ALIVE HUMAN BODY DETECTION SYSTEM USING BEAGLEBONE BLACK

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Abstract: The alive human body detection using ultrasonic sensor is proposed in this project. A mobile robot has been designed and developed. The robot has the camera in it which can make a live video and send to the rescue person. It has the PIR sensor to sense the human and an ultrasonic sensor to detect the obstacles. The video of the alive human in the rescue scenario or destructive places is displayed on the device (Laptop) which is held by the rescue person. This can be used to detect Terrorists or thieves hidden inside the building. It can also be used to detect alive humans from buildings that have been collapsed due to Natural calamities like Earthquakes.

Key Words: BeagleBone Black, Camera, PIR, Robot, Sensor, Temperature, Ultrasonic.

1. INTRODUCTION

Due to increasing number of crime and burglary, the need of security system is very essential. The security system that monitors the area throughout the time and reacts effective to the treat is in need. We have lots of security systems in the market for both indoor and outdoor applications such as ultrasonic detectors, CCTV, microwave detectors photoelectric detectors, infrared detectors etc. [1] However one or the other systems have the limitations of being expensive, more electrical power consumption, more memory space utilization of the recording system and complex circuitry, etc.[2]

A solution to overcome these problems could be by using a sensor of low cost which has the ability to detect the intruders as they come within the sensor's detection range and generates an output. This output can be used for further signal processing or activating other devices like alarm system, lighting system, recording system and similar devices. [2]

Most of the victims of earthquakes, avalanches or other natural disasters in various parts of the world, including the 2011 earthquake and tsunami in Japan, are people trapped under rubble of collapsed buildings. Humans, who get stuck inside rubbles of building in such situations, may not have sufficient energy to make loud cry to seek for help. Detection by rescue workers like policeman, fire fighters and medical services will be time consuming, if the area affected is vast. To overcome this disadvantage, the proposed system develops a robot for detecting live human. It can be used for detecting terrorists or thieves hidden inside a building as well as for other rescue operations.

2. LITERATURE SURVEY

In the existing system, a revolutionary method using microwaves called microwave life detection system which can be used to detect human subjects behind the barrier, wall or under earthquake rubble. With the help of microwave signals the life signs can be detected as it is able to sense the heart beat and breathing signals of human being trapped under collapsed debris. A microwave life detection system operates at appropriate frequencies lies in X-band, L or S band. [3]

Change Detection in Constellations Of Buried Objects Extracted from Ground-Penetrating Radar Data by "David WPaglieroni, Christian T Pechard, and N Reginald Beer" [4], Here the GPR is used to find the Object, the GPR is placed in the moving vehicle and it deducts the object and the captured object can be converted into 3D image by Digital image processing. In this system they are finding only the objects, if we use this system in collapsed buildings means, it denotes the objects and gives intimation to us. So this is difficult to save the human's life.

A Review on Ground Penetrating Radar Technology For The Detection of Buried or Trapped Victims by "Lorenzo Crocco, Vincenzo Ferrara" [5],in this system they used GPR, it transmits the signal to the human and reflected signal from (Heart beat & breathe) received by GPR to receiver. Antenna designing is complicated. The signals from the GPR do not penetrate through the concretes.

3. PROPOSED SYSTEM

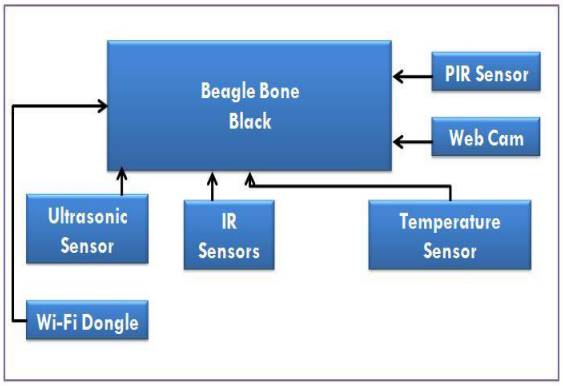


Fig 1: Block diagram of Proposed System

The above figure (Fig 1) shows the block diagram of the proposed system. It basically consists of two parts viz. hardware part and software. These two parts are interfaced to work with each other according to the response of the PIR sensor and Ultrasonic sensor.

