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Detecting Alive Human Using Robot for Rescue Operation

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Abstract: *In the current technological world, the technologies are evolving day by day. These developments make human life easier and more enthusiastic. The new high-speed technologies & growing computer capacity provides advancement in the field of control theory. In the modern world, there are continuous development of the skyscraper buildings & dwellings which increases the risk of losing life by natural calamities and manmade disasters. During earthquakes, landslides, and building collapse, a lot of times, humans are trapped under debris and it becomes impossible to detect their presence by the rescue team. Sometimes, it is impossible to reach certain locations in calamity affected zone. Many models have been proposed for detection of human's presence under the debris in affected zone. This paper analyses various models developed to find the alive human being during natural calamities.*

Keywords *– Alive Human Detection, Microcontroller, Natural Calamities, PIR Sensor, Web Camera.*

1. INTRODUCTION

In current era, natural calamities like Earthquakes, building collapse or manmade disasters often occur and they cannot be stopped. They produce a devastating effect and find no difference among human and material. Hence, many times humans are buried under the detritus and it becomes impossible to detect their presence. Detection by rescue workers becomes time consuming and due to the vast area, that gets affected it becomes more difficult. Almost all the proposed models were developed using a microcontroller and some set of sensors which commonly includes PIR sensor, Ultrasonic sensor and IR sensor. PIR technology analyses its environment and looks for a change in present heat signatures. The Ultrasonic sensor and IR sensor are used for proper navigation of the robot in the affected zone.

2. LITERATURE STUDY

Zia Uddin, et. al. [1] has developed a robot which is able to find a live human being with the help of PIR sensor from deep point of the disaster area. It uses a Joystick & RF technology to control robot and work with the control point. Ultrasonic sensor is placed for detecting obstacle for navigation of robot and has a gas sensor to detect gas leak in the affected area. IP Camera is integrated to analyse the conditions which will assist human detection with the highest chance of success in such a situation. The first level includes a PIR sensor that detect human presence by radiated infrared wave & second level is IP camera that confirms the presence of humans in the affected area. Because of the two levels human detection system the system is reliable for rescue missions. The microcontroller is programmed using the C language and ARDUINO IDE. The system provides good results and it is cost effective. Since it has joystick mechanism, hence it is handy to use.

Murulidhara T C, et. al. [2] proposed the design and implementation of an Unmanned Vehicle using ARM7 microcontroller along with web camera, pulse sensor and temperature sensor to detect the affected human beings in disaster environment. IR sensor is included in the model to avoid obstacles in its navigation path. The vehicle navigates through the debris automatically to check the presence of human life. As soon as it detects the presence of human, 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. ZigBee is used to send & receive data between robot and control unit. The base station receives the longitudinal and latitudinal location of affected humans through ZigBee Transceiver and display this information on monitor to speed-up the rescue operation. The hardware design consists of low cost, easily available & reliable components.

Rahu Krishna K, et. al. [3] has developed an autonomous robotic vehicle that moves in the earthquake prone area and helps in identifying alive people. It has sensors that detects the presence of the human being and indicates the presence to user. As stay the human body emits thermal radiation, which is received & manipulated with the aid of PIR sensor to detect human presence. Once the human located, it immediately gives and audio & visual alerts to the authorities. The PIR sensor is assembled on a robot which can operate in the areas which are prone to earthquakes. The robot has a 3-wheel geared driver & DC motors attached for forward, reverse, left & right actions. The controlling device of the system is a Microcontroller to which RF receiver, PIR sensor & DC motors are connected. The remote control has control buttons interfaced to RF transmitter. Whenever a button pressed, the data related to that button transmitted through RF transmitter to microcontroller. The microcontroller processes this data and acts accordingly and sends required control signals to the robot's motor drivers. PIR sensor is interfaced to the microcontroller which continuously monitors human presence and indicates to the controller. The controller alerts through buzzer if human presence is detected.

