VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELGAUM

A
PHASE-1 PROJECT REPORT
ON

Implementation of Autonomous Robotic System for Alive Human Detection in Earthquake Rescue Operation

Submitted in partial fulfillment of the requirements of the degree of

BACHELOR OF ENGINEERING
in
ELECTRONICS AND COMMUNICATION ENGINEERING
For the academic year
2019-2020

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CERTIFICATE

Certified that the Project work entitled **'Implementation of Autonomous Robotic System for Alive Human Detection in Earthquake Rescue Operation'** is a bonafide work carried out by **MANIKANTA H T [1KN16EC025], MD AAMIR HUMAYUN SHAIKH [1KN16EC027], MOHD AAMIR AHMED [1KN16EC029] & PRITHVI K A [1KN16EC035]** bonafide students of **KNS Institute of Technology, Bangalore** in partial fulfillment for the award of the degree of Bachelor of Engineering in **Electronics and Communication** of the **Visvesvaraya Technological University, Belgaum** during the year 2019-2020. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the report deposited in the departmental library. The project Phase-I report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said Degree.

Name & Signature of the Guide **Name & Signature of the HOD** **Signature of the Principal**

External Viva

Name of the Examiners **Signature with date**

1.

2.

ABSTRACT

Natural calamities do occur and they are unstoppable. But humans are becoming increasingly aware in the concept of intelligent rescue operations using which precious life and material can be saved. There are lots of disasters that occur all of a sudden and Earthquake is one such disaster. Earthquakes produce a devastating effect and they see no difference between human and material and it can lead to the loss of precious human lives. A lot of times humans are buried under the debris and it becomes impossible to detect them. Many people die by getting trapped in these drastic disasters on large scale just because they didn’t receive help at that instant of time. A timely rescue can save the people who are trapped under the debris and wounded. Detection by rescue workers becomes time consuming and due to the vast area that gets affected it becomes more difficult.

So the project proposes an autonomous robotic vehicle that moves in the earthquake affected areas and helps in identifying the alive person .The proposed alive human being detection system uses a specific set of sensors that includes PIR sensor, temperature sensor, vibration sensor, GSM module, GPS module, etc. which gives the information about the presence of alive human body. The robotic vehicle is also equipped with camera to monitor the earthquake affected environment. GSM technology will give an alerting message to the control room about the location of the person so that they can be rescued as soon as possible. The robot also monitors the health condition of the person such as body temperature, pulse rate and sends the data to the concerned authority

ACKNOWLEDGEMENT

We are grateful to the Founder & Late Chairman of our college, **Mr**. **C. K. Jaffer Sharief,** for having provided us with excellent facilities in the college during the course to emerge as responsible citizen with Professional Engineering Skills and moral ethics.

We areindebted to the Chairman of our college, **Mr**. **Abdul Rahman Sharief,** for his constant support, motivation and encouragement to excel in academics and carryout project works.

We thank our Principal, **Dr. S. M. Prakash,** for facilitating a congenial academic environment in the College.

We arethankful to our HOD**, Dr. AijazAli Khan,** for his kind support, guidance and motivation during the B.E Degree Course and especially during the Course of my project work.

We thank our Guide Dr. / Mr. /Mrs. /Ms. ---, for his/her valuable guidance, Suggestions and Encouragement throughout my project work.

We are also thankful to all the **staff members of the Department of Electronics and Communication Engineering**and all those who have directly or indirectly helped with their valuable suggestions in the successful completion of this project report.

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Chapter 1

INTRODUCTION

Earthquake occurs due to disturbance in the tectonic plates that lie under the surface of Earth. Earthquakes may be brief and mild or big and destructive. Earthquakes occur suddenly, usually without any warning signs, and can cause huge destruction. Though there is a separate branch of science referred to as seismology that study about earthquakes and try to predict their occurrence, however it doesn't help in determining the exact time or date of this natural calamity.

The rescue workers do not see any difference between the human and debris, and it becomes very difficult to detect these victims. These bowed buildings are unstable and may collapse anytime. Thus, use of heavy machinery on core site is not permitted, because it would weaken and suppress the structure which exposes the lives of rescuers and victims submerged in the remains

Huge loss of manpower in these disaster situations can be minimized if an effective method is used despite using conventional way of identifying the buried humans [1]. The core idea of this underlying work is to develop such a robot which could provide the significant help and safety to the rescue workers during the rescue operations in disastrous situations. It detects alive humans in the ruins of collapsed buildings due to the natural or human-made disasters like earthquakes and land-sliding without making any physical contact with them.

A robot is a reprogrammable, multifunctional manipulator designed to move materials, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks. Basically a robot consists of a mechanical structure, such as a wheeled platform, arm, or other construction, capable of interacting with its environment. Sensors are used to sense the environment and give useful feedback to the device. Systems to process sensory input in the context of the current situation and instruct the device to perform actions in response to the situation.

