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Optimized Terrain Robot for Liberating the Human in Catastrophe

Dinesh C[1], Sivabalakrishnan R[2]
[1,2]Assistant Professor, Department of Mechatronics
Bannari Amman Institute of Technology, Sathy (TN) -India

Abstract— In this project, a new approach for detecting and rescuing alive humans in destructed environments such as earthquake, etc. using an autonomous robot. Human detection in an unmanned area can be done only by an automated system. 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. Alive human body detection system proposed a monitoring system using PIR sensors (Passive Infra-Red) and camera to record transmit and analyze the conditions of human body. Movement of the robot is controlled by another set of IR sensors according to the input from PIR sensors and robotic arm is used to remove the debris. Having detected a sign of a living human, the PIR sensor triggers the camera to show live scene. The video is then displayed on the screen. Also this robot will make use of intelligent algorithm to control its arm to remove the debris and save the valuable human life. This system has the potential to achieve high performance in detecting alive humans in devastated environments relatively quickly and cost effectively.

Keywords— PIR sensors, IR sensor, Microcontroller, DC motor, Autonomous robot etc

I. INTRODUCTION

Disasters can disrupt economic and social balance of the society. Natural disasters occur frequently nowadays. Many human beings are victims of such occurrences. Because of high rise buildings and other manmade structures urban and industrial areas can be consider to be more susceptible to disasters. These disasters can be categorized into natural and human induced disasters. Natural disasters include floods, storms, cyclones, bushfires and earthquakes whereas besides natural disasters, the urban environment is prone to human induced disasters such as transportation accidents, industrial accidents and major fires. During such calamities, especially disasters, in order to prevent loss of life and property various essential services (like fire brigades, medical and paramedical personnel, police) are deployed. Some lose their lives because of not being treated at time. 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. To avoid such losses, a robotic system can perform well for providing alert (detection) of human being.

Burion [6] presented a project that aims to provide a sensor suite for human detection for the USAR robots. This study 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, but its limitation was its binary output. The USB camera was used for motion detection, but its limitation was its sensitivity to changes in light intensity. The microphone was used for long duration and high amplitude sound detection, but it was severely affected by noise.

Greer, Kerrow, & Abrantes 2002, [9] represented a thorough understanding of the urban disaster environment and an appreciation for traditional search and rescue techniques are crucial to determining the success of a hovering robot solution. Bahadori [16] presents an analysis of techniques that have been studied in the recent years for human body detection (HBD) via visual information. The focus of this work is on developing image processing routines for autonomous robots operating for detecting victims in rescue environments.

Pissokas [1] describe the social impact of urban devastations has given rise to the field of Urban Search and Rescue Robotics. The aim of this article is to present our experience and experimental results with various sensors designed and developed.

II. EXISTING MODEL

Alive human body detection system proposed a monitoring system using ultrasonic sensors and camera to record, transmit and analyse conditions of human body. The task of identify human being in rescue operations is difficult for the robotic agent but it is

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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 an 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. 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.

III. PROPOSED MODEL

The main purpose of the robot is to detect alive human beings after the occurrence of natural calamities with the help of PIR sensor. The robot based system will sense the radiation of human being and condition the sensed signal to communicate to the control section of this robot. Based on the responded commands the robot will react upon. 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 human, 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 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. While detecting human being, there may be some obstacle on the way of robot. In order to identify the obstacle and to have an alternate path to perform its defined task IR detection is used which effectively fulfils this operation.

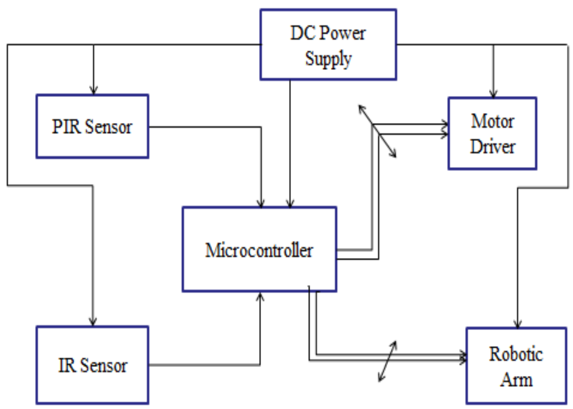

Fig 1: Block diagram of proposed system

The proposed system uses a PIR sensor in order to detect the existence of living humans and a low-cost camera in order to capture video of the scene as needed. Having detected a sign of a living human, the PIR sensor triggers a camera to capture a video of the scene.

