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Human Detecting Robot for Earthquake Rescue Operation Using IOT

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ABSTRACT: In this paper, a new approach for detecting alive humans in destructed environments using a autonomous robot is proposed. Alive human body detection system proposed a monitoring system using ultrasonic sensors and camera to record, transmit and analyze conditions of human body. The task of identify human being in rescue operations is difficult for the robotic agent but it is simple for the human agent. In order to detect a human body, an autonomous robot must be equipped with a specific set of sensors that provide information about the presence of a person in the environment around. This work describes a autonomous robot for rescue operations. The proposed system uses an ultrasonic sensor in order to detect the existence of living humans and a low- cost camera in order to acquire a video of the scene as needed. Additional, other sensors include temperature, fire and metal detector. Having detected a sign of a living human, the ultrasonic sensor Triggers the camera to show live scene. The video is then displayed on the screen. This approach requires a relatively small number of data to be acquired and processed during the rescue operation. This way, 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 devastated environments relatively quickly and cost-effectively. The detection depending on a number of 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. The aim of this article is to present our experience with various sensors designed and developed.

KEYWORDS: Earthquake Rescue robot, GPS, GSM, PIR sensor, temperature sensor, Raspberry Pi, robotic arm.

I. INTRODUCTION

Disasters can disrupt economic and social balance of the society. Because of high rise buildings and other manmade structures urban and industrial areas can be considered to be more susceptible to disasters. These disasters can be categorized into natural and human induced disasters. Natural disasters include building collapse and earthquakes. During such calamities, especially disasters, in order to prevent loss of life and property various essential services are deployed. According to the field of Urban Search and Rescue (USAR), the probability of saving a victim is high within the first 48 hours of the rescue operation, after that, the probability becomes nearly zero. Generally, Rescue People cannot enter into some parts / places of the war field or in the earth quake affected areas. All of these tasks are performed mostly by human and trained dogs, often in very dangerous and risky situations. The rescuer may become a victim who needs to be rescued. This is why since some years mobile robots have been proposed to help them and to perform tasks that neither humans, dogs nor existing tools can do. For this project, we will focus only on robots which will work in a disaster environment of manmade. The proposed system uses an ultrasonic sensor in order to detect the existence of humans and a low-cost camera in order to capture image of the scene as needed. Having detected a sign of a human, the ultrasonic sensor triggers a camera to capture a image of the scene. The simulated robot is assumed to have the capability to determine its current location in real-time, to wirelessly communicate with the rescue team, and to locally store the status and location information about the trapped victims in case the wireless communications link is temporarily disconnected.

II.METHODOLOGY

The project proposes a rescue robot that moves in the disaster, earthquake prone area and helps in identifying the human, injured people, location and rescue system operations. Hence due to the on timely detection in natural calamities this can save precious life & great loss even without the help of large number of rescue operators. The proposed system consists of a rescue robot, PC control Module. The rescue robot consists of three units that are namely Sensor unit, Motor driver unit, Transmission unit. The sensor unit must be directly interfaced to the Raspberry pi. The sensor devices monitor current readings and sends data to the Raspberry pi. The controller circuit is responsible for transmitting this information. Controllers are designed at hardware level .A PIR (Passive Infrared sensor) is utilized in

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the project which emits IR (infrared rays) in order to detect humans. As a human (body) emits thermal radiation. This thermal radiation is detected and manipulated accordingly by the PIR sensor in order to detect humans. Upon detection the person in need of help is located, at the receiver side it immediately provides an audio alert (buzzer) captured images to the concerned authorities. This PIR (Passive infrared) sensor is placed in front of the moving robot that can move in all the directions. The robot moves in either direction of the geared dc motor for optimum torque and minimum speed and motor derives with relays for turning and movement in forward,right, and left directions with accuracy. The motor drive is a two-wheel geared drive with DC motors attached to perform movements in either forward, left, right directions. On a contrary note, Detection of human by designated rescue workers is tiring, reliable but very time consuming; therefore, using the human detection robot for earthquake and other disastrous areas is much more beneficial for detection which is then followed by a rescue operation upon detection.

