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Mobile Rescue Robot for Alive Human Detection in Disaster Zones

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Abstract- *The objective of this project is to find the alive humans in destroyed building with the help of rescue robot in disaster prone and bomb blast areas. The alive human detection sensor is the special type of sensor which has two elements, the live body sensor and Amplifier Circuit. The passive infrared radiation emitting from the alive human bodies are sensed by the sensor and if there is a variation due to movement of alive human body, the difference output is generated. It will be amplified by differential amplifier and then the signal is fed to another amplifier unit in order to amplify the voltage level. Then the amplified signal is given to flash type reprogrammable microcontroller which controls the motor connected to the robot model. The robot moves according to the instructions provided by the operator. If the sensor detects the presence of alive human body, it forces the robot to stop there and microcontroller will activate the alarm. The driver circuit is constructed with transistor, which acts as a switch to turn ON and turn OFF alarm. Now the alarm makes the sound for the alive body indication.*

I. INTRODUCTION

Disaster is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Nowadays most of the people live in urban areas. Hazards that strike in areas with low vulnerability will never become disasters, as it is the case in uninhabited regions.

Every year, various collapse of man-made structures such as bridges, buildings and also natural catastrophes like earthquake, landslides occur in various parts of the world. The Urban Search and Rescue (USAR) say the probability of saving a victim is high only within the first 40hrs of rescue operation, and then the probability becomes zero.

In such cases, humans are being trapped in the cavities created by collapsed building either in conscious or unconscious state. One of the major natural disaster that took place in Jan 2001, at Gujarat resulted in a huge loss of human lives and property. A recent collapse of man-made multi-storied building at Moulivakkam in July 2014 claimed nearly 60 lives as per 'Hindustan times.

II. Literature Survey

In initial days dogs were used because of their high sensitivity to any slight motion or human presence. But it was hard to totally depend on them since they can predict the presence of a living victim and dead victim and also they were not able to expose the exact situation of the human. One major drawback was dogs couldn't work independently; they need assistance of a human. It means, the need is totally or partially independent to human factor but still depends on human.

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Later techniques such as

a. Optical devices namely Tactic Pole Utility System
b. Acoustic devices like Microphones and Amplifiers were used but with limited applications.

Robots are now achieving good progress in many fields like Military, Industry, Medicine, etc., with proven efficiency. They are playing an important role in replacing human factor in almost all fields.

Mauricio Correa, Gabriel Hermosilla, Rodrigo Verschae, Javier Ruiz-del-Solar. (2012), "Human Detection and Identification by Robots using Thermal and Visual information in Domestic Environments", J I tell Robot System (2012) 66:223-243 has given the concept of enabling robots to detect and identify humans in domestic environment. This work was done with the aid of Thermal and Visual Information sources that were integrated to detect humans and further processed to verify it.

Remote Operated and Controlled Hexapod (ROACH) is a six-legged design that provides significant advantages in mobility over wheeled and tracked designs. It was equipped with predefined walking gaits, cameras, which transmit, live audio and videos of the disaster site, as well as information about locations of objects with respect to the robot's position to the interface on the laptop. Specialized robots have been designed for these types of environments such as KOHGA the snake like robot. This robot was constructed by connecting multiple crawler vehicles serially, resulting in a long and thin structure so that it can enter narrow space.

Quality work has been done in the field of robotics. They came into existence in the early 21st century but since then enormous improvements have been made in its concept, design based on purpose of use. Various rescue robots have been developed and some of these are – CRASAR (centre for robot assisted search and rescue) in university of South Florida. This robot was used for first time in real conditions on 11th September 2001 in the world trade centre disaster. Different sensors like millimetre wave radar for measuring distance. A colour CCD camera for vision and a forward-looking infrared camera for the human heat detection were used.

Shwetha. R, Dr. Chethan H K, (2014), "Automatic and Manual Controlled Alive Human Detection Robot during disaster Management", International Journal for Technological Research in Engineering", ISSN: 2347-4718, Volume 1, Issue 11 has done a work on designing an economical robot, which works using AVR, MCU, PIR sensor. This robot senses the human body and these messages are sent through SMS using GSM technology to enable rescue operation.

Burion presented a project that provided a sensor suitable for human detection for the USAR robots. It evaluated several types of sensors for detecting humans such as pyroelectric sensor, USB camera, microphone, and IR camera. The pyroelectric sensor was used to detect the human body radiation. The USB camera was used for motion detection. A microphone was used for long duration and high amplitude sound detection. The IR camera was used to detect humans by their heat image. The main idea was to detect a change in the image scene by checking the values of the pixels. Several images for the scene were acquired and subtracted from each other to discover if a motion has occurred. The used technique was fairly efficient in detecting the victims.

III. Proposed System

This system proposes a mobile robot which helps in rescuing the victims of natural disaster. It helps the rescue team by identifying the alive human in disaster prone. It consumes lower power when compared to the existing system. Designing cost is also relatively low. It is easy to operate. PIR sensor is the only sensor used in this system. The proposed system does not emit any harmful radiation.

This project is very useful in the disaster and bomb blast areas for the rescue of human beings. It can also be used in military for the purpose of detecting invaders.

IV. Block Diagram

As shown in Fig. 1, this system consists of two sections a robot and its control section.

