

# Design and Implementation of Co-Ordinated Multi-Purpose Robotic System

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## Abstract

The wireless communication technologies are rapidly spreading too many new areas, including the automation and the importance of the use of wireless technologies in the data acquisition, building control, monitoring systems and automation of manufacturing processes will grow. Intelligent modern robots and cooperative multi- agent robotic systems can be very efficient tools to speed up search and research operations in remote areas. Robots are also useful to do jobs in areas and in situations that are hazardous for human. The main aim is to build a robot communication to detect Live human beings, who need help and the robot can controlled by PC through Zigbee protocol. The detected information can pass through Zigbee to server point and also give one siren/buzzer. To detect the Live humans, those who are affected by natural disasters like Earth quakes and need help can be identified by using this 'CO-ORDINATED MULTI AXIS ROBOT' which can also serves as a Fire Identification ROBOT.

## Keywords

*Robot, Zigbee, Micro Controller, Sensor, Serial Communication.*

## 1. Introduction

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

In terms of complexity embedded systems can range from very simple with a single microcontroller chip, to very complex with multiple units, peripherals and networks mounted inside a large chassis or enclosure. Now, let us see the details of the various building blocks of the hardware of an embedded system. As shown in Fig. the building blocks are explained below;

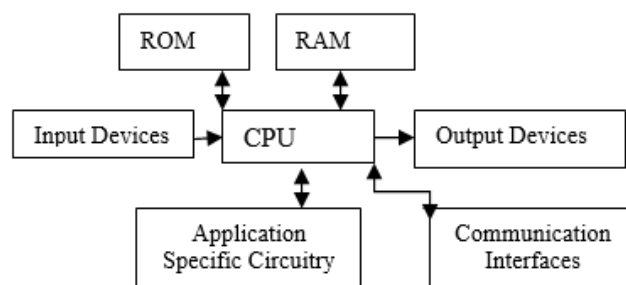


Fig 1.1: Basic building blocks of Embedded System.

### A. Central Processing Unit (CPU)

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). 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 converter 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. DSP is used mainly for applications in which signal processing is involved such as audio and video processing.

### B. Memory

The memory is categorized as Random Access Memory (RAM) and Read Only Memory (ROM). The contents of the RAM will be erased if power is switched off to the chip, whereas ROM retains the contents even if the power is switched off. So, the firmware is stored in the ROM. When power is switched on, the processor reads the ROM; the program is executed.

### C. 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 keypad-you press one key to give a specific command. A keypad may be used to input only the digits.

#### D. 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.

#### E. 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.

#### F. Application-specific circuitry

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

## 2. Zigbee Technology

Now a day's every system is automated in order to face new challenges. In the present days Automated systems have less manual operations, flexibility, reliability and accurate. Due to this demand every field prefers automated control systems. Especially in the field of electronics automated systems are giving good performance. And this is realized by making use of Zigbee technology for communication.

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 the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps.

## 3. Robot

It is defined as a branch of science which deals with "Artificial Intelligence" as its main subject.

#### A. ROBOT

1. The birth of a Robot [2] is due to automation of some human works.
2. The main object that we obtain as output of robotics is a robot.

##### 1 History of ROBOTS:

- |         |                         |
|---------|-------------------------|
| 1) 1954 | : Universal Automation. |
| 2) 1962 | : Unimation.            |
| 3) 1978 | : Puma.                 |
| 4) 1980 | : Industry Robots.      |
| 5) 1995 | : Mobile robots.        |
| 6) 2003 | : NASA.                 |

#### B. ROBOT Characteristics:

1. Identification
2. Movement
3. Manipulation &
4. Navigation

#### C. ROBOT PLATFORM



Fig3.1: ROBOT Platform of this paper

## 4. 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. For instance, if the mercury in a thermometer moves 1 cm when the temperature changes by 1 °C, the sensitivity is 1 cm/°C (it is basically the slope  $Dy/Dx$  assuming a linear characteristic). Sensors that measure very small changes must have very high sensitivities.

Sensors also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches.

