ATmega328 has 32 KB of flash memory for storing code. It also has 2KB of SRAM and 1KB of EEPROM.

c) Power supply

A power supply is a system that transfers electrical power through electrical currents. The suggested way to test a project is by variation power supply output. Although a dedicated supply is very useful, e.g. 5V or 12V but having a variable supply on hand is even more convenient, especially for testing purposes. We use a LM7805 voltage regulator IC for generating 5V.

d) Vibration sensor

This is an open type vibration sensor module. It is used to trigger the effect of various vibrations, theft alarm, earthquake alarm etc. This module is compared with the normally open type vibration sensor module, vibration trigger for longer periods of time, can drive the rely module.

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Figure5. Vibration sensor

In the vibration sensor the output is 0 (low voltage) when no vibrations are detected and if any the output is 1 (high voltage). The frequency range should be above 43.5MHz and the operating voltage is 3.3V to 5V. The vibration sensor model number used in our design is SW-18010P.

e) RF module

RF stands for radio frequency, and it has different types of wireless technology, including cordless phones, radar, ham radio, GPS, radio and television broadcasts. Radio frequency is an oscillating frequency within a range from around 433.4 to 473.0MHz. This distance refers to the frequency of electrical alternating current signals used for the development and identification of radio waves. Here the communication distance should be in 1000m in open space.

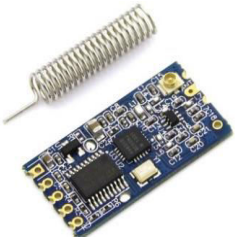

Figure.6 RF module

f) 16x2 LCD

16x2 characters LCD, black on green is 16 characters wide, 2 rows character LCD module. It utilizes industry standard controller, works in 4/8-bit parallel interface. Display area is LED back-lit in yellow colour. It translates a 16 character show per line, and two such lines exist. In this LCD each character is displayed in a 5x7 pixel matrix. A lot of combinations are available such as 8x1, 8x2, 10x2, 16x1 etc.

Figure.7 16X2 LCD

g) Heartbeat sensor

Heartbeat sensor is an electronic device used to measure the heart rate. The sensor can be worn on a finger and connected to the Arduino via a wire. The essence is an optical heart rate sensor that integrates an amplifying circuit and a noise cancelling circuit. The heart rate is measured according to blood flow to the tip of the finger. The operating voltage is around 3 to 5V and current requirement should be in 4mA. The model number for heartbeat sensor is SEN-11574.

Figure.8 Heartbeat sensor

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h) GPS module

GPS stands for Global Positioning System through which anyone can obtain the information regarding the exact location of a person anywhere in the world. The position accuracy should be 2meters. The supply voltage is around 2.7 to 6V Direct Current (DC). A GPS receiver acquires the location coordinates and sends information to the user. Using GPS technology, one can determine location, velocity and time, 24 hours a day, in any weather conditions, anywhere in the world for free. The maximum speed is 500M/s. The model number for GPS is NEO-6M module.

Figure.9 GPS module

i) Buzzer

A buzzer is an audio signalling device; the buzzer used here in the arduino is a piezoelectric buzzer which can be operated by an electromagnetic circuit or audio signal. The input voltage is 5V and resistance is 42ohms. The resonance frequency is 2048Hz. A click, beep or ring can indicate that the button has been pressed.

Figure.10 Buzzer

j) GSM module

GSM stands for Global System for Mobile communication which is an open digital cellular technology. It is used to transmit services for the mobile voice and data. The frequency range should be in between 900MHz/1800MHz. The power requirement is 4.5V to 12V. By allocating the bandwidth, it is used to transmit the data with high speed and protection. The model number SIM-900 GSM modem is used in this design that provides us with the 900MHz frequency connected to the global network.