A. Hardware Parts:

The hardware part consists of BeagleBone Black, PIR sensor, Ultrasonic sensor, Infrared sensor, Stepper motor, DC motor, H-Bridge, WebCam, and Temperature sensor.

i. BeagleBone Black

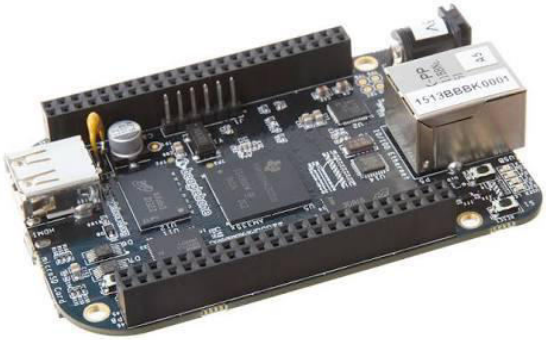


Fig 2: BeagleBone Black

The BeagleBone Black (BBB) is one of the most exciting embedded platforms in automation and robotics, and is a serious competitor for the well-known Raspberry Pi board. The BBB offer increased processing power and more features compared with Raspberry Pi. It is extremely expandable product that allows builders, makers, artists, and engineers the ability to create truly innovative projects. BeagleBone needs 5 volts and 500 mA of direct current to operate. All the sensors and the motors are connected to BBB.

ii. PIR Sensor

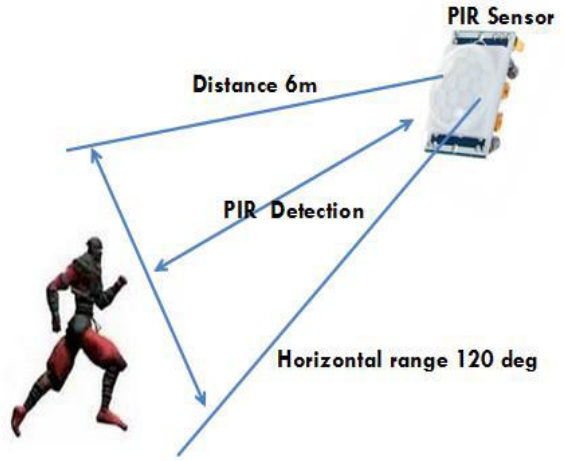
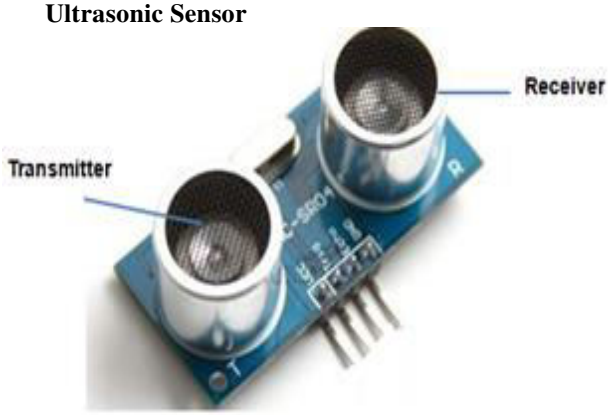


Fig 3: PIR Sensor detecting Humans.

