ISSN No: -2456 –2165

RF Controlled Alive Human Detection Robot

Kedar Deshpande
Bangalore, India
vvkedarvv@gmail.com

Aditi Khare
Bangalore, India
aditi.khare11@gmail.com

Abstract—A rescue robot is a robot that has been designed for the purpose of rescuing people. There are many things that could go wrong and affect certain parts of the population. There can be wildfires, tsunamis, earthquakes, and man-made disasters such as Chernobyl or 9/11. Rescue workers face many threats like collapsing buildings and victims trapped under rubble and many such situations unique to a particular environment. There is also the issue of deaths caused due to untimely hospitalization of victims. In the proposed project, we aim at providing aid for rescue operations in calamity hit areas which maybe natural or man-made. The robot will be able to detect live humans or animals and immediately inform the concerned authorities with the location. It will help finding humans easily and more effectively.

Keywords-Radio Frequency, Robots, PIR, GSM, GPS, ARM Microcontroller.

I. INTRODUCTION

Radio Frequency robots are controlled using radio frequency signals, of different frequencies depending on the required range. Hence the name. Robots are used for a spectrum of applications, including in automobile industries, healthcare, surveillance and in space. However, it has never been used for easing the process of rescue. The RF controlled robot is basically a mobile robot which can be controlled using radio frequency signals. It is sent into the disastrous area and every time it detects an alive human (or animal), it sends a location to the control center after which, the rescue workers can resume operations.

II. COMPONENTS

A. RF Transmitter – Receiver

In this project, we require 4 data pins to transmit and receive information required to move the robot in the forward, reverse, right and left directions. Since the RF transceiver (433 MHz) contains only one data pin, we will use an encoder-decoder package: H12E-H12D. The HT12E encoder IC converts the data which is of 4 bits received from the 4 data pins that are attached to the buttons into the serial data. The received signal data is then sent to the RF transmitter which in turn transmits it using radio signals. The RF receiver gets this serial data at the receiver end. Finally the serial data goes to the HT12D decoder IC which then converts it to 4 bit parallel data. [1]

Specifications:

- Receiver frequency: 433MHz
- Receiver supply current: 3.5mA
- Low power consumption
- Receiver operating voltage: 5v
- Transmitter frequency range: 433.92MHz
- Transmitter supply voltage: 3v~6v
- Transmitter output power: 4v~12 dBm
- Receiver Sensitivity: -105dBm
- Range: 2km

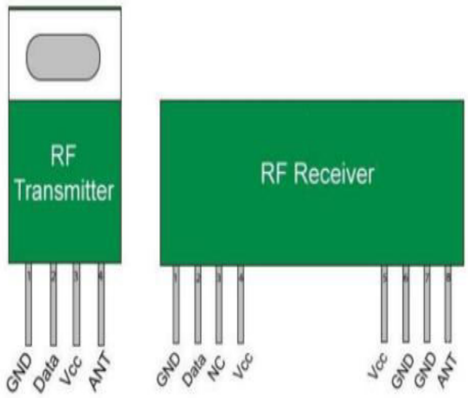

Fig.1 RF Transmitter-Receiver(google images)

B. PIR Sensor

PIR sensor - A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view.

Every object whose temperature is above absolute zero will emit heat energy in the form of radiation. This radiation radiates at infrared wavelengths and hence isn't visible to the human eye. However it can be detected via certain electronic devices which have been designed for this type of purpose. PIR devices are passive because they do not generate or radiate any energy for detection purposes. PIR works only by detecting the energy which is given off by other objects. Passive Infrared Sensor is an electronic sensor which measures the infrared light given off from objects in its radius. [2]

ISSN No: -2456 –2165

Specifications:

- Output: Digital pulse high (3V) when triggered. Digital low when idle.
- Sensitivity range: up to 20 feet (6 meters)

Fig. 2 PIR Sensor (google image)