This wireless robot travels in the disastrous area and coordinates rescue team in finding the alive victims by identifying the survived human under ruins of disaster. It is made possible by the integration of sensor network and other wireless technologies. A wireless camera embedded in the robot is accessed by the wireless communication interface.

Raspberry-Pi [5] is used as a central processing unit for taking input information from the user, and after processing, the output is given to the user. Instructions received from users are passed to respective parts as required by user for getting the demanded results. Henceforth, priceless life can be protected by well-timed finding in ruins even without the large number of rescue people. By using this wirelessly controlled robot, rescue workers do not have to risk their lives during the search operations.

So the project proposes an autonomous robotic vehicle that moves in the earthquake affected areas and helps in identifying the alive person using PIR sensor [6]. The main aim of the project is to implement a Wireless Robot which navigates around the disastrous areas and try to find the humans who are buried under the debris and need help as soon as possible. It detects the location of the person using GPS module [7] and send the location with the help of GSM module [7] to the rescue team. It also checks the body temperature using temperature sensor and pulse rate using pulse sensor [8].Then it sends these data of that person to the concerned authority.

Chapter 2

LITERATURE SURVEY

TITLE- Ground Robot for Alive Human Detection in Rescue Operations.

AUTHOR- Naeem Farooq, Umar Ilyas, Muhammad Adeel, Sohail Jabbar

ABSTRACT

In this modern era of technology, still conventional methods (human and trained dogs) are being used to find and rescue the victims who are buried under the rubble after natural or human-made destruction. Such operation is very dangerous for the rescue workers and victims as well, especially in the case, if the wreckage is dislocated. These traditional methods increase the chances of causalities due to their risky and time taking approaches. Hence, to make the rescue operation safer and effective, a small ground robot for humanitarian search has been proposed which detect alive human beings. This robot provides the momentous help and safety to the rescue workers during the search and rescue operations. This has been done by spotting live humans remotely without any physical contact with victims by sensing their body's temperature. This robot consists of a thermal sensor, microcontroller, gas sensor, HD wireless camera and many other modules which collectively perform to search living victims. Android application is developed to control the movements of the robot and to show received output values from sensors. We throw the robot and it gives better results than other existing ways.

TITLE- Unmanned Vehicle to Detect Alive Human During Calamity

AUTHOR- Murulidhara T C, C. Kanagasabapthi, Siva S Yellampalli

ABSTRACT

the proposed alive human detection system uses an ARM7 controller with a highly efficient low cost camera to capture image and detects human body through MATLAB Software using the Viola-Jones algorithm and a set of sensors like Pulse sensor and Temperature sensor will give the information regarding an alive human presence. IR sensor is used in this project to avoid obstacles in its navigation path. An Unmanned vehicle navigates through the debris automatically to check the presence of human life. After the detection, it checks the accident person's pulse rate, body temperature and sends these data along with GPS location information to the base station through Zigbee Transceiver. As this approach requires considerably small number of images, collection for processing, it will take the data transmission, less power consumption and cost of image processing. The base station will receive the Longitudinal and latitudinal location of affected human through Zigbee Transceiver and display this information on monitor to speed-up the rescue operation.

TITLE-Live Human Detection Robot
AUTHOR- Asha Gupta, Nidhee Panchal, Dhruti Desai, Divya Dangi.

ABSTRACT

In this paper, a new approach for detecting alive human beings in natural and man-made disasters using a specific set of sensors, ATMEGA16 Microcontroller, existing GSM technology and PLC systems. Many areas of world are getting affected due to sudden natural calamities like earthquakes, floods, wild-fires, storms and human induced disasters industrial and transportation accidents and one of the threatening to humans that is terrorists‟ attacks. We observe that people dies by getting trapped in these drastic disasters on large scale just because they didn’t get help at the instant of time when they required to be rescued. So the proposed alive human being detection system uses a specific set of sensors that includes PIR, temperature, vibration, IR, Ultra sonic detector, etc. which gives the information about the presence of alive human body. GSM technology will give an alerting message to control room of the affected sites‟ to give proper rescue to the affected victims through PLC logical programming. Also we are using HMI system. Therein a microcontroller ATMEGA16 holds all of these sensors which deals with movable robot systems. By this project it will be a great help indeed to rescuers in detection of the more & more alive human beings at the disaster sites at proper time. This is also user friendly, economical, semi-autonomous and efficient device by software programming interfacing for detection.

In this project we are proposing a system which can detect humans even if they are buried under debris. We are sending the location of the person to the rescue team and we are also sending the health condition of the person to the concerned authority so that they can get the help as soon as possible.