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. 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 human passes by, the infrared radiation from human body first intercepts one 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, whereby the sensor generates a negative differential change. These change pulses are what is detected.

iii. Ultrasonic Sensor



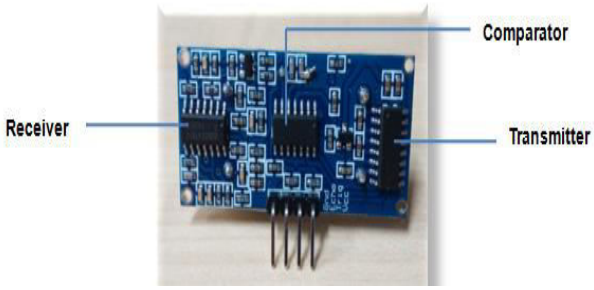


Fig 4: Ultrasonic Sensor

The ultrasonic transmitter emits ultrasonic pulses outward from the face of the sensor. The receiver receives echoes of those waves as reflected off an object. When the sensor receives the reflected echo, the comparator calculates the distance by comparing the emit-to-receive timeframes to the speed of ultrasonic waves. The value of distance (in cm) at which the object is detected will be displayed in the laptop.

iv. Infrared Sensor

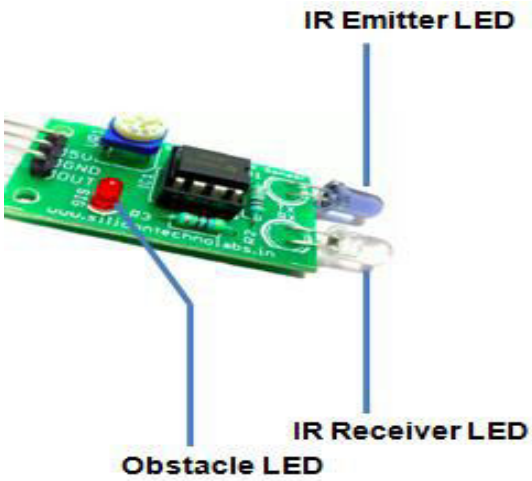


Fig 5: Infrared Sensor

Once power supply (3.3V) is given to the Infrared sensor, the IR Emitter emits Infrared rays. The Medium Range Infrared Sensor has a sensing range of approximately 2cm to 8cm. Once an obstacle is detected within its detecting range, the infrared rays will be reflected back and these rays will be received by IR Receiver. Once an obstacle has been detected, the obstacle LED starts glowing. Here, two infrared sensors are fixed on the left and right side of robot.

v. Stepper Motor and WebCam

Fig 6: WebCam fixed on Stepper motor

The stepper motor is used for changing the direction of Camera towards front, left or right.

vi. DC Motor

Fig 7: DC Motor

It is a unit which creates mechanical energy from electrical energy and which transmits mechanical energy through the gearbox at a reduced speed. A gear head and motor combination is used to reduce the speed of the motor to obtain the desired speed or torque.

vii. H-Bridge

Fig 8: L293D H-Bridge

The most common method to drive DC motors in two directions under control of a computer is with an H-bridge motor driver.

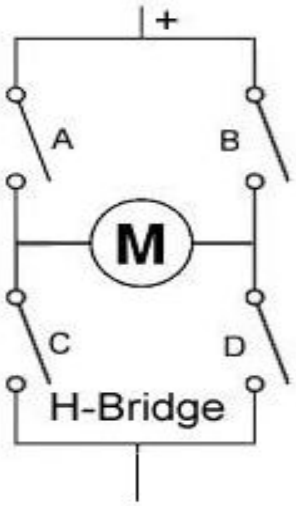


Fig 9: H-Bridge circuit

As you can see in the figure 9, the circuit has four switches A, B, C and D. Turning these switches ON and OFF can drive a motor in different ways.[7]

1. Turning on Switches A and D makes the motor rotate clockwise.

2. Turning on Switches B and C makes the motor rotate anti-clockwise

3. Turning on Switches A and B will stop the motor (Brakes)

4. Turning off all the switches gives the motor a free wheel drive

Lastly turning on A & C at the same time or B & D at the same time shorts your entire circuit. So, do not attempt this.