C. LDR Sensor

The broadly useful photoconductive cell is otherwise called LDR – light dependent resistor. It is a sort of semiconductor and its conductivity changes with relative change in the intensity of light. A light dependent resistor takes a shot at the guideline of photoconductivity, which is an optical wonder in which the material's conductivity increases when light is absorbed by it. At the point when light falls i.e. at the point when the photons fall on the device, the electrons in the valence band of the semiconductor material is excited to the conduction band. These photons in the incident light ought to have more energy than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. When light having enough energy strikes on the device, a large number of electrons are excited to the conduction band which results in a huge number of charge carriers. The aftereffect of this procedure is that more current begins moving through the device when the circuit is closed and subsequently it is said that the resistance of the device has been lessened. This is the common working principle of LDR. We will be using LDR to sense dark areas to switch on the light (LED in the project). This will help us get better visibility even during poor lighting.[5]
Specifications:

- Supply voltage: 5V
- Output voltage: 3-4V
- Sensitivity: upto 15 inches

D. LED

The lighting emitting diode is a p-n junction diode which is an uncommonly doped diode and made up of a special kind of semiconductors. At the point when the light emits in the forward biased condition, it is called as a light emitting diode. When the diode is forward biased, the electrons and holes are moving quickly over the junction combining constantly while removing one another out. Not long after the electrons are moving from the n-type to the p-type silicon, it joins with the holes, and after that it vanishes. Thus it makes the complete atom and more stable along with giving the little burst of energy in the form of a tiny packet or photon of light. The working principle of the LED depends on the quantum theory. The quantum theory states that when the electron moves down from the higher energy level to the lower energy level then the energy emits from the photon. The photon energy is equivalent to the energy gap between these two levels.

If the PN-junction diode is forward biased, then the current flows through the diode. LED is mainly used to light up the dark areas detected by the LDR sensor, so that the robot can be maneuvered with ease using a camera.[6]

E. GSM

GSM/GPRS module is used for communication purposes between two devices - a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture which is widely used for mobile communication and Global Packet Radio Service (GPRS) is an extension of GSM which enables a higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem that has been assembled with a power supply circuit and various communication interfaces (like RS-232, USB for the computer. GSM/GPRS MODEM is a class of wireless MODEM devices that has been designed for communication purposes of a computer with the GSM and GPRS network. It requires a Subscriber Identity Module (SIM) card similar to mobile phones to activate communication with the network. Also they also have International Mobile Equipment Identity (IMEI) number like the ones used in mobile phones for their identification. A GSM/GPRS MODEM can perform various operations like:

1. Send, delete or receive SMS messages in a SIM card
2. Read, add, search phonebook entries of the SIM card
3. Reject, receive or make a voice call.[3]

We are using SIM900 as our GSM RS232 serial interface.
Specifications:

- Frequency - 850 to 1190 MHz
- Baud rate - 9600 bps
- Input voltage - 4.5 to 12V

F. GPS

The GPS system has the following three parts: Space segment, User segment and Control segment. The diagram of the structure of GPS is shown below.

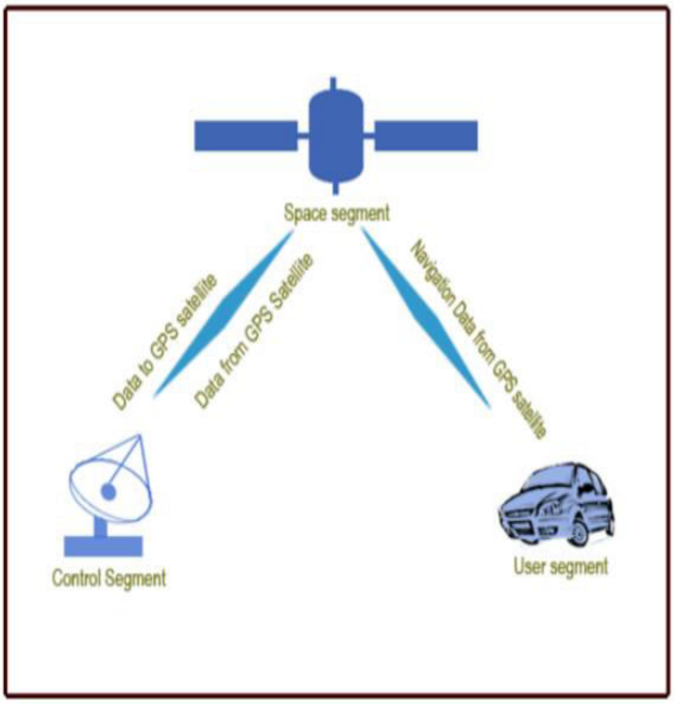

Fig.3 GPS Structure (google images)