III. BLOCK DIAGRAM

As shown in fig 1. This system consists of transmitter and receiver unit. Furthermore transmitter unit consist of rotational unit which has a specific set of sensors mount on it and a Raspberry pi. Receiver unit consist of camera which gets activated and starts capturing images as soon as ultrasonic sensor detects motion of human being and buzzer gets a beep and there is also an LCD which is used to display the temperature, motion and metal detection.

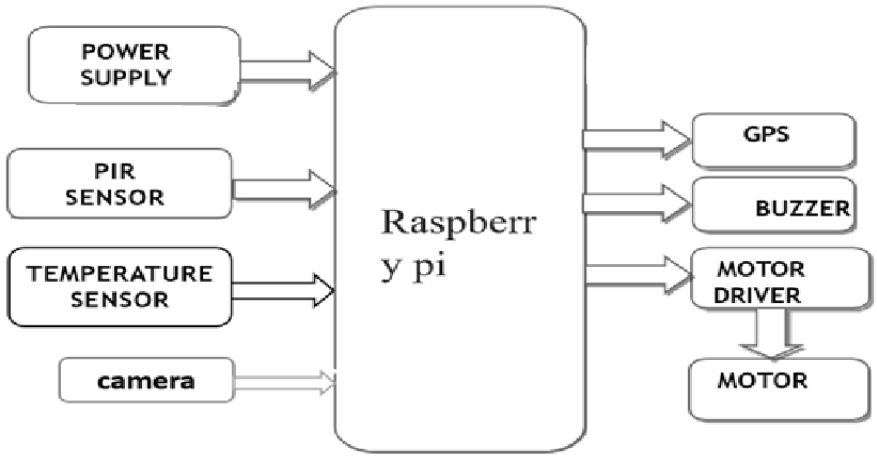

Fig. 1 Human Body Detection System Based on Sensors

A.IR SENSOR:

- An IR sensor can measure the heat of an object as well as detects the motion.
- These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor.
- IR sensor runs the operation up to 2.2v-5v.
- Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor.

B. TEMPERATURE SENSOR:

- A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.
- The temperature sensor here we are using is LM35 sensor.
- The temperature detects the temperature and transfer it to client for further action to proceed.

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C.WIRELESS TRANSMISSION:

- The robot position is tracked between intermittent global localization to have an all time position estimate available to the robot.
- Using GSM based wireless system for the efficient communication.
- The GPS receiver receives the Longitudinal and latitudinal value when the system detects the movement of the human body it sends the location details to the stations using GSM modem.

D.BUZZER:

- A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric.
- Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

E.MOTOR DRIVER:

- The motor driver is used to operate the front and the rear DC motors which in turn control the motion of the robot.
- The motor driver IC we are using is L293D.
- It is actually a current amplifier and converts the low current signal coming from a controller and amplifies it to provide the high current required for running the DC motors.

F.CAMERA:

- The camera is the eye for robot, call as rob vision helps in monitoring security system and also can reach into the places where the human eye cannot reach.
- Captures video of the disaster area, and it is displayed live on the LCD at the Transmitter section.

G.ROBOTIC ARM:

- The arm is the main section of the robotic arm and consists of three parts: the shoulder, elbow and wrist End Effector.
- The end effector acts as the hand of the robotic arm. Controllers are the main processors of the robotic arms and act as their brains.
- A typical robotic arm is made up of seven metal segments, joined by six joints.
- The computer controls the robot by rotating individual step motors connected to each joint The robot uses motion sensors to make sure it moves just the right amount.

H.LCD:

- LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation.
- LCD implemented is 16*2 LCD on encoding of information 4 data bit.
- LCD & Display components are used to give visual feedback and display text, images and videos.