#### A. TEMPERATURE SENSOR (LM35)

The LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.



Fig 4.1: LM 35 Temperature sensor.

#### B LM35 Sensor Specification

The LM35 series are precision integrated-circuit LM35 temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 sensor thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 sensor does not require any external calibration or trimming to provide typical accuracies of  $\pm 1/4^\circ\text{C}$  at room temperature and  $\pm 3/4^\circ\text{C}$ . Cover a full  $-55$  to  $+150^\circ\text{C}$  temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60  $\mu\text{A}$  from its

supply, it has very low self-heating, less than  $0.1^\circ\text{C}$  in still air.

The LM35 is rated to operate over a  $-55^\circ$  to  $+150^\circ\text{C}$  temperature range, while the LM35C sensor is rated for a  $-40^\circ$  to  $+110^\circ\text{C}$  range ( $-10^\circ$  with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D sensor is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

#### C IR sensor

This sensor can be used for most indoor applications where no important ambient light is present. For simplicity, this sensor doesn't provide ambient light immunity, but a more complicated, ambient light ignoring sensor should be discussed in a coming article. However, this sensor can be used to measure the speed of object moving at a very high speed, like in industry or in tachometers. In such applications, ambient light ignoring sensor, which rely on sending 40 KHz pulsed signals cannot be used because there are time gaps between the pulses where the sensor is 'blind'.

The solution proposed doesn't contain any special components, like photo-diodes, photo-transistors, or IR receiver ICs, only a couple of IR led's, an Op amp, a transistor and a couple of resistors. In need, as the title says, a standard IR led is used for the purpose of detection. Due to that fact, the circuit is extremely simple, and any novice electronics hobbyist can easily understand and build it.

#### 1 Object Detection using IR light

It is the same principle in ALL Infra-Red proximity sensors. The basic idea is to send infrared light through IR-LEDs, which is then reflected by any object in front of the sensor.

Then all you have to do is to pick-up the reflected IR light. For detecting the reflected IR light, we are going to use a very original technique: we are going to use another IR-LED, to detect the IR light that was emitted from another led of the exact same type! This is an electrical property of Light Emitting Diodes (LEDs) which is the fact that a led produces a voltage difference across its leads when it is subjected to light. As if it was a photo-cell, but with much lower output current. In other words, the voltage generated by the LED's can't be - in any way - used to generate electrical power from light, It can barely be detected. That's why as you will notice in the schematic, we are going to use a Op-Amp (operational Amplifier) to accurately detect very small voltage changes.

##### 1.1. Features

- 1) High reliability
- 2) High radiant intensity
- 3) Peak wavelength  $\lambda_p=940\text{nm}$
- 4) 2.54mm Lead spacing
- 5) Low forward voltage

## 1.2. Descriptions

- 1) EVERLIGHT'S Infrared Emitting Diode (IR323/H0-A) is a high intensity diode, molded in a blue transparent plastic package.
- 2) The device is spectrally matched with phototransistor, photodiode and infrared receiver module.

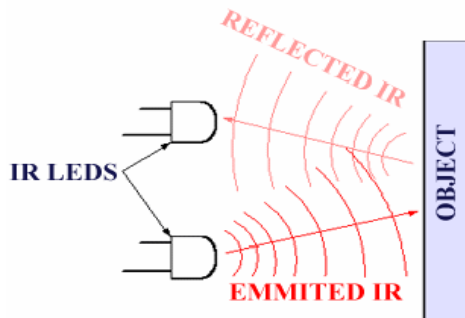


Fig 4.2: IR sensor

## 1.3. Applications

- 1) Free air transmission system
- 2) Infrared remote control units with high power requirement
- 3) Smoke detector
- 4) Infrared applied system

### PIR

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors.

### Operation:

Strictly speaking, individual PIR sensors do not detect motion; rather, they detect abrupt changes in temperature at a given point. As an object, such as a human, passes in front of the background, such as a 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.