I. WORKING PRINCIPLE

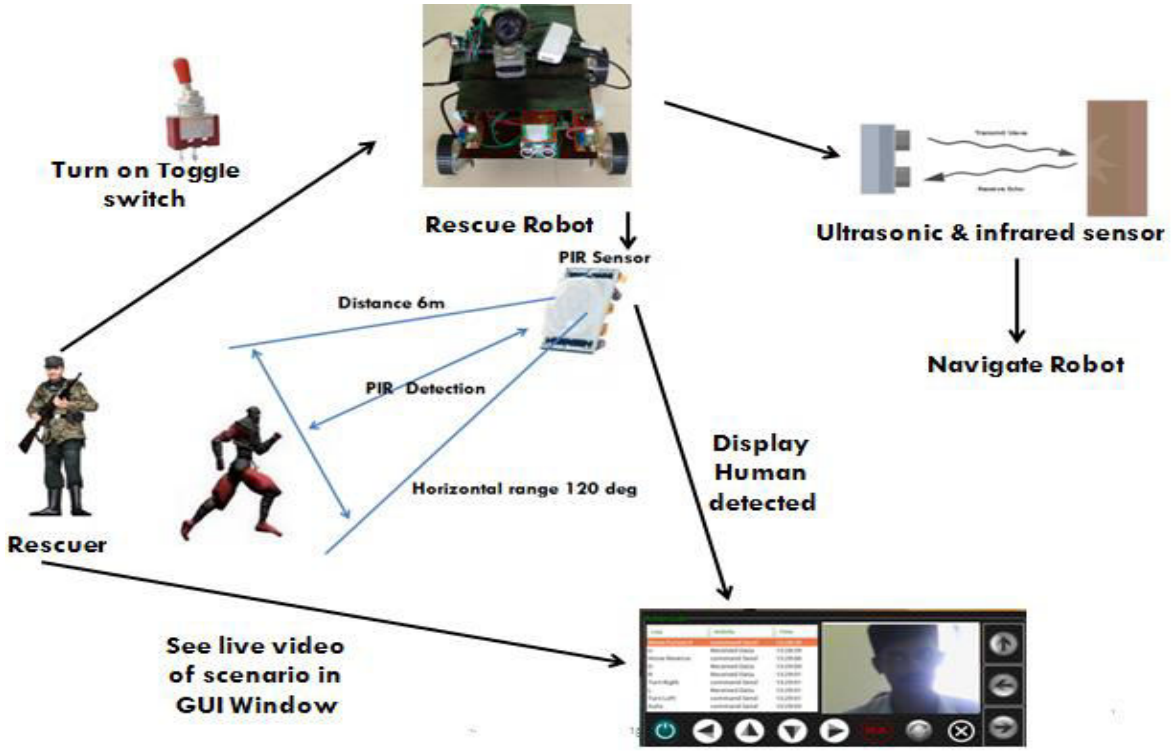


Fig 10: Working Principle

Fig 10 shows the working principle of the proposed System. The rescuer has to turn on the toggle button to start the circuit. After few seconds, the boot up procedure of BBB will be completed. Once this is done, the rescue has to run the python script stored in BBB, to start its functioning. In another terminal, the python script for the GUI window is run. Once the window appears, the rescuer should enter the IP address of BBB, to connect the laptop with Robot.

If the IP address entered matches with the IP address of BBB, next window appears, where the live video of the current scenario will be seen. The robot can be navigated using the navigation buttons on the GUI window. In order to establish a communication link between the laptop and robot, a UDP socket is created. Using UDP socket, the navigation commands can be given.

M/A button on the GUI window is used to switch from Manual mode to Auto mode. The robot can be navigated either in Manual or in Auto mode. Standby button in GUI window is used to stop the navigation of robot.

i. Manual Mode:

By default the robot will be in Manual mode. In this mode, the navigation of robot and direction of camera will be under the control of rescuer. The navigation buttons in GUI window are used for this purpose.