Sabyasachi Bhowmick, et. al. [4] designed a simple Robot that detect the human with a new way. System has an input that are a PIR sensor, Ultrasonic Sensor, IR sensor. Ultrasonic sensors & IR sensor used for navigation of the Robot. PIR Sensor is used for searching human presence. RF transmitter is used to send the information of human presence & is received the information through the receiver circuit. Next receiver immediately generates output which turns the buzzer/alarm and it displays ON. A program is written and executed for the purpose of using AVR Microcontroller. Two DC motors are connected with wheels, & one castor wheel is connected to help the robot in navigation. 9V battery was connected as power source. While testing the robot, many obstacles were placed in the path and the ROBOT detected those obstacles successfully and the Ultrasonic Sensor was able to detect its path every time. At the second part when a human was in the range of 4 ft. of the PIR Sensor, PIR sensor make a robot stopped and started analysing the output and turning the RF transmitter ON. On the other hand, the RF receiver received the transmitted signal showing an output to the LCD as 'Human Detected'.

Saravana Kumar K, et. al. [5] proposed a robot which is used to detect human to overcome robbery and to enhance security measures. The robot has receiver side and the transmitter side. The transmitter is of ATMEGA328 microcontroller PIR sensor takes a input of microcontroller, and an Obstacle sensor. The outputs are displayed on RF transmitter & L293D motor drive module that is connected to DC motor. The DC motor is there to move the robot in left, right and forward and backward directions. PIR sensor is used to detect presence of human. The PIR sensor has limited range up to 12ft and has an angle of rotation 180 degree. At receiver end has of ATMEGA328 microcontroller. Its input & output are buzzer and a RF receiver. After reviving the signal by the RF receiver, it notifies the Arduino. Arduino sends a signal to the buzzer, which makes the buzzer to sound continuous beeps. This beeping shows that there is a human to the rescue team. This system is capable of detecting the presence of human in the range of 10-12ft successfully.

M.Brem Kumar, et. al. [6] proposed a system that uses camera module and ultrasonic sensors that analyses the conditions to find the presence of human. The proposed model is used to detect human and uses a low- cost camera that helps to video the scene as needed. Additionally, other sensors include temperature, fire and metal detector works as bomb sensor to detect the presence of bomb in war field & in rescue operations. As soon as it detects a sign of a living human, the ultrasonic sensor triggers the camera to stream live scene. The video is then displayed on the screen. This approach needs a relatively small number of data to be acquired & processed during the whole operation. Like this, the real-time cost of processing and data transmission is considerably reduced. This system has the potential to achieve high performance in detecting alive humans in affected environments quickly and cost effectively. The detection depending on multiple factors such as the body position and the light intensity of the scene. Results show that the system provides an efficient way to track human motion in devastated environment.

Mr. S.P Vijayaragavan, et. al. [7] has developed an autonomous robot that moves within the affected earthquake prone areas which helps in identifying the humans. The system is developed using Embedded Microcontroller PIC16F877A, ZigBee Transmitter and Receivers, PIR sensor and also other supporting components. The benefits of using PIC16F877A is that it provides maximum clock frequency up to 20MHz and faster than other controllers. ZigBee transceiver is used to transmit and receive data between robot and therefore the control unit. Passive Infrared (PIR) sensor is used to detect alive human. As live physical body emits thermal heat Radiation which is captured by PIR sensor to identify alive humans. They also developed an on-screen application to manage the robot using Visual basic. The system is safe for the user due to use of robotics and no manual work. The user just has got to control the robot and do necessary action as soon as user receives the positive signal from the system.

Mohit Bais, et. al. [8] discussed a new approach for detection of alive human beings in natural calamities and man-made disasters using a specific set of sensors, ATMEGA16 Microcontroller, GSM technology and PLC systems. The proposed alive human being detection system is developed using a specific set of sensors which includes PIR, temperature, vibration, IR, Ultrasonic detector, Bluetooth module HC05 transmitter & receivers. They all together give the information about the presence of a living human body in calamity affected zone. PIR and IR sensors are used to detect the presence of humans. Obstacle sensors detect the obstacle & the analog signals are received by AVR microcontroller. AVR is programmed to send the human presence information to remote control place using the GSM modem. Signals from PIR sensors are transmitted to the microcontroller which will digitize the signal and transmit it to the RF Transceiver Bluetooth module. RF transceiver is used to transmit and receive data between robot and the control unit.