Chapter 3

TECHNOLOGY USED

3.1 System Overview

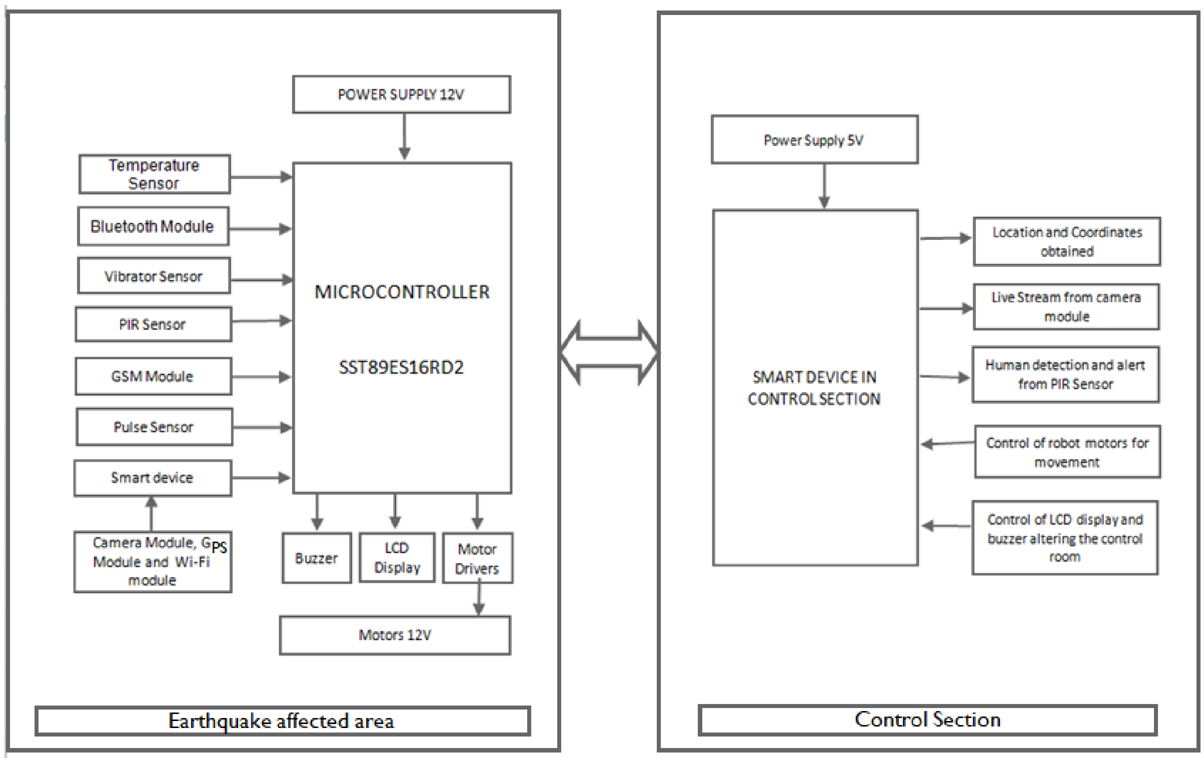

Fig 3.1: System overview

The block diagram describes the overall detailed design of the project with the complete overview of each module. The system uses number of sensors which includes earthquake detector, PIR Sensor, temperature sensor, pulse sensor, GSM module and a smart device which consists of GPS, camera and Wi-Fi module.

Here the microcontroller SST89ES16RD2 plays the main operation of controlling and performance of the robot. Leveraging the company's innovative packaging technology, the new SST89ES16RD2 is available in a 6mm x 6mm WQFN package, making it the smallest 8051-based microcontroller currently on the market. The device's miniature size and low power consumption are ideal for small form factor mobile applications, such as notebook PCs, MP3 players and GPS systems, as well as home entertainment devices including HDMI products.

Each sensor has different functionality to be performed, firstly the earthquake detector sensor senses the earthquake, the PIR sensor is used for detecting alive human trapped in earthquake affected areas, temperature and pulse sensors to know the health condition of the human got trapped, and the camera to stream it to the authorized user.

The GPS module in the robotic vehicle detects the location of the trapped person and sends it with the help of GSM module to the rescue team so that they can be rescued as soon as possible.

3.2 Hardware Requirements

3.2.1 Microcontroller SST

The main centre part of the project is the microcontroller. Here we are using the 8051 based Philips SST 89E516RD2 microcontroller. The devices use the 8051 instruction set and are pin-for-pin compatible with standard 8051 microcontroller devices. The 89E516RD2 are 80C51 microcontrollers with 64kB flash and 1024 B of data RAM.