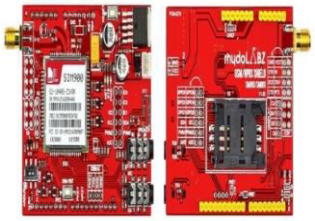

Figure.11 GSM module

k) Push button

Push button switch is a simple electrical switch mechanism that activates certain operations by the system. Here we use an E-switch push button which has 50mA current rating. Typically, the surfaces usually smooth, and can be easily pressed or moved. Most usually it's biased switches, but unbiased buttons need a spring to return to their unpushed state.

Figure.12 Push button

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III.DESIGN AND IMPLEMENTATION

The microcontroller has a range of features that make it easy that program and compile any Arduino based software. It is programmed with Arduino IDE [10].

A. Transmitter Section:

Initially 5V of DC power is supplied to the Arduino ATmega2560 microcontroller. Once the microcontroller is activated the GPS turns ON and the co-ordinates of the location is obtained and displayed on 16x2 LCD in the transmitter end. Then the vibration experienced by the device is detected by the vibration sensor and if the vibrations are greater than 43.5MHz. The heartbeat sensor which is in ON position also starts displaying the readings on the LCD display. The information is transferred to the receiver section through wireless communication device i.e. RF module when receiver and transmitter are in short distance from each other.The GSM in its active state creates the link of exact location with help of co-ordinates and sends the link along with heartbeat to the receiver through SMS [11]. The emergency switch when externally triggered directly sends the location and heartbeat to the receiver in the absence of vibrations indicating the person in the transmitter terminal is in danger. During this process the buzzer also starts beeping indicating alert.

B. Receiver Section:

The receiver is supplied with 5V of power supply. The RF module and GSM gets activated and the information transferred from transmitter is displayed in the mobile application [12]. This link can be opened using internet and exact location is tracked prioritizing the heartbeat rate. The switch present in the receiver section is when externally triggered activates the transmitter and sends the data through RF module which is displayed on the LCD display present in the receiver section i.e. it displays the latitude & longitude along with pulse rate of a person when the receiver is near to transmitter with a buzzer beeping and LED indication of transmitter for easy identification in short range and in case ease of failure of GSM. With help of this we can detect alive people who are stuck under obstacles and rescue them within time.

When the accident takes place, the vibration sensor detects the disaster and a message consisting of occurrence of disaster is displayed on the receiver at the rescue team's end. If the victim is conscious after the disaster, he/she can press the dedicated button on the transmitter which sends the emergency signal to the rescue team.The heartbeat range should be in between normal (60-100BPM). If it turns out to be 0 then the victim is estimated to be death. The vibration frequency range should be in 43.5MHz. If the vibration frequency is more than threshold i.e. 43.5MHz then it is considered as an abnormal condition. The information is transmitted through GSM module; in case of network failure it is transmitted through RF technology.

IV. EXPERIMENTAL RESULTS

The below figures show the experimental results of the model. The step by step illustrations of the whole process stating the conscious and unconscious stages of the victim and the transmission and receiving of vitals and co-ordinates are as follows.

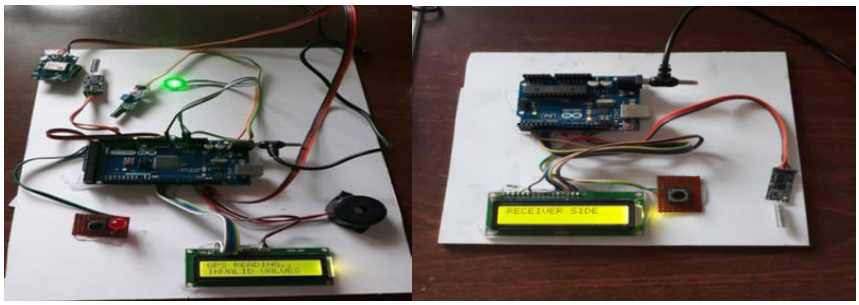

Figure.14:(a) Transmitter (b) Receiver

The above figure.14(a) shows the transmitter section which consists of heartbeat sensor, vibration sensor, RF module, GPS module, buzzer, emergency switch indicating LED and 16x2 LCD.The receiver section is shown in figure.14(b)which consists of RF module, emergency switch, GSM module and 16x2 LCD.

