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Rescue Robotics Using Artificial Intelligence

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Abstract: Structural collapse disasters routinely inspire sympathy not only for victims and their families, but also for heroic personnel who are faced with a tremendously complex, hazardous and often frustrating task environment. Military operations and rescue activities in the aftermath of recent earthquakes and bombings indicate a tremendous need for greater access. Recent developments in the remote inspection industry show great potential for employment of small robotic micro-rover systems in expanded roles for urban search and rescue.

This paper discusses key issues in the application of robotic systems to search and rescue activities and discusses ongoing development of a knowledge-based for efficient management of automated search assets. It is designed to provide a robotic system that can combat in wars and other military purposes. In this paper, we propose a vision based technique that can be employed in case of hazardous condition where human beings cannot be employed. The main aim is to operate the robot which can work automatically on an object with a mechanical linkage. It identifies the intruders by using facial recognition technique. First using the technique of artificial intelligence the changes in the environment like fire, pit, obstacles, bomb and human live body are recognized. The robot is controlled from a remote location in addition to remote monitoring.

The development of this application uses an 8051 microcontroller which is developed to control the peripheral devices using the sensors such as passive infrared sensor, light dependent resistor and thermostat. The robot is expected to perform various works like moving forward, reverse, left and right with super intelligence technology like detecting the obstacle, bomb, metal, fire and also for detecting pits.

The microcontroller gets all the input from the sensors and controls the robot according to it. The Zigbee technology is used to communicate with the robot in remote location.

Keywords: Robot, Zigbee, Microcontroller, Sensor.

I. INTRODUCTION

In its most basic sense, we define "robot" as an engineered machine that senses, thinks, and acts. Thus a robot must have sensors, processing ability that emulates some aspects of cognition, and actuators. Sensors are needed to obtain information from the environment. Reactive behaviours (like the stretch reflex in humans) do not require any deep cognitive ability, but on-board intelligence is necessary if the robot is to perform significant tasks autonomously, and actuation is needed to enable the robot to exert forces upon the environment[1].

Generally, these forces will result in motion of the entire robot or one of its elements (such as an arm, a leg, or a wheel) [2].This definition does not imply that a robot must be electromechanical; it leaves open the possibility of biological robots, as well as virtual or software ones. But it does rule out as robots any fully remote-controlled machines, since those devices do not "think", e.g., many animatronics and children's toys. That is, most of these toys do not make decisions for themselves; they depend on human input or an outside actor.

Rather, the generally accepted idea of a robot depends critically on the notion that it exhibits some degree of autonomy or can "think" for itself, making its own decisions to act upon the environment. Thus, the US Air Force's Predator unmanned aerial vehicle (UAV), though mostly tele-operated by humans, makes some navigational decisions on its own and therefore would count as a robot. By the same definition, the following things are not robots: conventional landmines, toasters, adding machines, coffee makers, and other ordinary devices.

As should be clear by now, the definition of "robot" also trades on the notion of "think", another source of contention which we cannot fully engage here. By "think", what we mean is that the machine is able to process information from sensors and other sources, such as an internal set of rules either programmed or learned, and to make some decisions autonomously.

The main aim of the paper is to implement a Wireless multipurpose Robot which can be[3] controlled through PC using Zigbee interface and navigates around the disaster areas and tries to find the humans who need help

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and tries to identify the forest fire. Here the Robot can detect the live human based on the IR radiation emerging from the humans. Apart from this the Robot is built with some artificial intelligence for its safety. It has built in Proximity IR sensor for obstacle avoidance and temperature sensor for forest fire identification. An Embedded System is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few predefined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale.

II. ARCHITECTURE OF RESCUE ROBOT

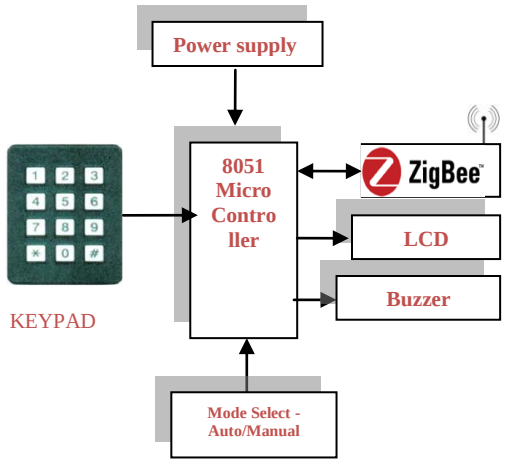

Figure1: Block diagram of control section

A. Microcontroller

A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to- digital convertor etc. So, for small applications, a micro-controller is the best choice as the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use many external components with them.