Main components of the Human Detection Robot System

Microcontroller

PIR sensor

IR sensor

DC motor drive

A. ATMEGA16 Microcontroller

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. Heart of the robot system is the microcontroller. ATMEGA 16 is used for various features over the AT89s52 which was used in the base paper.PIR sensor is used for the detection of alive human being and IR sensor is used for detection of obstacles and pits in the disaster areas.

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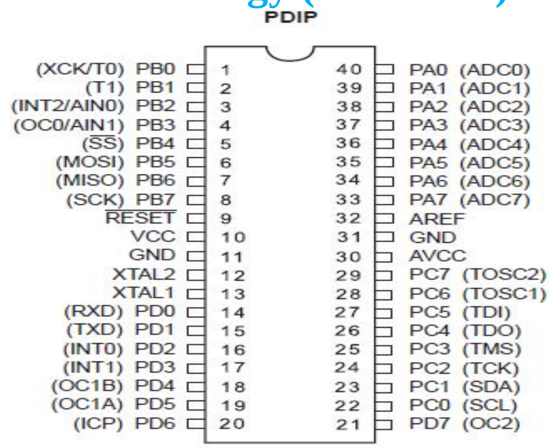

Fig 2 Pin Diagram of ATMEGA 16

The peripheral features of ATMEGA16 are as follows:
High-performance, Low-power AVR® 8-bit Microcontroller.
Advanced RISC Architecture.
131 Powerful Instructions.
Most Single-clock Cycle Execution.
32 x 8 General Purpose Working Registers
8-channel, 10-bit ADC
8 Single-ended Channels
7 Differential Channels in TQFP Package Only
2 Differential Channels with Programmable Gain at 1x, 10x, or 200x
Byte-oriented Two-wire Serial Interface
Programmable Serial USART
Master/Slave SPI Serial Interface

B. PIR Sensor

The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin.

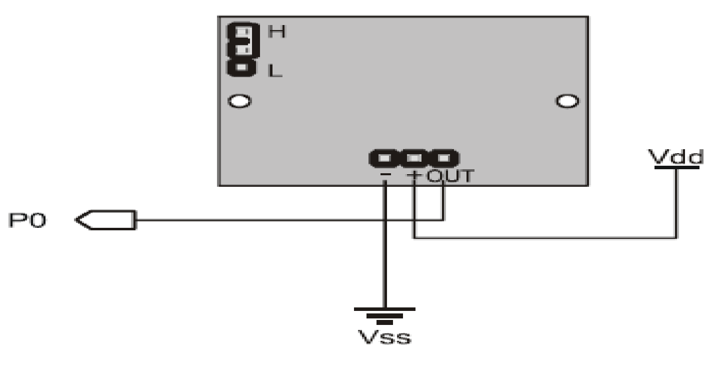

Fig 3. Circuit Diagram of PIR Sensor

Pyroelectric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge when exposed to infrared radiation. The changes in the amount of infrared striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a special filter called a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion.

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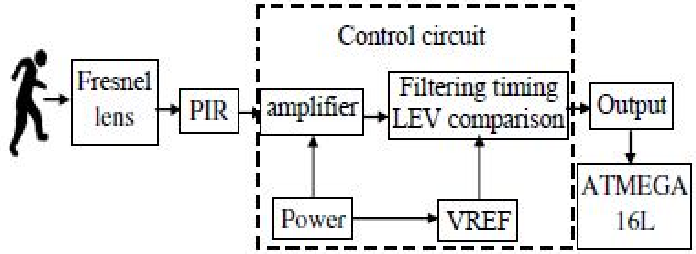

Fig 4. Working of Human Detection

C. Connecting And Testing

Connect the 3-pin header to your circuit so that the minus (-) pin connects to ground or V_{ss}, the plus (+) pin connects to V_{dd} and the OUT pin connects to your microcontroller's I/O pin. One easy way to do this would be to use a standard servo/LCD extension cable, available separately from Parallax (#805-00002). This cable makes it easy to plug sensor into the servo headers on our Board Of Education or Professional Development Board. If you use the Board Of Education, be sure the servo voltage jumper (located between the 2 servo header blocks) is in the V_{dd} position, not V_{in}. If you do not have this jumper on your board you should manually connect to V_{dd} through the breadboard. You may also plug the sensor directly into the edge of the breadboard and connect the signals from there. Remember the position of the pins when you plug the sensor into the breadboard

D. DC Motor Driver

DC motor driver interface consists of H-bridge circuit in between microcontroller and motor. Motor cannot be driven directly from microcontroller, as the current sourced from microcontroller is insufficient. The intermediate H-Bridge controls the motor according to the motor supply voltage provided to H-Bridge.