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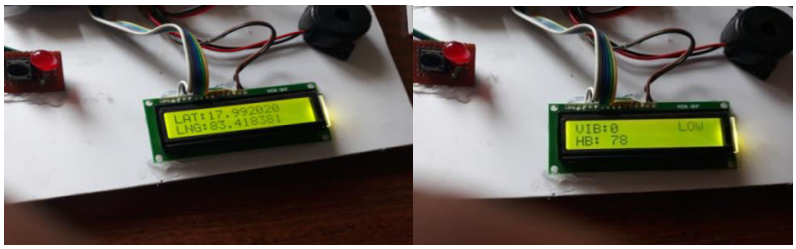

Figure.15:(a) GPS co-ordinates displayed on LCD (b)Heartbeat readings displayed on LCD

The figure.15(a) shows the accident/disaster takes place, it gives the exact location of the victim along with GPS co-ordinates that consists of latitude & longitude.The heartbeat readings of the victim at the receiver sectionis shown in figure.15(b).The above figure.16(a) shows the alert message consisting of link to track the victim and heartbeat readings also included in it. This information is sent to the registered mobile number of the user. In this case it will be the emergency unit. Figure 16(b) shows us the location of the victim for the recue team to reach for rescue operation.

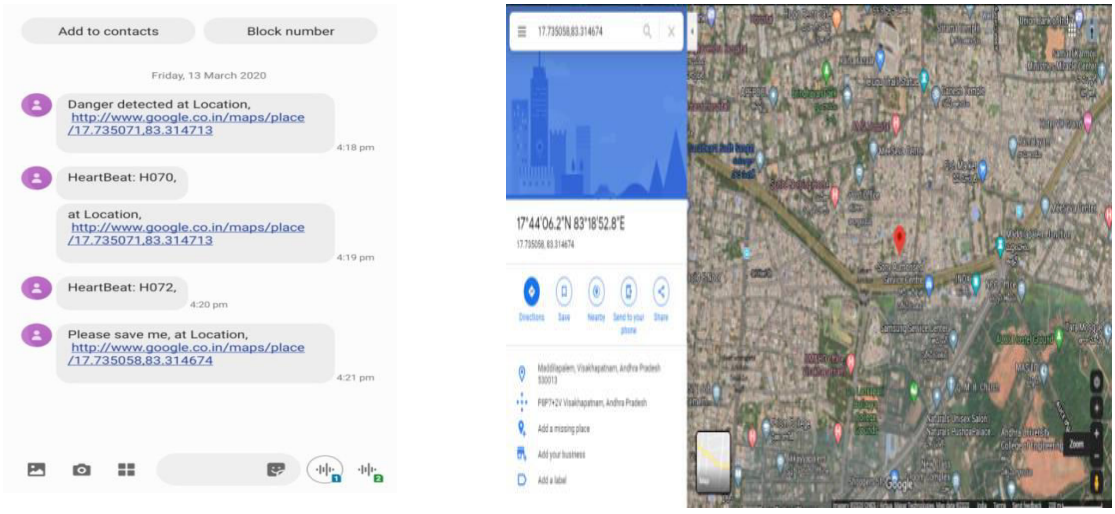

Figure.16: (a) Text message received after the disaster (b) Location of the victim

V.CONCLUSION

With implementation of this device, number of lives could be saved in short period of time. This safety device can also be used in day to day life where one can come across an unexpected situation and has no one around to help in such cases they can push the emergency switch embedded in the device and can seek for help. This device alerts the person in the other end and transmits the location and current status while sending a message for help. It has a buzzer that goes on when something unusual has taken place.This device can also be developed by integrating with RFID tags which can be used to search for person to person when the system failures and transmitter is unable to send data to receiver. This system can further be deployed into gadgets that are carried by one self, such as mobile phones, wrist watches, wrist bands etc.

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