Design & Implementation of Alive Human Detection Robot

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Abstract— Disasters like earthquakes, tsunami, bomb explosion and floods often cause loss of precious human lives. During such emergency situations, and especially in urban disasters, in order to prevent loss of life and property, various essential services like policemen, fire fighters and medical assistance etc. are deployed. Rescue operations are performed mostly by human and trained dogs, often in very dangerous and risky conditions. Hence, to make the rescue operation more safe and effective, mobile robots have been proposed which detect alive human beings and wirelessly communicate with the rescue team. This work aims to develop an economical robot, which works using AVR MCU, PIR sensor etc. It can be used in areas where rescue is needed. The robot senses the human body temperature using PIR sensor and alarm/indicator indicates the signal when it detects alive body and the message is sent through sms using ZigBee technology to enable rescue operation.

Key words: PIR Sensor, Obstacle IR Sensor, Rescue Robot, AVR Microcontroller using Zigbee Technology

I. INTRODUCTION

The advent of new high speed technology and the growing computer capacity provided realistic opportunity for new robot controls and realization of new methods of control theory[1]. Now a day, Natural disaster like flood, earthquake and cyclone keep happening frequently which cause loss of precious human lives. Detection by rescue workers becomes time consuming and due to the vast area that gets affected it becomes more difficult[2].since some years mobile robots have been proposed to help them and to perform tasks that neither humans, dogs nor existing tools can do. In our project we mainly use PIR Sensor (passive infrared rays) which emits infrared rays to detect human beings. We are using ZigBee for the efficient wireless communication. Furthermore Robot section consists of a movable unit, which has ZigBee module, camera, PIR sensor, gas sensor and temperature sensor mount on it and AVR microcontroller is used.

II. A REVIEW OF PREVIOUS RESEARCH

In[1], Mohit Bais, Kanupriya Madan, Ankit Bharti, Prof. Prity Yadav have proposed a new approach for detecting alive human beings in natural calamities and man-made disasters using a specific set of sensors like ATMEGA16 Microcontroller, existing GSM technology and PLC systems. Many areas of world are getting affected due to sudden natural calamities like earthquakes, floods, wild-fires, storms and human induced disasters. They observe that people die by getting trapped in these drastic disasters on a large scale just because they don't get help at that instant of time, when they require to be rescued. So the author proposed alive human being detection system uses a specific set of sensors that includes PIR, temperature, vibration, IR, Ultra sonic detector, etc. which gives the information about the presence of an alive human body. GSM technology is used which give an alerting message to control room of the affected site to give proper rescue to the affected victims through PLC logical programming. Also they are using HMI system. They use, a microcontroller ATMEGA16 holds all of these sensors dealing with movable robot systems.

In [2], Jinu Sebastian1, Lidiya KA2, Martha George3, Asst.Prof. Sija Gopinathan4 have proposed a new project for detecting alive humans in destructed environments using a mobile robot. In olden days, human detection in an unmanned area can be done only by an automated system. Alive human body detection system proposed a monitoring system using PIR sensor and camera to record, transmit and analyze conditions of human body. In order to detect a human body, a robot must be equipped with a specific set of sensors called PIR sensors to detect the alive human beings and they use a camera to acquire a video of the affected area. In Additional, the author used other sensors include temperature and gas detector to analyse the surrounding condition. This approach requires a relatively small number of data to be acquired and processed during the rescue operation. The above system has the potential to achieve high performance in detecting alive humans in devastated environments relatively quickly and cost effectively.

III. PROPOSED SYSTEM HARDWARE

The project proposes an autonomous robotic vehicle that moves in the earthquake prone area and helps in identifying the live people and rescue operations. The rescue operation by the workers in the earthquake affected areas is very difficult because it involves large area and hence it is time consuming. So to rescue precious life we use the robotic alive human detection robot. So that it is possible to save the people life by timely detection in natural calamities even without the help of large number of rescue operators. The PIR Sensors are used to detect alive humans. The robot is made up of AVR Microcontroller, RF Modules, Sensors, Camera and so on. In our project the special sensors like temperature and gas leakage sensors are used for effective results of the project.
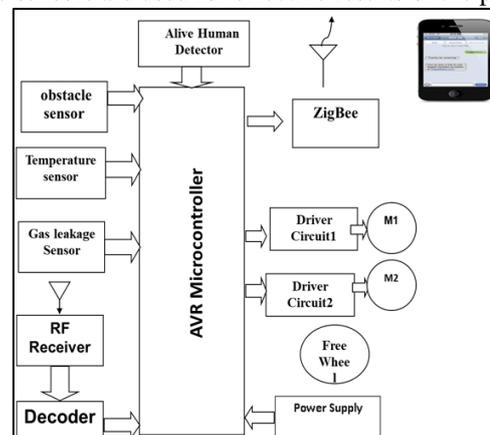

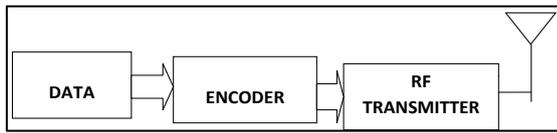Fig. 1: Block Diagram of Robot Unit

Fig 2: Block Diagram of Remote Unit

A. PIR sensor

Sensors like Temperature sensor gives the Surrounding temperature of the disaster area. PIR sensors allow you to sense motion always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. PIRs are basically made of a pyroelectric sensor, which can detect levels of infrared radiation. Human body radiates infrared waves with wavelengths of 8 to 12 micrometers. When the PIR Sensor detects any signal, it sends the response to the rescue team through the RF transceivers [3]. Gas leakage Sensor detects any poisonous gas detected or not in the disaster area.