- Space segment – The satellites are the most important aspect of the Global Positioning System (GPS) which locates the position by broadcasting the signal used by the receiver. These signals can be blocked when they travel through opaque objects like buildings, mountains and even people. The signals of the four satellites should be locked to find the specific position. Also constant movement is necessary to get clear reception.
- User segment – This segment contains all the military and civilian users. It comprises of two things - a sensitive receiver which detects signals and a computer for conversion of the data into useful information. GPS receiver helps to locate your own position but doesn't allow you being tracked by a third person.
- Control segment – The control segment aids the entire system to work efficiently. It is important that the transmission signals be updated and the satellites should be kept in their appropriate orbits.[4]

G. Motor Driver Circuit

We use L293d as our driver. One L293d can control 2 motors. L293D is a motor driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC. It can control a set of two DC motors together in the desired direction. Its working is based on the concept of H-bridge which is a circuit that allows the voltage to be flown in either direction. Voltage is required to change its direction for being able to rotate the motor in clockwise or anticlockwise direction. Therefore H-bridge IC is ideal for driving a DC motor. In a single L293D chip there are two H-Bridge circuits which rotate the two dc motors independently [7]. H-bridges are often used in robotics and other applications to allow DC motors to run in the forward or backward direction.

Most DC-to-AC converters, AC/AC converters, DC-to-DC push–pull converter, motor controllers etc. use H bridges. A bipolar stepper motor is driven by a motor controller containing two H- bridges.[8]
Specifications:

- Supply-Voltage Range: 4.5 V to 36 V
- L293D is characterized for operation from 0°C to 70°C.
- Can run two dc motors of 12V each

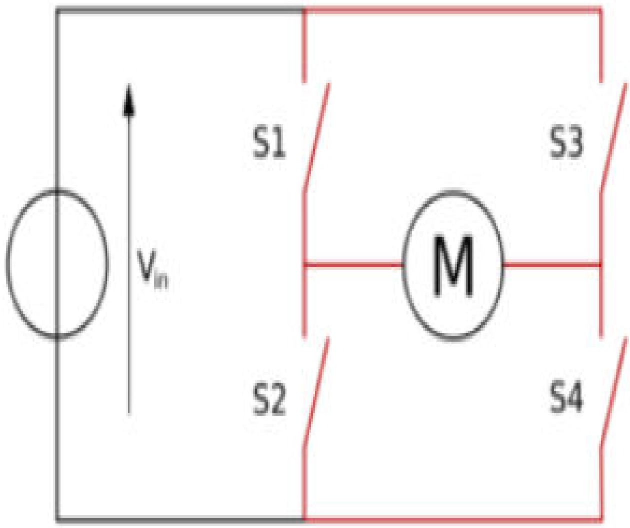

Fig.4 H-Bridge(google images)

H. Battery

A 12V lead-acid battery is used to run all the components on the robot.

III. DESIGN AND TESTING

A. Remote Control

The remote control is used to maneuver the robot in the area of surveillance. It consists of 4 push-buttons which are connected to the RF transmitter. A 9V battery is used to power the remote control but since the RF transmitter has an input power rating of 5V, an IC 7805 regulator is used. It steps down the 9V to 5V which is fed to the transmitter. The 4 push-buttons are used to move the robot in left, right, forward & backward directions. Two push-buttons can be pushed simultaneously to move it in a combination (for example – a combination of forward & right will make the robot move diagonally). The remote control uses a 433 MHz transmitter and hence it is capable of controlling the robot's movements up to 300 meter.