IV. RESULTS AND DISCUSSIONS

This provide the experimental result of identification and recognition of human based on the three condition: number of human, direction of movement and distance between the sensor and human. The first condition shows the recognition percentage between 98 to 78 for single person with variable distance from 2 to 25 feet in Table.1 and fig. 5.

TABLE 1. SINGLE HUMAN MOVEMENT DETECTION AND IDENTIFICATION WITH VARIABLE DISTANCE

S. No.	Distance in feet	Time in Sec	No. of persons	% of Movement Detection
1.	2	2	1	99
2.	5	4	1	95
3.	10	10	1	87
4.	15	12	1	83
5.	20	18	1	78
6.	25	infinity	1	-

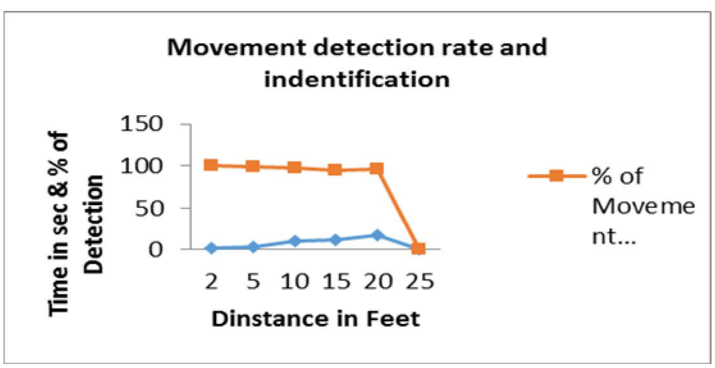

Fig 5. Single Human Movement Detection and Identification

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Table 2. TWO OR THREE HUMAN MOVEMENT DETECTION AND IDENTIFICATION WITH VARIABLE

S. No.	Distance in feet	Time in Sec	No. of persons	% of Movement Detection
1.	2	1	2 to 3	99
2.	5	2	2 to 3	96
3.	10	6	2 to 3	91
4.	15	10	2 to 3	87
5.	20	14	2 to 3	83
6.	25	Out of range	2 to 3	-

The second condition shows the recognition percentage between 99 to 83 for two or three persons with variable distance from 2 to 25 feet in Table.2 and fig. 6. This provides good in detecting human by increasing number of person.

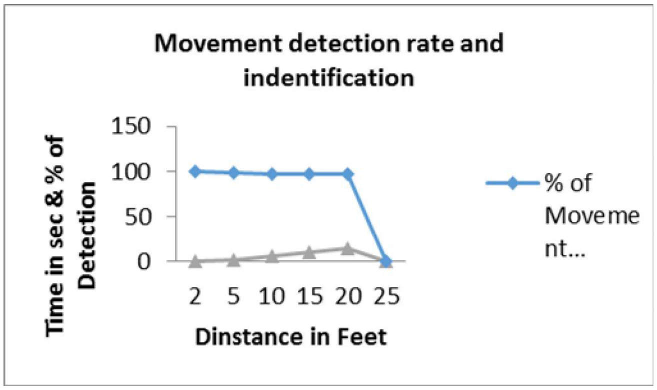

Fig 6. Single Human Movement Detection and Identification

The third condition shows the recognition percentage between 100 to 90 for two or three persons with variable distance from 2 to 25 feet in Table.3 and fig. 7. This provides good in detecting human by increasing number of person.

TABLE 3. FOUR OR MORE HUMAN MOVEMENT DETECTION AND IDENTIFICATION WITH VARIABLE

S. No.	Distance in feet	Time in Sec	No. of persons	% of Movement Detection
1.	2	0.7	4 to 5	100
2.	5	1	4 to 5	100
3.	10	5	4 to 5	96
4.	15	7	4 to 5	93
5.	20	10	4 to 5	90
6.	25	Out of range	4 to 5	-