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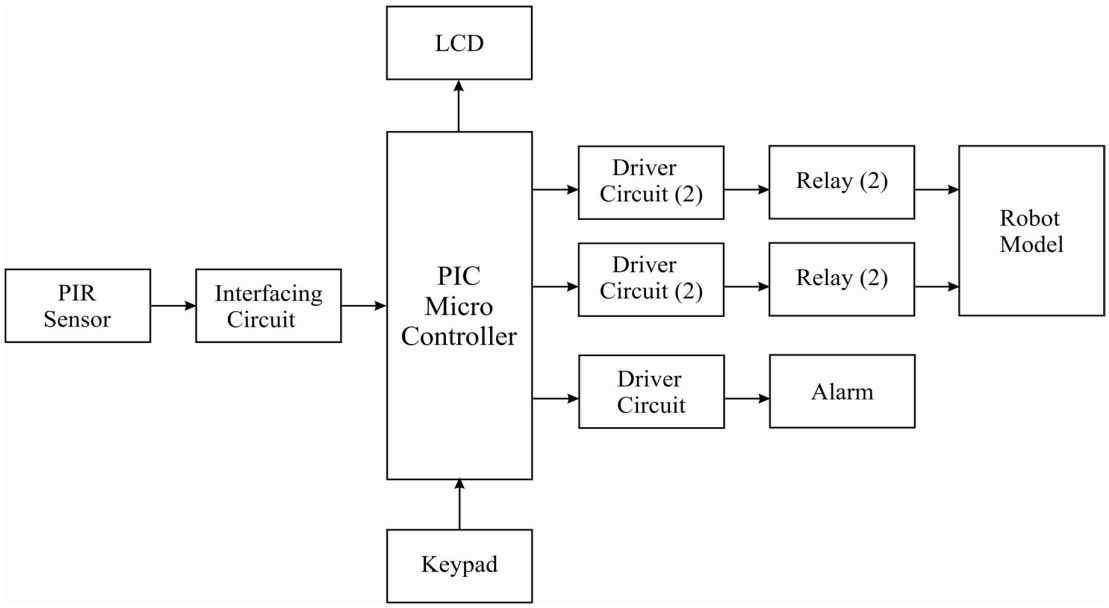

Fig.1 Alive Human Detection System

The Alive Human bodies in the destroyed building are sensed by the sensor. If the sensor detects the human body, the microcontroller forces the robot to stop. The driver circuit acts as a switch to alarm.

V. Hardware Components

a. Embedded Microcontroller PIC 16F877

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

PIC (16F877): Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are the other features of PIC 16F877.

Special about PIC is that, has high performance RISC CPU, fully static design, wide operating voltage range, two capture, compare and PWM modules, Synchronous Serial Port(SSP) with SPI.

Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM data memory.

b. PIR Sensor

The PIR sensor has two slots in it; slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor) half of the PIR sensor which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, when the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like human passes, it first intercepts one whereby the sensor generates a negative differential change. These change pulses are what is detected. Fig.2 shows the schematic representation of PIR Sensor.

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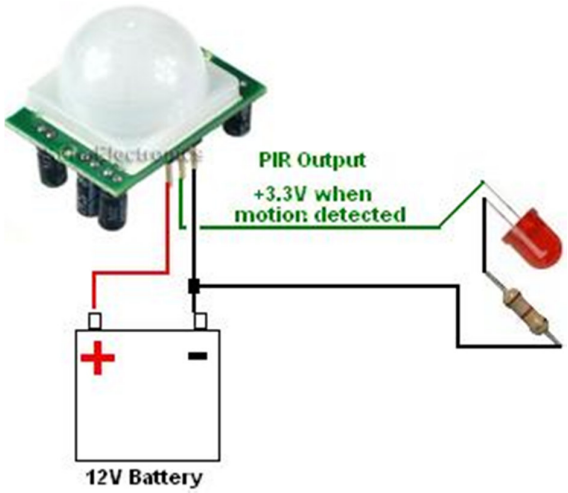

Fig.2 PIR Sensor

c. Amplifier

An amplifier is an electronic device that can increase the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with larger amplitude. In this sense, an amplifier modulates the output of the power supply to make the output signal stronger than the input signal.

d. Relay

Relays are electromechanical devices that use an electromagnet to operate a pair of movable contacts from an open position to a closed position. The advantage of relay is that it takes a relatively small amount of power to operate the relay coil, but the relay itself can be used to control motors.

e. Motor & Motor Drive

Motor causes the movement of robot which can move over disaster zones. Motor Drive is the interfacing circuit between microcontroller and robot.

f. Alarm & Keypad

Alarm indicates the presence of alive human body. Matrix Keypads are very common input devices in embedded systems. They have simple architecture and are easy to interface.

VI. Software Tools

MPLAB IDE

It is used for programming the PIC 16F877 microcontroller.MPLAB IDE(Integrated Development Environment) is a free, integrated tool set for the development of embedded applications employing microchip's PIC and ds PIC microcontrollers. MPLAB IDE runs as a32-bit application on MS Windows, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

VII. Conclusion and Future Work

The proposed system has two sections for this operation and these two sections are inter-related to each other. The first section is the control section, which makes the movement of robot into the debris. The second section is the sensor section, which searches for the alive human and send information to the rescue team. In future, automatic pick and drop of blocks and human with robot arm can be implemented which can further reduce the time consumption.

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