Specifications

- 8051 CPU with 5V operating voltage from 0 to 40 MHz
- 64 KB of on-chip flash user code memory with ISP and IAP.
- SPI and enhanced UART.
- Four 8-bit I/O ports with three high-current port 1 pin.
- Three 16-bit timers/counters.
- Programmable watchdog timer.
- Eight interrupt sources with four priority levels.
- Second DPTR register
- Low EMI mode (ALE inhibit)
- TTL- and CMOS-compatible logic levels
- Brownout detection
- Low power modes
    - Power-down mode with external interrupt wake-up
    - Idle mode

Fig 3.2.1: Raspberry-Pi

3.2.2 PIR SENSOR

As live human body emits thermal radiation it is received and manipulated by the PIR sensor to detect humans. PIR sensors are passive infra-red sensors. They detect change in the heat and this can be used to detect movement of people. It has digital output and can be directly given to the digital pins and no ADC is needed. It operates at 5V DC .The PIR (Passive Infra-Red) Sensor is a pyro-electric device that detects motion by measuring changes in the infrared (heat) levels emitted by surrounding objects. This motion can be detected by checking for a sudden change in the surrounding IR patterns. When motion is detected the PIR sensor outputs a high signal on its output pin. This logic signal can be read by a microcontroller or used to drive a transistor to switch a higher current load. PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro-electric sensor, which can detect levels of infrared radiation. Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low.

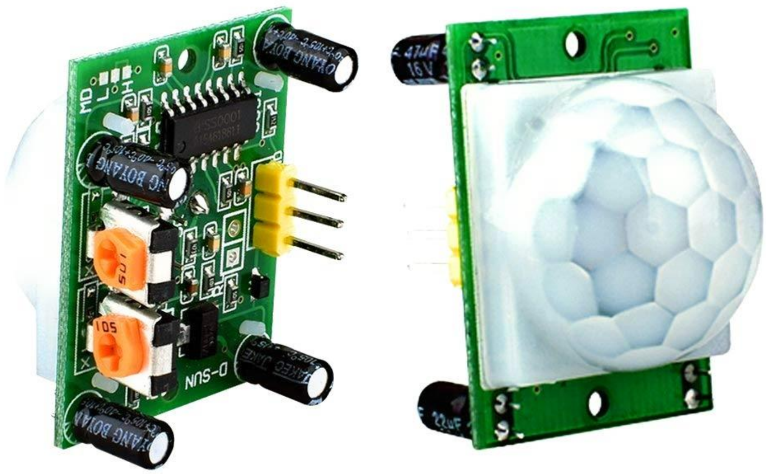

Fig 3.2.2: PIR Sensor

3.2.3 GSM MODULE

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

Fig 3.2.3: GSM Module

3.2.4 GPS MODULE

GPS Stands for "Global Positioning System". GPS is a satellite navigation system used to determine the ground position of an object. GPS technology was first used by the United States military in the 1960s and expanded into civilian use over the next few decades. Today, GPS receivers are included in many commercial products, such as automobiles, smart phones, exercise watches, and GIS devices. GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on Tx pin with default 9600 Baud rate. This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc. Each string starts with '$' and ends with carriage return/line feed sequence.

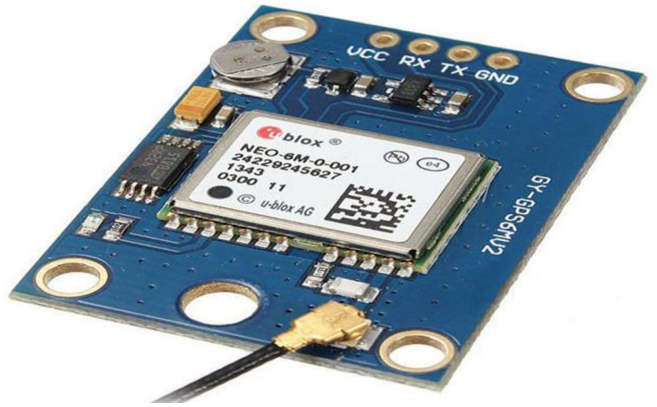

Fig 3.2.4: GPS Module

3.2.5 Camera Module

The Camera Module can be used to take high-definition video, as well as stills photographs. It’s a leap forward in image quality, color fidelity, and low-light performance. It supports 1080p30, 720p60 and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi. The camera works with all models of Raspberry Pi 1, 2, 3 and 4. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Pi camera Python library.

Fig 3.2.5: Camera Module

3.2.6 TEMPERATURE SENSOR:

The LM35 is one kind of commonly used temperature sensor that can be used to measure temperature with an electrical o/p comparative to the temperature (in °C). It can measure temperature more correctly compare with a thermistor. This sensor generates a high output voltage than thermocouples and may not need that the output voltage is amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/°C. The LM35 does not need any exterior calibration and maintains an exactness of +/- 0.4°C at room temperature and +/-0.8°C over a range of 0°C to +100°C.One more significant characteristic of this sensor is that it draws just 60 micro amps from its supply and acquires a low self-heating capacity. The LM35 temperature sensor available in many different packages like T0-46 metal can transistor-like package, TO-92 plastic transistor-like package, 8-lead surface mount SO-8 small outline package.