Three PIR sensors are fixed on this robot i.e in the front, left and right. When a human is detected by any of these sensors, a message will be displayed on the GUI window, in which direction the human was detected.

ii. Auto Mode:

In Auto mode, the robot navigates automatically. If any object is detected by the infrared sensor, the robot navigates away from it. The direction of navigation is determined with the help of two infrared sensors, fixed on the left and right side of the robot. If the object is detected in the left by the infrared sensor, then navigation takes place towards right and vice versa. In auto mode, whenever a human is detected, the camera will turn automatically towards the direction where human was detected.

FLOW OF OPERATION:

The first step is to establish a UDP socket communication on the server side. There are two modes of operation in the robot: Auto Mode and Manual Mode. The robot can be navigated either in Manual or in Auto mode. By default the robot will be in Manual mode. In the second step, the BeagleBone Black will check if the mode of operation is in Manual mode or not. If its in the manual mode, the navigation of robot will be under the control of rescuer.

The navigation buttons in GUI window are used for this purpose. If its not in the manual mode i.e if its in

Auto mode, then if any obstacle is detected during navigation, the robot will navigate away from it automatically. The direction of navigation is determined by reading the values of ultrasonic and IR sensor values. If the object is detected in the left by the infrared sensor, then navigation takes place towards right and vice versa.

While navigating, the robot will check whether any of the three PIR sensors has turned on, if yes then the direction of camera will be pointed towards the direction of PIR sensor, which detected the presence of human, in auto mode. Once human is detected, a message is displayed in the GUI Window of Rescuer's device.

II. RESULTS

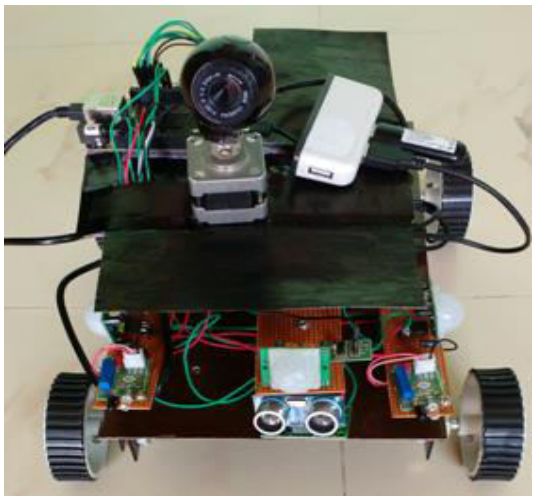


Fig 11: Front View of Rescue Robot

The above figure (Fig 11) shows the front view of the rescue robot that has been designed and developed for Human detection.

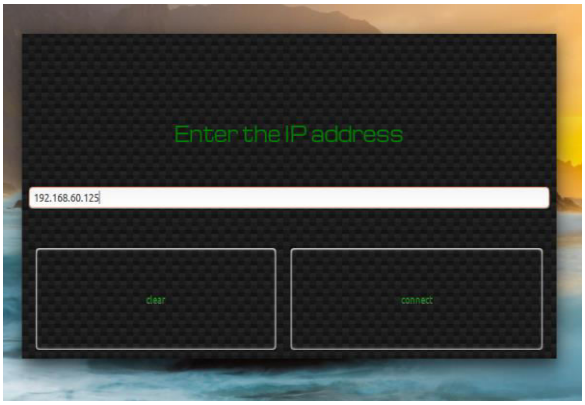


Fig 12: GUI Window 1

Fig 13: Window which is displayed when incorrect IP address is entered.

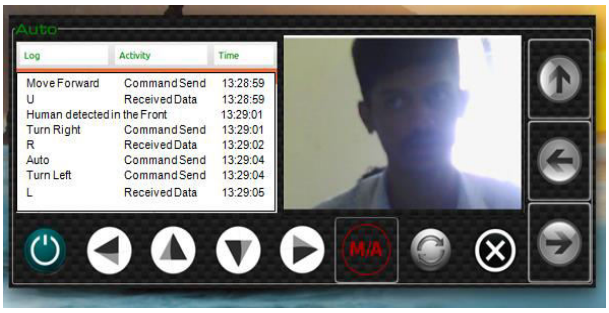


Fig 14: Human Detected

Fig 12 is the GUI window which appears when the python script in Rescuer's laptop is executed. Here the IP address of BBB is entered first and then the connect button is pressed. If the IP address entered is incorrect, the window shown in Fig 13 is displayed. Fig 14 shows the GUI window, which displays the message when human is detected.