Shwetha R, et. al. [9] aims to develop a cost-effective robot, which works using AVR microcontroller, PIR sensor, IR sensor etc. The system is employed in areas where rescue is required. The robot senses the body heat temperature using PIR sensor and alarm which indicates the signal when it detects alive physical body, then message is shipped through SMS through GSM technology to enable operation. PIR sensor is directly connected to the digital pins which is operating at 5V DC. The motion is to be detected by checking for a sudden change within the affected area. Obstacle sensors are used to detect the obstacle and is used to send the analog signals to AVR Microcontroller. AVR controller is programmed to navigate and manage the robot automatically counting on obstacle detected. PIR sensor detects the human at affected area which are alive and signal is given to AVR microcontroller. AVR is programmed to send the alive human presence information to remote place using the GSM Modem. The system is remote controlled & designed for limited range. RF frequency range is 434 MHz and remote controlling is meant for limited distance.

Geetha Bharathi, et. al. [10] developed a mobile controlled robotic vehicle which moves in the disaster-prone area & it detects alive human presence in such devastating environments and helps to identify the live people and rescue operations. In this project Passive Infrared (PIR) sensor has been used. The system consists of a Robot section and Control section. Robot section consists of a movable unit, which has Bluetooth module, GPS Receiver, an LCD display, PIR sensor mount on it and a microcontroller ATMEGA-328. Control unit consists of a manual control using a remote to control the movement of the robot and a PC interfaced with the robot section using Bluetooth to get the output of GPS receiver. i.e. to find the exact location of the human. Initially, the Robocar navigates in an open field and PIR sensor checks for the alive human. If result is yes, then the GPS shows the exact location of the human in the PC screen that is in the Control section, with the rescuers. This Robot has camera, so as to record and display data when sensor triggers it. As soon as it detects human in its range, the message "Human Detected" is shown on the LED screen.

Shuddha Chowdhury, et. al. [11] developed a Robot model, which roams around the war field, any disaster affected area to detect the presence of alive human in that calamity zone. The robot is designed with full 360-degree movement to move into the war filed, earth quake affected area, to find out the Alive or Survived Human beings. They used 8-bit microcontroller AT89S52, PIR (Passive Infrared) sensor and IR sensor as highlight components and they are configured with other components. PIR Sensor is sensitive to heat or rather the infrared light that is emitted by warm or hot objects like humans. The most often use of the PIR sensor is as an area sensor, which detects someone moving in the front yard. The logic of PIR sensor is that it must detect significant change of the normal level of heat in the field of its view. The model consists of an IR based human

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radiation sensor, which picks up signals from human body radiations and gives a signal output. The human body radiates infrared waves with wavelengths of around 8-12 micrometres. Whenever a human being comes under the vicinity of the system, the IR system gives the signal. The robot also has a wireless RF transmitter which sends the message to the remote location whenever it finds any alive human.

Krashna V. Panpaliya, et. al. [12] proposed a robotic system for military zone to detect alive human body. The system has a specific sensors PIR sensor, IR sensor, Heartbeat sensor etc. In addition, has a wireless camera module. PIR sensor is a motion sensor that detects the motion of the human with the thermal temperature of the environment. It has two modes where robotic system is working i.e. it has a manually operated mode and user controllable mode. System operates on manual mode in which all the used sensors are capable for automatic action, in user controllable mode user, gives the signal to the system that uses RF module, and control it manually. The operations that the system perform is on embedded PIC microcontroller and ZigBee transmitter and receiver. The battery backup is week, due to which they have to use a solar panel. In addition, the system is on GSM technology by using image processor. In camera module, web camera is used and it is used on the robot. By having a camera, the video is transmitted to the receiver and it will transmit the video coverage of the paths that is to be taken. This system works perfectly fine and it can take actions automatically or can be controlled manually.