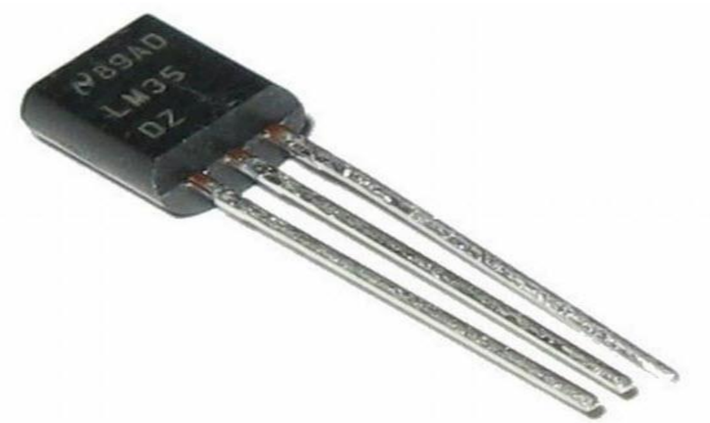

Fig 3.2.6 LM35

3.2.7 MOTOR AND MOTOR DRIVE:

Motor denotes the robot which can move over earthquake prone areas. Motor drive is the interfacing circuit between microcontroller and robot. The project uses DC motor.DC motors have polarity and direction of rotation depends on direction of current. But a DC motor cannot be interfaced to the microcontroller directly because it requires much higher voltage and current. Motor drive is used for this. It is built using an NPN transistor –BC547. It acts as an interfacing device to supply required power to the motor.

3.2.8 EARTHQUAKE DETECTOR:

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

3.2.9 PULSE SENSOR:

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for . It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart- rate data into their projects. It also includes an open-source monitoring app that graphs your pulse in real time.

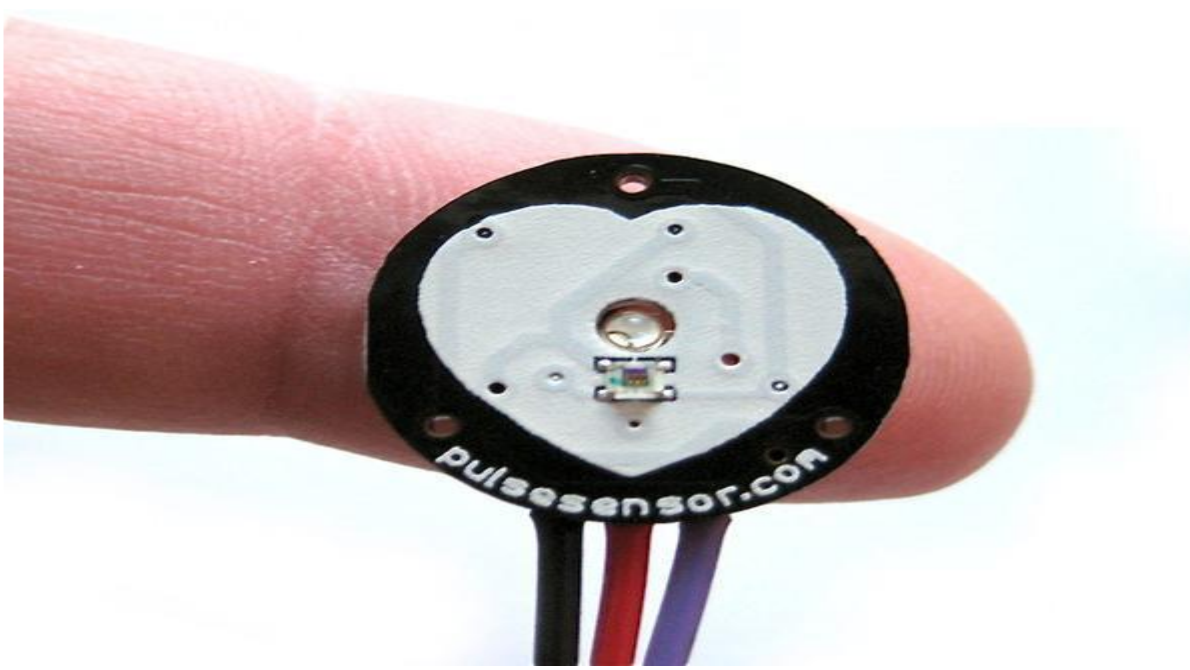

Fig 3.2.7: Pulse Sensor

3.2.10 THERMAL SENSOR:

A temperature sensor is a device, typically, a thermocouple or RTD, that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature. An RTD (Resistance Temperature Detector) is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner.