III. CONCLUSION

The goal of this project is to provide a low cost rescue robot for human detection in a disaster environment. Though, the existing Urban Search and Rescue Robots are equipped with various sensors, but the problem with them is the cost. The sensors used in the development of this project are easily available and cost effective. There are a variety of enhancements that could be made to this system to achieve greater detection accuracy and increased robustness. In this paper, a new method for detecting surviving humans in destructed environments using simulated autonomous robot is designed. The robot uses two levels of sensing in order to achieve higher cost-effectiveness in the detecting process in terms of the actual cost of equipment, the processing cost, the communication cost, the storage cost, and the power cost. The first level is an ultrasonic sensor that is used as the primary sensor in order to detect the existence of living humans in a scene. The second level is a PIR sensor. This level uses low-cost web camera in order to confirm the existence of a human. The robot can be run in Manual or Auto Mode that is either manually controlled or can run automatically. Hence this project provides better solution for the rescuer to detect Terrorist/ Thieves hidden inside a building.

IV. FUTURE ENHANCEMENT

Since the system developed is a low cost system therefore it has a wide future scope. Though many systems with a wide range of sensors have been developed, but there are many problems faced by them such as cost, size, environment difficulties etc. A Bomb (Metal) sensor can be introduced to detect the presence of suspected material in Rescue operations with this project. In order to detect the borders of the ground, 2 CNY70 IR sensors can be placed at the bottom of the robot. An IP camera can be used for capturing the video of the scenario even in dark situations. Our future aim is to reduce the response time to a greater extent. Gas sensors can be included in this project. A gas sensor detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak. Other sensors such as Fire sensors can also be included for notifying the rescuer in case of fire in the scenario.

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Authors' Profiles

Divya SN has completed Bachelor of Engineering in Computer Science and Engineering at Sri Sairam College of Engineering (Formerly Shirdi Sai Engineering College), Bangalore, Karnataka, India. Her research interests include Image Processing, Computer Graphics, and Animations, Web Designing, Programming languages and Robotics.

Some of **Divya's** previous paper publications include Detection of Diabetic Retinopathy using Kirsch Edge Detection and Watershed Transformation Algorithm in International Journal of Advance Research, Ideas and Innovations in Technology, August 2015, Detection of Fibroid Using Image Processing" in International Journal of Emerging Technology & Advanced Engineering, March 2015 and Plant Disease Detection Technique Tool-A Theoretical Approach" in International Journal of Innovative Technology and Research, April 2015.

Divya SN has secured the Best Poster Award for the title "RESCUE ROBOT"- An Alive Human Body Detection System Using Beagle Bone Black, in the National Conference on "Disaster Management and Satellite Environmental Applications" Organized by Department of Chemical Engineering, Siddaganga Institute of Technology, Tumakuru, Karnataka, India in association with Indian Space Research Organization (ISRO), Bangalore, on March 19th 2016 and also the Best Paper Award for the same topic, in the one day National Level Conference on "Ideas For Sustainable India", held on March 18th 2016 at New Horizon College, Bangalore, Karnataka, India. She secured first Place for Paper Presentation in 1st IE(I) Tamilnadu State Centre Students & Technicians Convention and All India Seminar on "Innovation, Technology and Knowledge Economy" on 6th – 7th March 2015, at Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India. She also secured First Place and Gold Medal in Paper Presentation in All India Conference on "Emerging Engineers and Building Up Technical Innovation In Modern Era" on September 2014, at Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India.