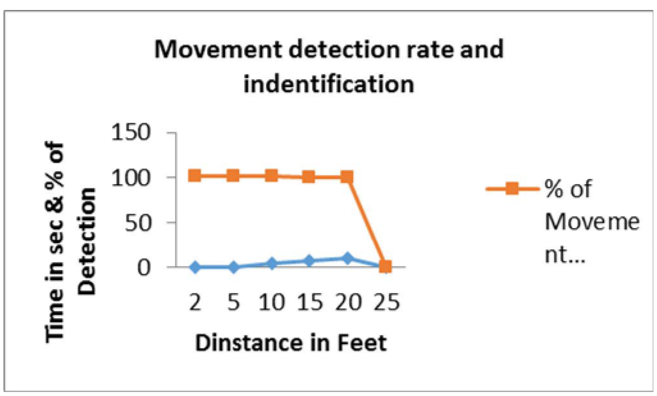

Fig 7. Single Human Movement Detection and Identification

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V. CONCLUSIONS

This paper presented a human movement detecting system based on pyroelectric infrared (PIR) sensors and is based on the direction of movement, the distance of the body from the PIR sensors, the speed of movement during two-way of the object. The op-amp circuits, a data logger and a rechargeable battery is used to collect PIR sensor signals. The PIR-based modules have collected PIR sensor signals when eight different experimental participants were walking through the monitoring field in three different conditions. Results show that it is feasible to detect the direction and speed of movement and the distance of the body from the PIR sensors; and identifying subjects with 100% recognition for four or more Human Movement Detection and Identification with variable. The recognition of human reduced to 78% under Single Human Movement Detection and Identification with variable.

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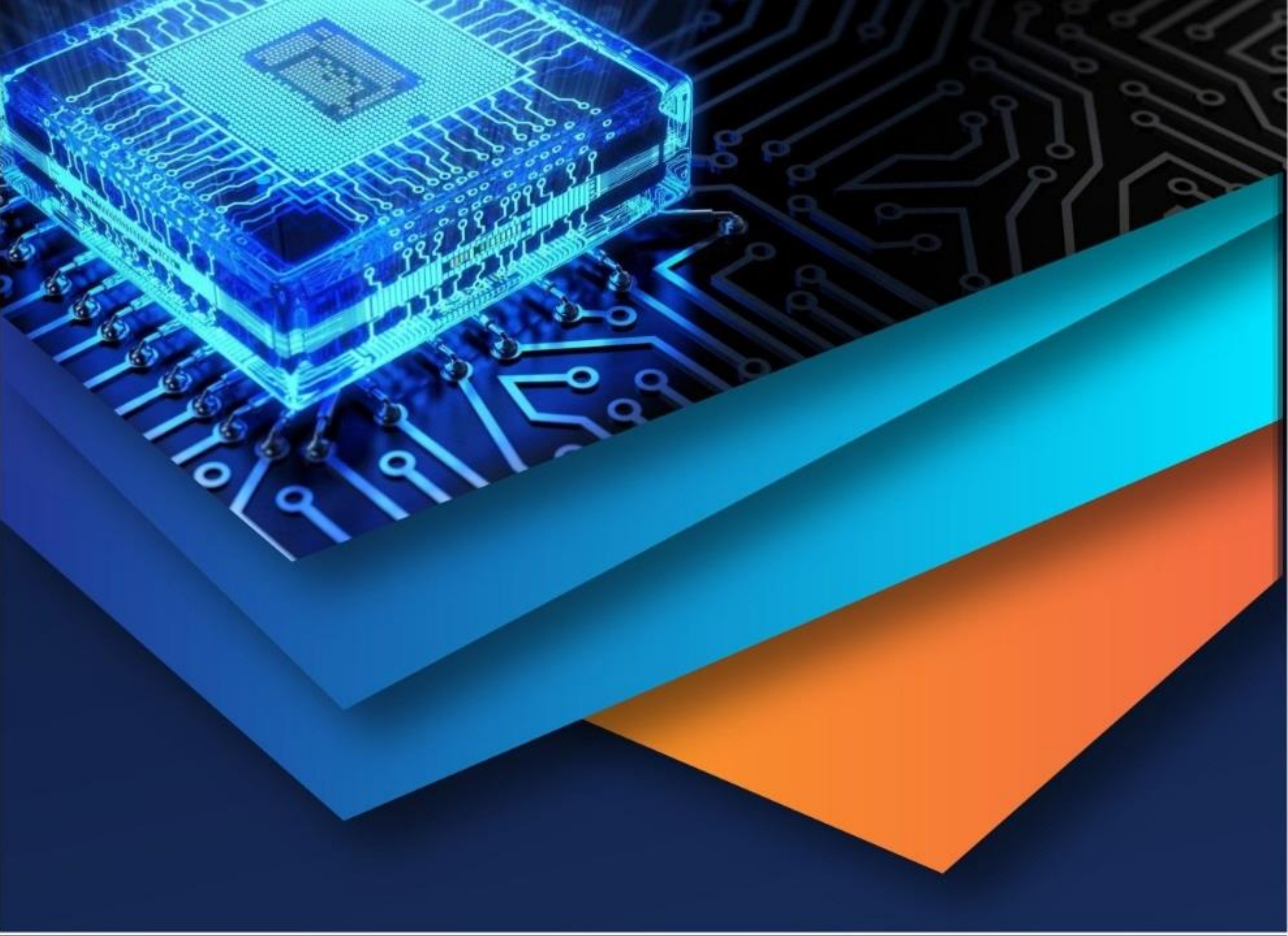

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