B. Input Devices

Unlike the desktops, the input devices to an embedded system have very limited capability. There will be no keyboard or a mouse and hence interacting with the embedded system is no easy task. Many embedded systems will have a small keyboard- you press one key to give a specific command.

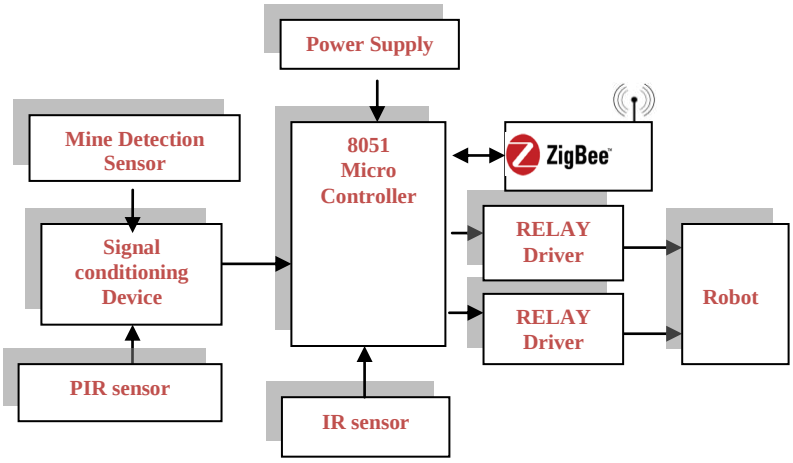

Figure2: Block diagram of robot section

C. Output Devices

The output devices of the embedded systems also have very limited capability. Some embedded systems will have a few Light Emitting Diodes (LEDs) to indicate the health status of the system modules, or for visual indication of alarms. A small Liquid Crystal Display (LCD) may also be used to display some important parameters.

D. Communication Interfaces

The embedded systems may need to, interact with other embedded systems at they may have to transmit data to a desktop. To facilitate this, the embedded systems are provided with one or a few communication interfaces such as RS232,RS422, RS485, Universal Serial Bus (USB), and IEEE 1394, Ethernet etc.

E. Application Specific Circuitry

Sensors, transducers, special processing and control circuitry may be required for an embedded system depending on the application. This circuit interacts with the processor to carry out the necessary work. The entire hardware has to be given power supply either the 230 volts main supply or through a battery.

F. Zigbee Technology

In the present days Automated systems have less manual operations, flexibility, reliability and accurate. Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies. It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and 2.4GHz ISM bands worldwide at a maximum data-rate of 250kbps.

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G. Sensors

A sensor (also called detector) is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards. Sensors are used in everyday objects such as touch sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics. A sensor is a device which receives and responds to a signal when touched. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes.

III. HARDWARE IMPLEMENTATION

Heart of our robot is Atmel's AT89S51 [5]. Microcontroller acts as master controller, decodes all the commands received from the transmitter and give commands to slave microcontroller. It also acts as Slave microcontroller which is responsible for executing all the commands received from the master and also generating PWM pulses for the speed control. Based on the input codes master will give command to slave microcontroller and robot will behave as follows.

- moves in forward direction
- moves in reverse direction,
- speed controls in both the direction
- it can even turn left or right while moving forward or in reverse direction.
- Instant reverse or forward running without stopping.

A. Transmitting Unit (control section)

In this circuit 8051 microcontroller is used. It is divided into four ports, port 1, 2 are the general I/O ports for producing the input and output connection between the controller and I/O devices. Keypad is the input device for the controlling section in order to produce the input instruction to the controller. Here, in this mode, the user has the full control of the robot. The user can control the robot from the remote location by using this keypad. Port 2 (from 8-15) which is also an I/O port is interfaced with the LCD for getting the output.

The inputs from the microcontroller are fed through the pin 7-14.MAX 232 is used to interface the Zigbee with the microcontroller and it helps to produce the serial communication between them. MAX232 is a dual driver/receiver and typically converts the received/transmitted signals and finally gives the information to the Zigbee. ZIGBEE is the transceiver (transmitter/ receiver). The information from the manual key is given to the microcontroller. The controller processes the received signal and is given to the Zigbee with the help of MAX232 which is transmitted to the robot section.

B. Receiving Unit (robot section)

Three sensors are used to sense the obstacles, bomb, and human beings. The information from the sensor is given to the microcontroller with the help of port 1 and is given to the robot through the same port. The information from the controller is passed to the robot through a relay. Relay is nothing but switch in order to get the information and produce the order to the robot to do specified task.