3.3 Software Requirements

3.3.1 Embedded C

C is a high-level programming language intended for system programming. Embedded C is an extension that provides support for developing efficient programs for embedded devices**.** Yet, it is not a part of the C_language**.** Embedded C programming language is an extension to the traditional C programming language, that is used in embedded systems. The embedded C programming language uses the same syntax and semantics as the C programming language. The only extension in the Embedded C language from normal C Programming Language is the I/O Hardware Addressing, fixed-point arithmetic operations, accessing address spaces, etc.

The five layers are:

1. Comments
2. Pre-processor directives
3. Global declaration
4. Local declaration
5. Main function()

CHAPTER 4

METHODOLOGY

The autonomous robotic vehicle consists of a power supply unit, Raspberry-Pi as a controller, GPS module, GSM module, Wi-Fi module, PIR sensor, Temperature Sensor, Camera and pulse sensor. The methodology is divided into two main parts. Firstly it will detect the human with the help of PIR along with thermal sensor and the second part is sending the location.

4.1 Human detection using PIR sensor

The autonomous robotic vehicle will have a PIR sensor for detecting the humans. A PIR or a Passive Infrared Sensor can be used to detect presence of human beings in its proximity. Basically motion detection use light sensors to detect either the presence of infrared light emitted from a warm object or absence of infrared light when a object interrupts a beam emitted by another part of the device. A PIR sensor detects the infrared light radiated by a warm object. It consists of pyro-electric sensors which introduce changes in their temperature (due to incident infrared radiation) into electric signal. When infrared light strikes a crystal, it generates an electrical charge. Thus a PIR sensor can be used to detect presence of human beings within a detection area of approximately 14 meters.

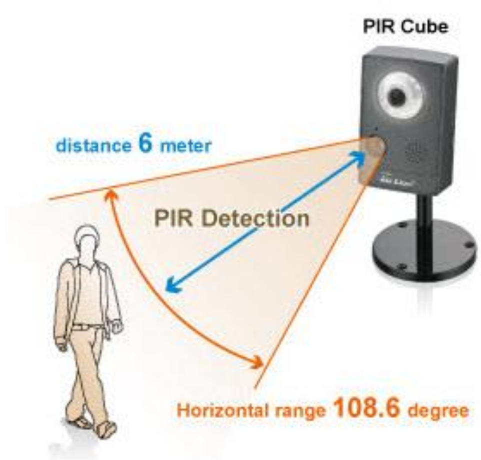

Fig 4.1: Human detection using PIR sensor

4.2 Sending the location

Another key element of the system is automatic location reporting system.The main component of this set-up consists of the Raspberry-Pi microcomputer, GPS module and a GSM module. If a person is detected, the same microcomputer would send the location of the person to the rescue team. The Global Positioning System (GPS) module is used to find the location of the person. Upon detection of the person, the microcomputer would connect to the geosynchronous satellites using the pre-installed antenna in the module. The receiving end of the system would obtain the coordinates of where the person was located.

4.3 Flow Diagram

The main process of the system focuses on the automatic detection of human trapped in the earthquake affected areas and reporting of its specific location as well as health condition of the person to the rescue team. The design of the whole system would be concerned with the integration of the various schemes. The process of the system is shown on Fig 4.2.