Control Centre Block Diagram

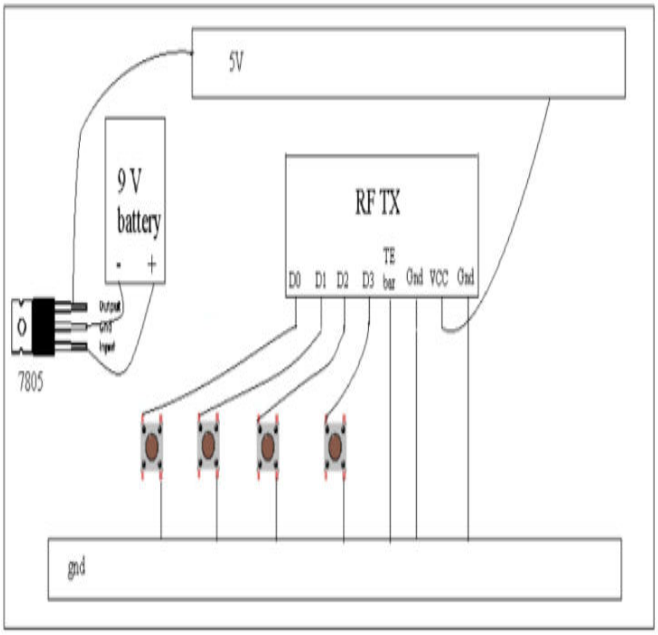

Fig.5 Remote Control Circuit Diagram

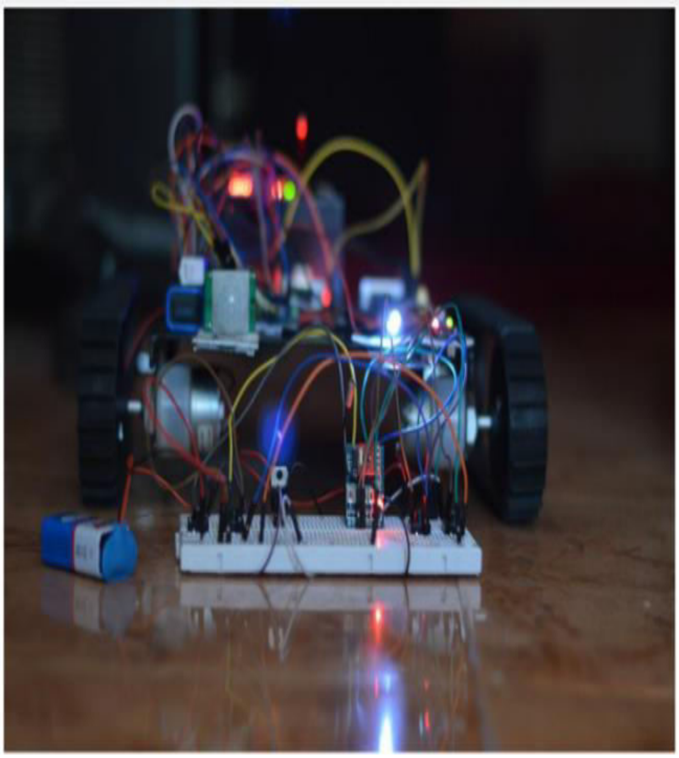

Fig. 6 Remote Control

B. Robot

We have installed DC motors and connected them to a motor driver circuit installed on a chassis. This is further fit on to 4 wheels which moves forward, backward, left & right. The motor driver circuit is in turn connected to the 433MHz receiver. The receiver receives the transmitted input using which it drives the motors via the motor-driver circuit. The motor driver is connected to the 12V supply which is necessary to drive the motors. The main element of the robot is the Passive Infra-Red (PIR) sensor. This sensor is connected to the GPIO Pin0.7 of the ARM LPC2148 microcontroller. The microcontroller is programmed to initiate the GPS to track location once PIR detects the infra-red rays.

The GPS is included to track location. It is connected to UART1. Once the PIR detects an alive body, the GPS is used to extract the current longitudinal and latitudinal coordinates.

It is then programmed to transmit this to the GSM module via the microcontroller. GSM stands for Global System for Mobile communication. The GSM module is connected to UART0 and is implemented to forward the stress location tracked by the GPS to the remote station. It includes a SIM (Subscriber Identity Module) card and the SMS (Short Message Service) feature is utilized to send the location.