IV. COMPONENTS OR SUBSYSTEMS DESCRIPTION

A. Microcontroller circuit (AT89c51)

It is the heart of the system which controls all the activities of transmitting and receiving. The IC used isAT89c51.The AT89c51 [6] is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89c51is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

B. Power supply circuit

The main building block of any electronic system is the power supply to provide required power for their operation. For the microcontroller [4], keyboard, LCD, RTC, GSM, +5V are required & for driving buzzer +12V is required. The power supply [7] provides regulated output of +5V & non-regulated output of +12V. The three terminals IC7805 meets the requirement of +5v regulated. The secondary voltage from the main transformer is rectified and filtered by capacitor. This unregulated DC voltage is supplied to the input pin of regulator IC. The IC used are

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fixed regulator with internal short circuit current limiting and thermal shutdown capability.

C.IR sensor

This sensor [3] can be used for most indoor applications where no important ambient light is present. This sensor is used to measure the speed of object moving at a very high speed, like in industry or in tachometers. The basic idea is to send infrared light through IR-LEDs, which is reflected by any object in front of the sensor. The reflected IR light is detected using another IR-LED of the same type.

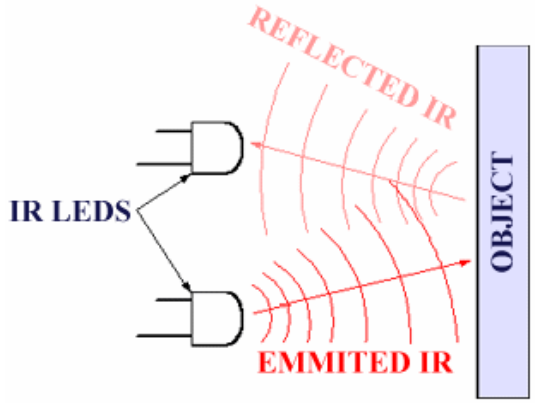

Figure3: IR sensor

D.PIR sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects. They are most often used in PIR- based motion detectors. The individual PIR sensors do not detect motion; rather they detect abrupt changes in temperature at a given point. As an object, such as human, passes in front of the background, such as wall, the temperature at that point will rise from room temperature to body temperature, and then back again. This quick change triggers the detection. Moving objects of identical temperature will not trigger detection.

V. RESULTS AND DISCUSSION

This paper consists of two sections. One is Robot section and the other is Control section. In robot section, the sensors regarding the respective parameters are made to available such as temperature sensor, IR sensor and PIR sensor etc. In the Control section, the parameters are displayed on PC. In Robot and control sections, microcontroller forms the control unit. In this system, a robot is fitted with motors. A microcontroller is used to control all operations. According to the motor operations the ROBOT will operate in specified directions. The detection of parameters is done in a continuous manner and the detected value is transmitted using the Zigbee transceiver to the Control section. Then at the control section, it receives the data with the help of Zigbee transceiver and these data is displayed in the PC and if any live human is detected, the message will be displayed on PC. Robot keeps on moving in two modes i.e., Manual mode and self-mode. It's brought under user's control in the case of manual mode. In self-mode, robot starts moving over surface and takes action according to the scenario. To detect the obstacles, we have deployed Infrared sensors (left sensor and right sensor) in the front portion of the module. While moving on the surface, if the left sensor is detected, robot takes back the position for a moment and moves right. If the right sensor is detected, robot gets back and moves left.

VI. CONCLUSION

This paper "Rescue Robotics Using Artificial Intelligence" has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of all reasoned out and placed carefully thus contributing to the best working. The controller makes use of a PIR based input sensor to sense the human being and give us an alert indication. Also use of a Temperature sensor leads to identify the fire. Hence this paper provides best solution for the live human detection for who need help and also finds the fire. As we all know, these days India is sick off massive terror attacks, bomb explosions at plush resorts. To avoid such disasters TECHNOLOGICAL power must exceed HUMAN power. Human life and time are priceless. It's our onus to take an initiative to design a model of an apt robot that meets combatant needs. So to avoid terror attacks, to ensure more security at the border and high density areas it's wise to maintain a world class military technology in accordance with combatant needs. Even every nation needs its own defense system for their integrity and security. In such a way construction of these robots will carry nation's name, fame globally.

VII. APPLICATIONS

- Can be adequately implemented in national defense through military-industrial partnership. It is shown in the figure.

Figure6: Top view of combat robot

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- Can be vastly applied in Resorts, borders of noted buildings.
- Installation of combat robots [8] in the stadiums, sacred places, and government and non-government organizations assures top security.

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BIOGRAPHY

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