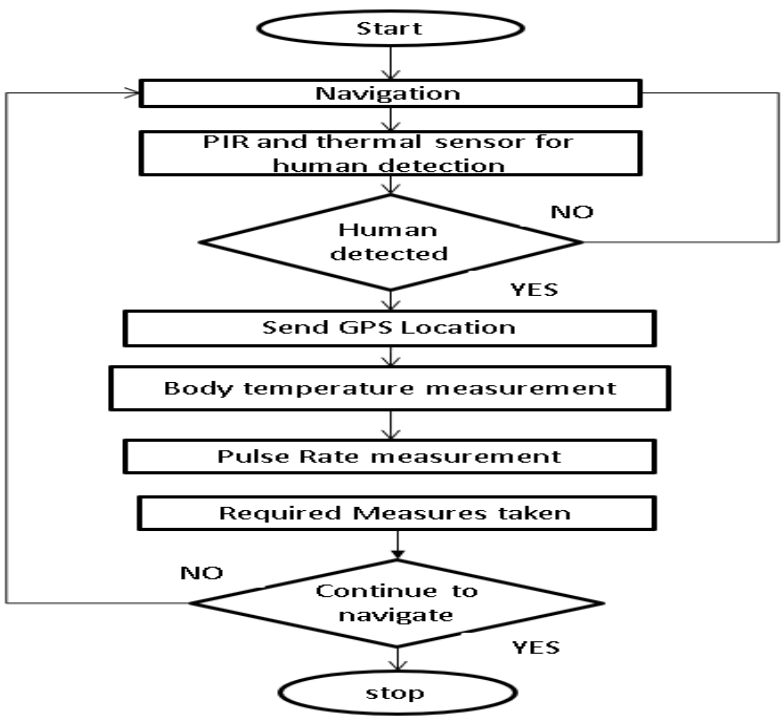

Fig 4.2: Flow Chart

The process is composed of two parts, automatic detection of human and reporting the location as well as health conditions to the rescue team. Once the system is powered on, the camera would start and we can navigate the robotic vehicle with the help of joystick.

Initially the autonomous robotic vehicle navigates in the earthquake affected areas and sends the live video to the rescue team. The PIR sensor will detect the human trapped in the area. After detecting the human GPS module will detect its location and send it to the rescue team with the help of GPS module. The robot will keep on navigating until it detects the humans. Once the human is detected, body temperature of the person will be determined with the help of temperature sensor and the pulse sensor will be used to measure the pulse rate of the person. The location and health condition of the person is then sent to the rescue team using GSM module.