B. Micro Controller

We are using AVR (Advanced Virtual Risc) Microcontroller in this system. AVR Microcontroller calling as master of the project. It receives the data from sensor and Remote unit and control the driver circuit depending on conditions. Signals from PIR sensors are given to the microcontroller and this microcontroller will digitize the signal and send it to the Zigbee. Here we are using ATMEGA8L Microcontroller IC.

C. Motor & Motor Drive

Motor denotes the robot which can move over earthquake prone areas. Motor drive is the interfacing circuit between microcontroller and robot. The project uses DC motor. A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power [6].A DC motor cannot be interfaced to the microcontroller directly because it requires much higher voltage and current. Motor drive is used for this. It is built using an npn transistor – BC547. It acts as an interfacing device to supply required power to the motor.

D. RF Transmitter & Receiver

The RF module operates at Radio Frequency it is used to send and receive data between robot and the control unit. In this RF system, the digital data is represented as variations in the amplitude of carrier wave which is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because signals through RF can travel through larger distances making it suitable for long range applications.IR mostly operates in line-of-sight mode and RF signals can travel even when there is an obstruction between transmitter & receiver. RF transmission is more strong and reliable than IR transmission. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

E. Encoder & Decoder

The RF module is used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. Encoder and decoder are optional, their existence is to 1) avoid confusing when multiple RF links in range 2) isolate disturbance.

F. Power Supply

A power supply is a device that supplies electric power to an electrical load. A regulated power supply is one that controls the output voltage or current to a specic value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supplies energy source. Power supply unit consists of Step down transformer, Rectifier, Regulator unit, filters.

G. Advantages

− It is a safe method for rescue operation to detect alive humans.
− It uses ZigBee technology to send the message quickly.
− It is fast and accurate.
− It reduces the work load & Number of staff is not required more.
− Low power device.
− AVR microcontroller we used which is a Open source software and portable with all wires.

H. Disadvantages

− Low battery backup.
− Initial cost is high

IV. IMPLEMENTATION

A. Software Implementation

Software tools being used to interface the hardware system to software system are:
1) Arduino software
2) Embedded C

When PIR detects the human being in disaster area covered by mobile robot, then proposed system sends its current location & shows live vision to the rescue team.

B. Algorithm

− Program: Alive Human Detection Robot
− Purpose: Design and Implementation of Alive Human Detection Robot
− Description: Alive human detection robot vehicle detects the alive human buried under the debris during natural calamities and control the robot automatically and manually for its movements.
− Input: Remote buttons, Body temperature and IR rays.
− Output: Message to control room if alive human found and if robot stopped.
1) Step 1: set up all the devices
2) Step 2: serial data-1 (alive human detection robot)
3) Step 3: Automatic guidance
If←right obstacle
Move left
If←left obstacle
Move right

If←front obstacle
Move backward
If←back obstacle
Move forw   If←all side obstacle found
Serial data—2 (all direction obstacle found, robot found)
End if
End if
End if
End if
End if
4)   Step 4: Manual control
If←right button
Move right
If←left button
Move left
If←forward button
Move forward
If←backward button
Move backward
End if
End if
End if
End if
5)   Step 5: if PIR=True?
Buzzer sound
Serial data—3(alive human detected!)
Take rescue operation
End if
6)   Step 6: if temp=True?
Buzzer sound
Serial data-4(surrounding temperature value noted)
End if
7)   Step 7: if gas=True?
Buzzer sound
Serial data-5(poisonous gas detected)
End if
8)   Step 8: Finished

C. Hardware of Robot

In the robot section the RF receivers receives the encoded analog signals from RF transmitter and decode the signals, based on the signals it moves the vehicle in appropriate directions. The data is given through the buttons in the remote. The generated analog signals is encoded and send to the RF receiver of the Robot section. Based on that signals the robot vehicle is guided with the appropriate movements.
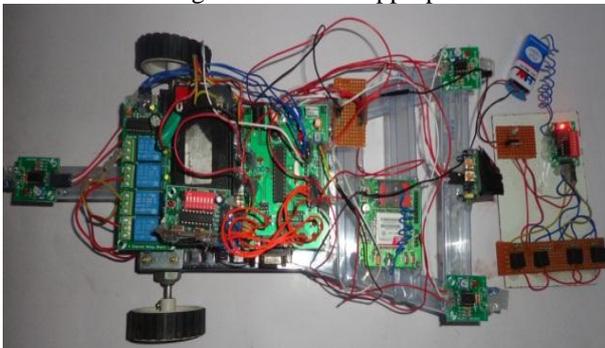

Fig. 3: The Robot & Control Unit

V. CONCLUSION

Automatic and manual controlled alive human detection robot has been designed and demonstrated. AVR Microcontroller is reprogrammable so that we can reprogram it when we need modify the features. RF frequency range is 434 MHz. Remote controlling is designed for limited distance, in future we can enhance the wireless remote control distance for more distances. In this project we implemented a low cost autonomous pc controlled rescue robot. With the help of this robot, search and rescue operations can be made much effective and easier. The circuit was assembled on the PCB. After assembling the circuit on the PCB, it was checked for proper connections before switching on the power supply. After switching on the power supply the PIR module was checked for detection of human. Then the robot car was tested by controlling using PC. Many lives can be saved by using this autonomous vehicle during an earthquake disaster in a short duration which becomes time consuming and unaffected if done manually.

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