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IV. MODULE DESCRIPTION

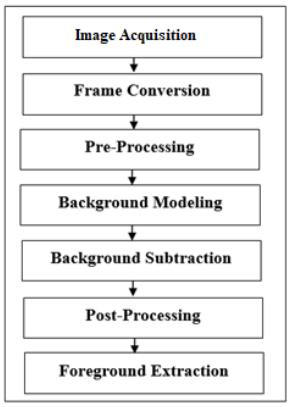

Fig. 2Module Description with algorithm

1) **Video Acquisition:** First step deals with acquiring the video by any one the devices, such as Handy cam, Mobile Camera, USB camera and CCTV Camera etc.
2) **Frame Conversion:** Once the video is capture, those videos are converted into frames and suitable type of processing can be done conveniently.
3) **Pre-Processing:**Pre-processing is applied on the frames of the images. Some of the common methods of preprocessing are smooth, dilate, erode and median etc.
4) **Background Modeling:** Once the pre-processing is done, background modeling is used to create an ideal background (static or dynamic) according to the environmental changes. Background Modeling important step of the system to perform some image subtraction operations. It is the default characteristics of any background subtraction system. According to the literature there are several background modeling techniques which are categorized as recursive or non-recursive techniques. For this system recursive technique being used.
5) **Background Subtraction:** This is the main step in the background subtraction system. In this step any significant changes in the image region from background model are identified & then pixels constituting the regions undergoing change are marked for further processing. Usually connected component labeling algorithm is applied to obtain connected regions corresponding to the object.
6) **Post-Processing:** Finally, post-processing is done to improve the results. There are many post processing techniques that can be used after background modeling and subtraction. These techniques have an objective to improve foreground mask.
7) **Foreground Extraction:** This is the final step in the process which extracts the moving object from the frame. The result of this step helps in the judgment of the efficiency of the background subtraction system.

V. SYSTEM IMPLEMENTATION

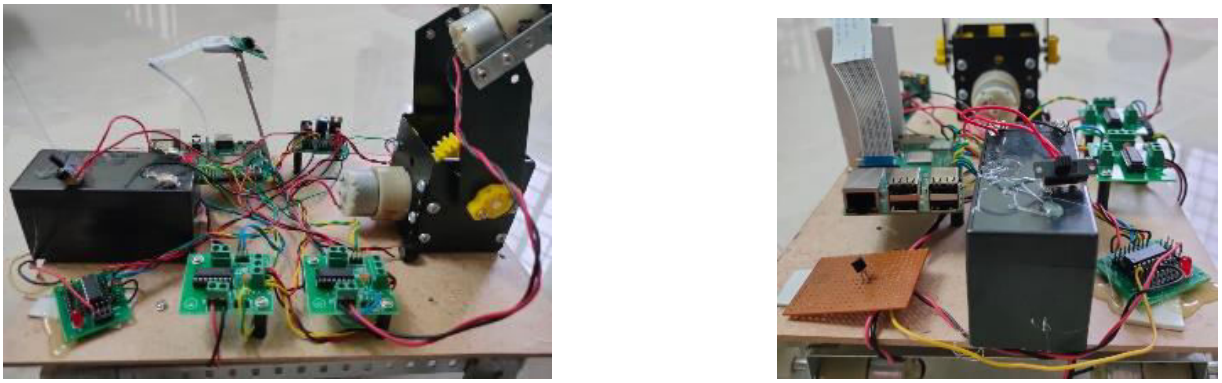

Fig.3 Connections of hardware

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Raspberry pi is used for two mode of action .The Remote Control mode, where the rover is controlled manually from remote International Journal of Pure and Applied Mathematics Special Issue 69 device through the web server connecting it with an internet connection. This is done when the signal is passed from the Raspberry Pi and being the master controls the movement of the rover. The movement of the robot is controlled with keys for all four directions besides with start and stop function in the web server. During autonomous mode the rover is programmed through the Raspberry Pi while the ultrasonic sensor detects in case of any obstacle and changes its direction accordingly.