PIDs can be equipped with more than one internal sensing element so that, with the appropriate electronics, it can detect the apparent direction of movement. As an object passes in front of adjacent sensors in turn, this implies the direction of movement. This may be used by on-board electronics to reduce false alarms, i.e., by requiring

adjacent sensors to trip in succession. It may also be used to signal the direction of movement to a monitoring apparatus.

PIDs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available -- typically designed to mount on a ceiling. Some larger PIDs are made with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PID. There are also PIDs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage or with individually selectable segments to "shape" the coverage.

## 5. Architecture of Thesis

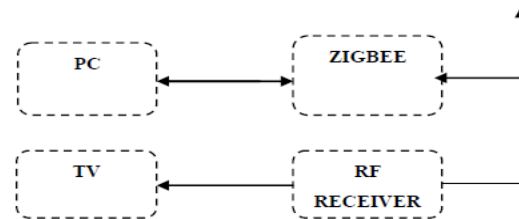


Fig 5.1 Transceiver 1

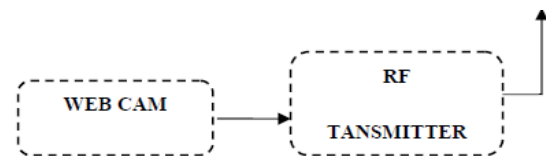


Fig 5.2 Transceiver 2

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 micro controller 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.

In this system we have temperature sensor. Whenever the sensor senses the high temperature, the warning indication will be given to the personal computer.

## 6. Conclusion

This paper “**Design and Implementation of co-ordinated Multipurpose Robotic System**” 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 forest fires. Hence this paper provides best solution for the live human detection for who need help and also finds the Forest fires.

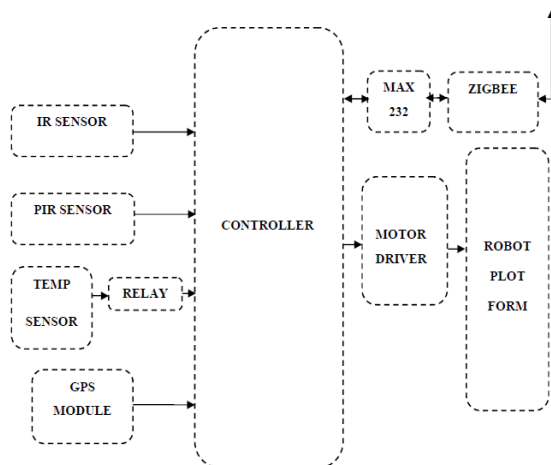


Fig 5.3 Transceiver 3

*A Flow Chart*

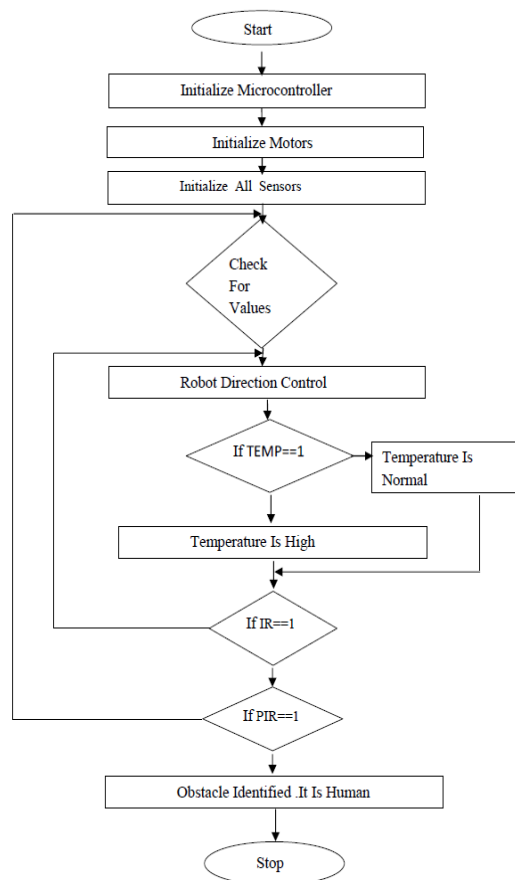


Fig 5.4 Flow Chart of entire project

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