4.4 Circuit Diagram

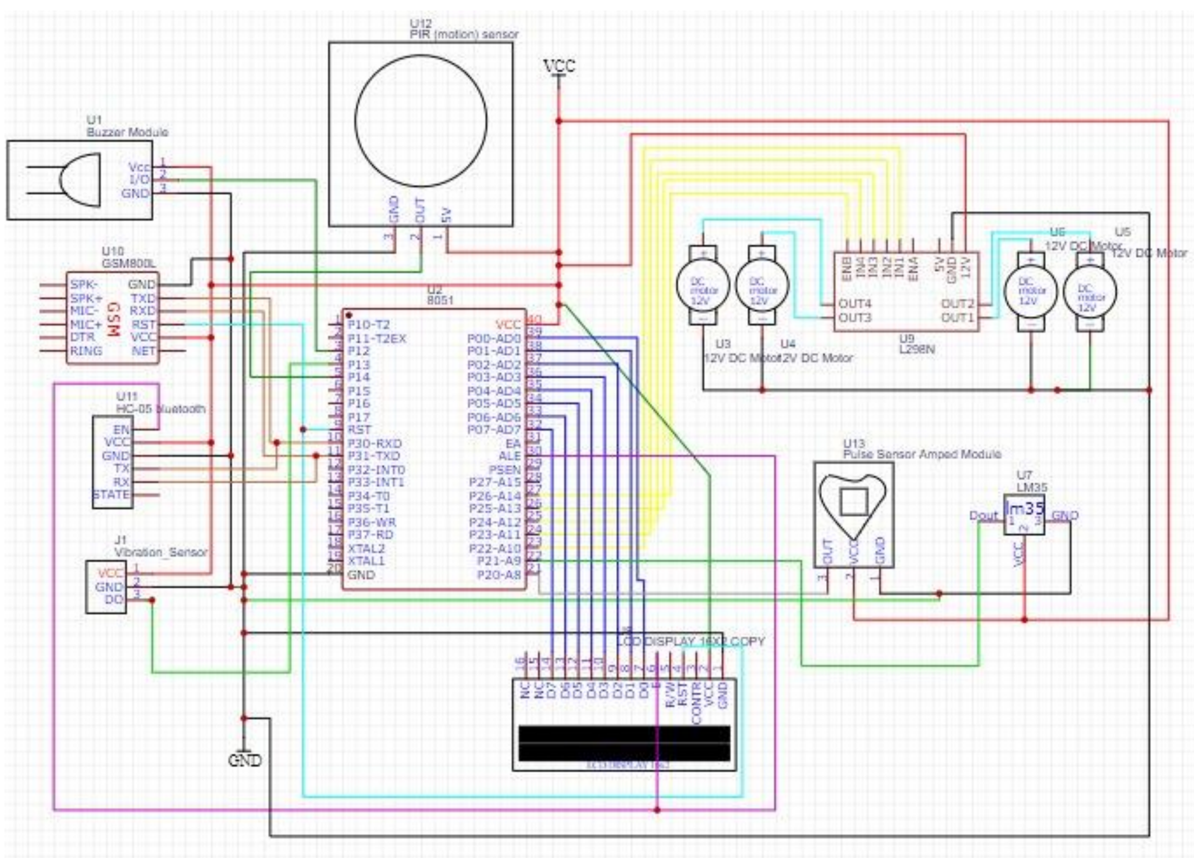

Fig 4.3: Circuit Diagram

4.5 Program code

```
#include<P89V51RD2.H>           // header file of RD2 microcontroller
#include<113_ALCD.c>
#include<113_UART.c>
//------------------------------------------------------------------------------------------------------------
// Global CONSTANTS
//------------------------------------------------------------------------------------------------------------
sbit w_m1=P2^4;
sbit w_m2=P2^5;
sbit w_m11=P2^6;
sbit w_m22=P2^7;
sbit buzzer=P2^1;
sbit pir=P1^1;
sbit vib=P1^2;
//sbit pir=P3^3;
//sbit water_pump=P3^4;
//------------------------------------------------------------------------------------------------------------
------
// Function PROTOTYPES
//------------------------------------------------------------------------------------------------------------
------
void forward_motor();
void reverse_motor();
void left_motor();
void right_motor();
void Device_Init( void );
void main( void )
{
        forward_motor();
```

```
reverse_motor();
left_motor();
right_motor();
Device_Init( );
while(1)
{
        if(pir==1)
        {
                ALCD_Message( 0x01,"" );
                buzzer=1;
                ALCD_Message( 0x80,   "HUMAN DETECTED" );
          MSDelay(1000);
                ALCD_Message( 0x01,"" );

                buzzer=0;
        }
        if( vib==1)
        {
                ALCD_Message( 0x01,"" );
                //buzzer=1;
                ALCD_Message( 0xC0,   "EARTHQUAKE" );
          MSDelay(1000);
                ALCD_Message( 0x01,"" );
                //buzzer=0;
        }
        if(Rx_ST_Flag==1)
    {
                Rx_ST_Flag=0;
```

```
                if(Rx_data_arr[0]=='1')
                        {
                                forward_motor();
                          Rx_count=0;


                          }
                        else if(Rx_data_arr[0]=='2')
                        {
                                reverse_motor();
                                Rx_count=0;
                        }
                        else if(Rx_data_arr[0]=='3')
                        {
                                left_motor();
                                Rx_count=0;
                        }
                                else if(Rx_data_arr[0]=='4')
                        {
                                right_motor();
                                Rx_count=0;
                        }
                }
        }
}
void Device_Init( void )
{
        xdata unsigned char UC_count = 0xFD;     // For 9600 Buad Rate
        EA = 0;
```

```
        UART0M1_Tx_Init( );
        Timer1M2_Init( UC_count );
        EA = 1;
        TR1 = 1;
ALCD_Message( 0x80, "WELCOME" );
        MSDelay(1000);
        ALCD_Message( 0x01, "" );
}
void forward_motor()
{
        w_m1=1;
  w_m2=0;
  w_m11=1;
        w_m22=0;
        MSDelay( 1000);
                w_m1=0;
   w_m2=0;
   w_m11=0;
         w_m22=0;
}
void reverse_motor()
{
        w_m1=0;
  w_m2=1;
  w_m11=0;
        w_m22=1;
        MSDelay( 1000);
                w_m1=0;
```

```
  w_m2=0;
  w_m11=0;
       w_m22=0;
}
void left_motor()
{
      w_m1=1;
 w_m2=0;
 w_m11=0;
      w_m22=1;
      MSDelay( 1000);
            w_m1=0;
  w_m2=0;
  w_m11=0;
       w_m22=0;
}
void right_motor()
{
      w_m1=0;
 w_m2=1;
 w_m11=1;
      w_m22=0;
      MSDelay( 1000);
            w_m1=0;
  w_m2=0;
  w_m11=0;
       w_m22=0;
}
```

Chapter 5

APPLICATIONS AND RESULTS

5.1 Applications

1. This equipment can be used in earthquake prone areas
2. In military applications to detect the presence of human being
3. In rescue operations where human reach is impossible
4. In disaster management
5. In crisis management

5.2 Expected Result

The autonomous robotic vehicle will be able to go to the earthquake affected areas and detect the humans buried or trapped under the debris. It will also send the live video of the affected area. After detecting the human it will send the location to the rescue team so that they can be rescued as soon as possible. The robot will also be able to detect the health condition of the person such as body temperature, pulse rate and send the data to the concerned authority.

PLAN OF WORK

SL NO	MONTH	WORK
1	OCTOBER	LITERATURE REVIEW
2	NOVEMBER	COLLECTING HARDWARE COMPONENTS
3	DECEMBER	STUDYING OF MICROCONTROLLER SST, PIR SENSOR,PYTHON PROGRAMMING GSM & GPS
4	JANUARY	IMPLEMENTING THE SOFTWARE DESIGN
5	FEBURARY	IMPLEMENTING THE HARDWARE DESIGN
6	MARCH	OVERALL REVIEW IMPLEMENTATION
7	APRIL	PROJECT REPORT SUBMISSION

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