A direct current, or DC, motor is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction. To control the direction of the spin of DC motor, without changing the way that the leads are connected, you can use a circuit called an H-Bridge

You can use discrete transistors to make this circuit, but for this tutorial, we will be using the L298 H-Bridge IC. The L298 can control the speed and direction of DC motors and stepper motors and can control two motors simultaneously. Its current rating is 2A for each motor. At these currents, however, you will need to use heat sinks

VI. CAPTURING IMAGE

Fig .4 sample captured image

A webcam is a video camera which feeds its images in real time to a computer or computer network, often via USB, Ethernet or Wi-Fi. Their most popular use is the establishment of links, permitting computers to act as conference stations. This common use as a via camera for the World Wide Web gave the webcam its name. Other popular uses include security surveillance and computer vision. The Webcams are known for their low manufacturing cost and flexibility, making them the lowest cost form of telephony. They have also become a source of security and privacy issues, as some built-in webcams can be remotely activated via spyware.

To take pictures in 0.025s with picamera you'll need a frame-rate greater than or equal to 80fps. The reason for requiring 80 rather 40fps (given that 1/0.025=40) is that currently there's some issue which causes every other frame to get skipped in the multi- image encoder so the effective capture rate winds up as half the camera's framerate.The Pi's camera module is capable of 80fps in later firmwares (see camera modes in the picamera docs), but only at a VGA resolution (requests for higher resolutions with framerates >30fps will result in upscaling from VGA to the requested resolution, so this is a limitation you'd face even at 40fps)

VII. APPLICATIONS

Robots can perform variety of functions independently. General purpose robots may perform a variety of functions simultaneously or they may take on different roles at different times of day. This specific Rescue robot that has been designed for a specific purpose can be used for the following applications:

- In disaster zones, whether it natural or man-made disaster.
- In Rescue operations where human reach is not possible.
- This helps to reduce the time, hence it is less time consuming.
- A camera is used to capture and can detect the person.

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- As the Robot can move, it covers lot of distance that reduces the use of man power.

VIII. CONCLUSION

In this project, a new system and methodology for detecting surviving humans in destructed environments using an emulated autonomous robot is proposed.The goal of this was to provide a low cost rescue robot for human detection in a disaster environment.The sensors used in the development of this project are easily available and cost effective. It has a wide future scope.By this system, it will be a great help indeed to rescuers in detection of the human beings at the disaster sites.

This is also user friendly, economical, semi-autonomous, and efficient device for detection of humans.The experiments demonstrated that the proposed system can achieve a relatively high detection accuracy of up to 91% in certain conditions and an overall average detection accuracy of 86% for all experiments and environments tested. This research demonstrates that using relatively simple image processing and neural networks techniques in critical applications such as the urban search and rescue is conceptually efficient and has the potential for playing a significant role in more sophisticated urban search and rescue systemsThe presented sensor combination can be used to detect the human presence at different locations and under the debris caused by the natural calamities like the earthquake. It is not practically possible for the rescue team personnel to cover the entire area in a short span of time. This is where our proposed model comes in handy.

In the present study the locations chosen are open space,behind a transparent door and behind a wall. However, thereis a limitation that a slight movement is required for the Doppler radar sensor to detect the presence of a human being. Therefore, if there is no motion present, the Doppler sensor cannot detect human being presence and for such instances we propose a strong microwave sensor to be used.

The Dopplerradar sensor being too sensitive can also detect any type of motion which could not necessarily be a human being hence it is necessary to integrate it with a PIR sensor which turns on the moment it detects human body radiations and would confirm the presence of a human being by sounding the buzzer.

IX. FUTURE SCOPE

Our project is mainly intended to operate a robot using PC. The system also to detects the victim in disaster zone. The PIR sensor detects any human presence in its way and if any human presence is being detected it stops and buzzers an alarm system. The drawback of this project is that the status of robot is not known. This can eliminate by having a GSM module, which gives the status of robot working. We can also add Ultrasonic module, which is used for obstacle detection with GSM module which gives respective information. By connecting wireless camera to the robot, then we can see the outer world from our personal computer only by using GPRS and GPS. We can use this robot at so many fields and we can use to handle so many situations. By connecting bomb detector to the robot, we can send it to anywhere. By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective fields. By connecting corresponding instruments to the robot we can use it in agriculture for farming purpose.

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