In conditions of low-light, the LDR (Light Dependent Resistor) sensor is enabled. This is further connected to a flash (we have used a white LED in our prototype). The flash turns on in case of low-light conditions detected.to illuminate the area to be scanned by the camera.

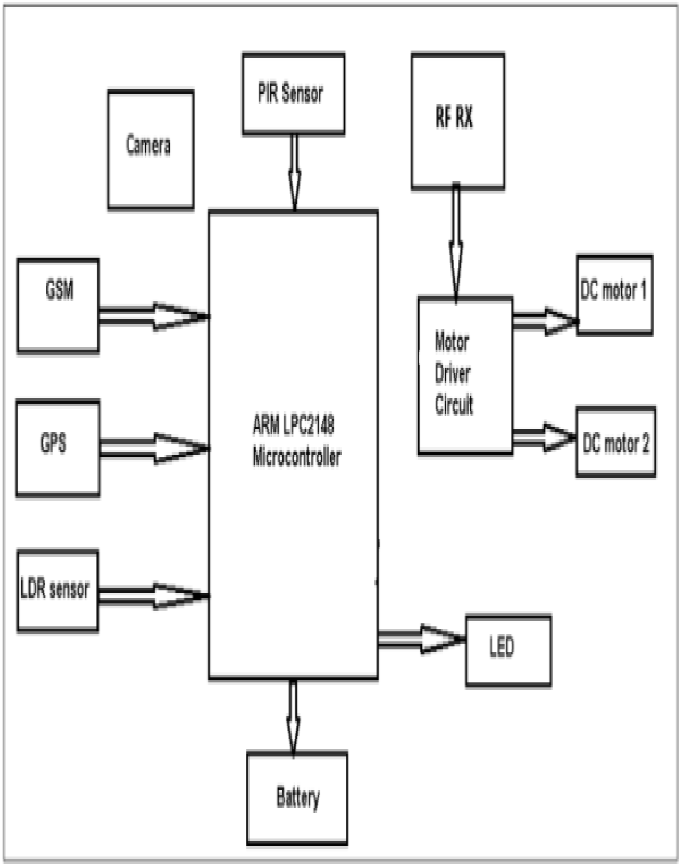

Fig. 7 Robot Block Diagram

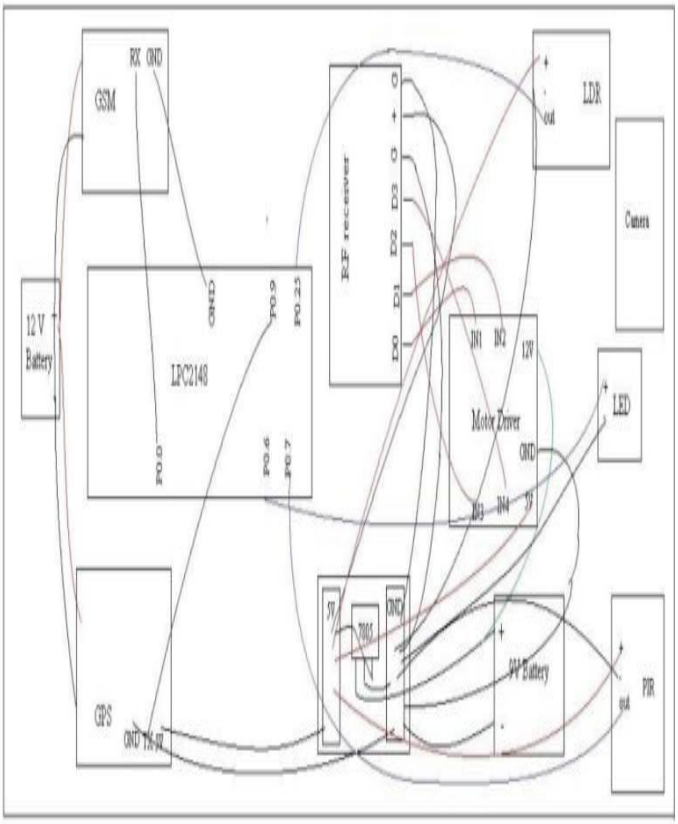

Fig. 8 Robot Circuit Diagram

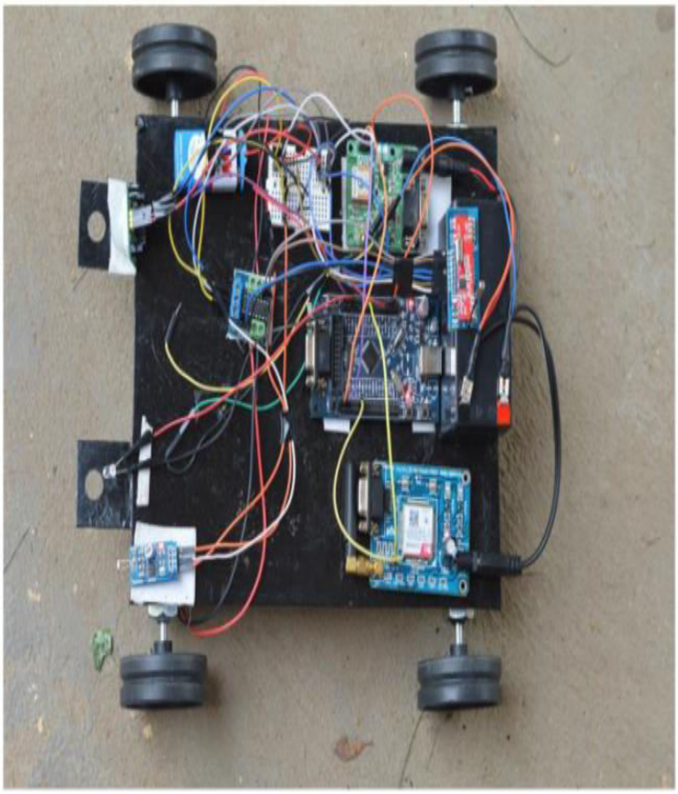

Fig.9 Robot

C. Testing

The RF remote is used to maneuver the robot. It is powered by a 9V battery which is stepped down to 5V using IC7805 voltage regulator. The remote consists of 4 push buttons which determine the direction of the robot. We have used a 4 bit ASK RF transmitter to send the data corresponding to the specific button pressed. Observed range is up to 300 meters.

The RF receiver is connected to the motor driver L293d which in turn drives the dc motors of the robot. The observed sensitivity of the PIR sensor is up to 8 inches. The GPS provides location with accuracy of up to 3 meters. The system is powered using a 12V battery whose lifetime is 10 hours.

300 rpm dc motors are used. Radius of the wheel is 2.5 cm. Hence speed obtained of the robot is 0.7 m/s. The weight of the system is 2.3 kg.