Asha Gupta, et. al. [13] discussed a new methodology for detection of alive human beings in natural or man-made disasters using some specific set of sensors which includes ATMEGA16 Microcontroller, GSM technology and PLC systems. PIR sensor is there to detect the presence of human. PIR sensor helps to detect the human presence by detecting the thermal radiations emitted by human body. The PIR sensor has a limited range up to 12ft & it can rotate up to 180 degrees. The motive of the system is to develop wireless robot that can be operated via desktop using ZigBee transceiver & it is able to navigate in the disaster environment & try to find human being who need help. Victims may be trapped under debris or in voids, making it difficult to find them and determine their state of health. That's why it is important to select a set of different sensors that are complementary and are able to operate in these conditions. The system also uses WPL soft which is a software for PLC (Programmable logic controller), PROTEUS which is a best simulation software for various designs with microcontroller, BASCOM which is a very powerful and easy to use compiler for the AVR series of micro controllers which are developed by Atmel. It is very much important to choose a set of different sensors which are complementary and are able to operate in the provided conditions.

Midhat Noor Kiyani, et. al. [14] proposed a model which is able to take two maps i.e. localize map and the global map. Using these maps, it generates a shortest path. The proposed system is given a map of the arena to localize itself & plan the path. Map of the area is given to robot before the start of its search and rescue operation. Two maps are used by the robot i.e. primary map and secondary map. Primary map is given in the form of a matrix in which a node represents each block. It can also do obstacle removing from its path. By using this, they map the position of walls and outer rims, and colour of the floor of the affected area. The paper involves the robot design which is can localize self in the familiar environment but the not known location. A technique of comparison of primary and secondary matrices was applied for localization, and modified version of Dijkstra technique was implemented for shortest path determination. The robot is able to search for the objects & move them to their respective final destination point in the known environment. As the robot needs to go through the rough terrains and unlevelled surfaces in the real-time event, it must be light as well as small enough even to go through the narrow places.

A. Shobika et. al. [15] proposed a human detection quad-copter which is able to detect alive human being in debris so that timely help can be provided to the victims. The proposed system comprises of Passive Infrared sensor (PIR) that provides the information about the presence of alive human being. Radio Frequency (RF) Technology is used to control the quad-copter. ATMEGA8A microcontroller gives an alerting message for the rescuer of the affected sites, so that they can give proper rescue to the victims. In disaster environment, it is great help to rescuers in detection of alive humans in the proper time. The system is user-friendly, semi-autonomous, economical & efficient. The system is a quad-copter that fly in a disastrous environment and helps in identifying the alive people and rescue operations. A PIR sensor is used, it emits infrared radiations for the detection of humans. Alive human body emits thermal radiations which is received & manipulated by PIR sensor for detection of humans. Once human is located, it immediately gives audio alert to the rescuer, so that help can be provided to

the live person very fast. This PIR sensor is placed on a moving each direction quad-copter which can fly in the earthquake prone areas.

3. ANALYSIS TABLE

The Table given below is a summary of research papers on assisting visually challenged. It states the different techniques used for assisting sightless and also highlights their advantages and disadvantages.

Table 1: Analysis Table

Sr. No.	Paper Name	Technique Used	Advantages	Disadvantages
01.	Search and Rescue System for Alive Human Detection by Semi-autonomous Mobile Rescue Robot.[1]	Arduino, PIR sensor, Ultrasonic sensor, RF technology, Camera module.	The robot is controlled using joystick mechanism which is handy to control. It is 2 level detection system and cost effective.	PIR sensor can detect humans only if he is somewhat visible. The sensor has the rotation range of 180 degree.
02.	Unmanned Vehicle to Detect Alive Human During Calamity.[2]	ARM 7 controller, IR sensor, Viola Jones algorithm.	The vehicle sends the Longitudinal & Latitudinal information about location of affected human with his/her pulse rate, body temperature.	This implementation requires a computer system to get the desired output.
03.	Wireless Human Detection Robot. [3]	PIR sensor, RF transmitter and receiver, three-wheeler robot.	The system proposes a wireless robot which can be mobilized. The system can monitor the environment in real time.	The system is cost in-effective due to use of expensive components in the controller.
04.	An Approach to Design a Simple Human Detecting Robot for Cost Effective Home Security System as well as Various Rescue Missions. [4]	ATMEGA-32, PIR sensor, Ultrasonic sensor, RF transmitter and receiver, LCD.	It can detect human in any environment irrespective it is day or night.	The system is unable to detect humans in debris.
05.	Human Detection Robot using PIR Sensors Device. [5]	ATMEGA328 microcontroller, PIR sensor, RF Transmitter and receiver.	PIR sensor helps to detect the human presence by detecting the heat.	The accuracy of the system reduces in open channel due to PIR sensor.
06.	Alive Human Body Detection system using an Autonomous Mobile Rescue Robot.[6]	Ultrasonic sensor, Temperature sensor, Fire sensor, Bomb sensor, RF module.	The system requires small amount of data to be acquired for processing purpose.	The system has cost, size and environment related difficulties.
07.	Live Human Detecting Robot for Earthquake Rescue Operation.[7]	Microcontroller PIC16F877A, ZigBee Transmitter and Receivers, PIR sensor.	The System is safe even for the user because of the use of robotics and no manual work.	Battery backup and cost are the major issues with the proposed system.