IV. PROJECT CODE

```
#include <LPC214x.H> /* LPC214x definitions */
#include "uart0.h"
#include "uart1.h"
#include "mainuart.h"
#include "gsm.h"
unsigned int z=0,k=0,step1=0,step2=0,step3=0,control=1;
unsigned char temp=0;
unsigned char detected=0;
unsigned int start_loc=0,end_loc=0,trigger=0,stored=0;
unsigned char location[30];
void send_sms1();
void send_sms2();
#define pir (!(IO0PIN&(1<<7)))// Evaluates to True for a
'LOW' on P0.7
#define ldr (!(IO0PIN&(1<<25)))// Evaluates to True for a
'LOW' on P0.25

int main (void)
{
//volatile unsigned char rx_char=0;
uart0_init();
uart1_init();
//printstring1("UART0 Rx Interrupt Test");
IO0DIR &= ~((1<<7));
IO0DIR &= ~((1<<25));
IO0DIR |= (1<<6);//LED

while (1)
{

if(ldr)
{
printstring0("HIGH light");
IO0CLR |= (1<<6);

}
else{
printstring0("low light");
```

```
IO0SET |= (1<<6);
}

if(pir)
{
//printstring0("not detected\n\r");
detected=1;
}
else if(detected==1)
{
IO0SET |= (1<<10)

//control=0;//just for starting initialization of gps

module

printstring0("pir detected");
printstring1("pir detected");
U1IER |= 0x01;
begin:delay(20);
U1IER |= 0x00;
//printstring1(Gps);
pos=0;
k=0;
for (k=0;k<400;k++)
{
if ((Gps[k-3]=='$')&&(Gps[k]=='R'))
{
start_loc=k;
step1=1;
}
}
k=0;
for (k=start_loc;k<400;k++)
{
if(Gps[k]=='A')
{
start_loc=k;
step2=1;
break;
}
}
for(k=start_loc;k<400;k++)
{
if(Gps[k]=='E')
{
end_loc=k;
step3=1;
break;
}
}
k=0;

if((step1==1)&&(step2==1)&&(step3==1)&&((end_loc-
start_loc)<28))

{
printstring1("locations\n\r");
printnum0(start_loc);
printnum1(start_loc);
printstring1("\n\r");

for(k=start_loc+2;k<=start_loc+26;k++)

{
location[k-(start_loc+2)]=Gps[k];
printchar1(Gps[k]);
if(Gps[k]=='E')
break;
}

}

else

{
U1IER=0x01;
goto begin;
}

send_sms1();
//U1IER |= 0x01;
trigger=0;
start_loc=0;
stored=0;
end_loc=0;
detected=0;
}
}

}

void send_sms1()
{
printstring0("AT+CMGF=1");
printchar0(0x0d);
printchar0('\n');
delay(2);
printstring0("AT+CMGS=\"9686269737\"");
printchar0(0x0d);
printchar0('\n');
delay(2);
// main message to be sent start from hear
printstring0("HUMAN detected");
printstring0(location);
printchar0(0x1A);
delay(1);printchar0(0x0d);printchar0('\n');
delay(2);
}

void send_sms2()
{
printstring0("AT+CMGF=1");
printchar0(0x0d);
printchar0('\n');
delay(2);
printstring0("AT+CMGS=\"9686269737\"");
printchar0(0x0d);
printchar0('\n');
delay(2);
```

```
// main message to be sent start from hear
printstring0("bomb detected");
printstring0(location);
printchar0(0x1A);
delay(1);printchar0(0x0d);printchar0('\n');
delay(2);
}
```

V. CONCLUSION

In accordance with the objective of the project, which is to enable the robot to detect a human and perform rescue operations by sending location to the authorities who will provide help, the following tasks have been executed:

- A remote controller designed to maneuver the robot.
- Sensors – PIR & LDR installed to detect human and low-light conditions respectively.
- LED installed to provide light in low-light conditions.
- Messages containing location sent via GSM to help center.

The project helps contribute in rescue operations in areas of natural and man-made disasters to lessen the burden on human force to perform the tasks. The project is low-cost compared to the loss of human life and high-tech robots that consume space. The design is simple to understand and implement. It provides control to the operator apart from being semiautonomous. As a future scope, solar batteries can be installed instead of the rechargeable lead acid battery we are currently using. The robot can also be enabled to send location without use of GSM as some network providers may not have their towers and switching centers at all locations.

We have tried our best to make the robot cost-effective – by using components that readily available, safe – the live feed enables us to view any damage made to the robot, and efficient – as it sends messages to rescue center with location to help out the human.

REFERENCES

[1]. RF transmitter receiver: https://www.engineersgarage.com/electroniccomponents/rf-module-transmitter-receiver.

[2]. PIR: https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/how-pirs-work.

[3]. GSM: https://www.engineersgarage.com/articles/gsm-gprs-modules?page=1.

[4]. GPS: https://www.engineersgarage.com/articles/global-positioning-system-gps.

[5]. LDR:https://www.electrical4u.com/light-dependent-resistor-ldr-working-principle-of-ldr/

[6]. LED: https://www.elprocus.com/light-emitting-diode-led-working-application/

[7]. Motor driver: http://www.rakeshmondal.info/L293D-Motor-Driver

[8]. H Bridge: https://en.wikipedia.org/wiki/H_bridge