08.	Alive Human Detection Robot.[8]	P89V51RD2BN Microcontroller, PIR sensor, IR sensor, PLC logical programming.	The system is developed using specific set of sensors, ATMEGA microcontroller etc. The system uses transceiver which is Reliable and accurate.	Battery backup for camera module is weak. The cost of using high range sensors may be high.
09.	Automatic and Manual controlled Alive Human Detection Robot during disaster management.[9]	PIR sensor, IR sensor, AVR microcontroller GSM technology.	The system uses GSM technology to get the live location of affected human.	The system does not provide the exact position of human in the debris or buildings.
10.	Alive Human Detection in Disaster zones using manually controlled robots.[10]	Microcontroller ATMEGA-328, PIR sensor, GPS module, Bluetooth module.	The proposed system uses PIR sensor for human detection. It is cost effective than existing system.	It requires a computer system to be installed at disaster prone area.
11.	A Proposal of User Friendly Alive Human Detection Robot to Tackle Crisis Situation.[11]	Microcontroller AT89S52, PIR sensor and IR sensor.	The robot has 360° rotation mechanism. The use of IR sensor with PIR sensor increases accuracy of the system.	The system is unable to provide the location of human because there is no GPS module in it.
12.	Detection of Alive Human body in Military area.[12]	PIC micro-controller, PIR sensor, RF module, GSM technology.	The system can perform the actions automatically or can be controlled by any user.	The system is designed for limited distance only. The battery backup is in-efficient.
13.	Live Human Detection Robot.[13]	ATMEGA16 microcontroller, PIR Sensor, Ultrasonic Sensor.	PIR sensor helps to detect the human presence by detecting the thermal radiations emitted by human body.	The accuracy of the system reduces when temperature is high in surroundings.
14.	A Prototype of Search and Rescue Robot.[14]	Dijkstra's Algorithm, Map-matching Algorithm, Route Planning.	The robot was easily able to localize itself in the known environment when its image matrix is given.	The model is not robust that is it can't be used in the non-ideal actual operations. The major difficulty in the rescue robot is the robot's design.
15.	Human Detection System Using Drone for Earthquake Rescue Operation.[15]	ATMEGA8A microcontroller, PIR sensor, Brushless DC motor, RF transmitter and receiver.	The system is user friendly, economical, semi-autonomous and efficient for human detection. Since the system is a quad-copter, it is easy for navigation.	As the system's main component is PIR sensor, it may fail in changing environment conditions.

4. CONCLUSION

In the modern era, we lose a lot of lives due to natural calamities or manmade disasters. The rescue team apply a lot of efforts to reduce the devastating effect of the calamity. To help the rescue team in searching the buried people inside the debris, various models were developed. These models are most commonly a robot and are consists of a microcontroller and some set of sensors. The objective of all the proposed models are more or like identical having different set of features. The model gives a considerable amount of accuracy. In the paper, we studied & analysed various models that have been advanced to discover the human's presence underneath detritus. The growing technology will come up with more reliable models having more features and better accuracy.

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