Operation of Wireless Sensors for Premonition and Mitigation in Disaster

Pragati Jain[1], Sahana T.Edwin[2]

M.Tech Student, Babulal Tarabai Institute Of Research & Technology, Sironja [1]

Head of the Department, Babulal Tarabai Institute Of Research & Technology, Sironja [2]

Abstract: Many areas of world are getting affected due to natural calamity. Disasters are exceptional & unstoppable events that are either man made or natural, such as terrorist attacks, earthquakes, wildfires and floods etc. Disasters create emergency situations to provide basic services to the victims must be coordinated quickly. Many times we observe that many people dies by trapping in these disasters but the people also dies on large scale just because they didn't get help at instant time or the help provided to them is late. This project proposes a system based on Wireless Sensor Network (WSN) which is designed for human existence & detection in an unmanned area can be done only by an automated system. This system proposed a monitoring system using sensors unit and transmit data. Mobile robots perform cooperative Simultaneous human body localization function and communicate over the WSN. The main objective of this thesis is to rescue more & more number of people from the adverse condition.

Keywords: Wireless Sensor Network (WSN), Negative Temperature Coefficient (NTC), Positive Temperature Coefficient (PTC)

1. INTRODUCTION

The situation in the wake of a disaster is often chaotic and disaster victims who have become trapped or otherwise incapacitated by the events surrounding them are for the most part fully reliant on the efforts of rescue workers. It is therefore vital to the lives of victims that the search and rescue operation happens as quickly and efficiently as possible. Advanced technology has so far only played a minor role when rescue workers along with trained dogs attempt to locate and evacuate victims who have been trapped in damaged or collapsed building.

Literature Review

R.K. Jha, S. Kumar & K. Madhav [1] written on the application of the Wireless Sensor Network for disaster management. The module made for wireless sensor network consists of a fixed node with the rescue team and a moving node with the robot. When a natural disaster like an earthquake hits a populated area or an accident like gas leakage takes place in a building, rescue teams have to get a quick overview of the situation in order to identify possible locations of victims, which need to be rescued, and dangerous locations, which need to be secured. In order to provide the rescue facility, advanced robots embedded with lots of sensors and functions are centre of attraction of people and researchers all around the world. The paper by Raghad Dardar discuss a low cost and low Power consumption robot used for guiding rescue teams when disasters happens using wireless sensor network. The papers published by Albert W. Y. Ko and Henry Y. K. Lau discuss various things of rescue mechanisms including camera mounted probes, search dogs, and audio devices.

The paper by Trupti B. Bhondve proposes a monitoring system using sensors unit and camera module to record, analyze conditions of human body and transmit data.

2. PROPOSED SYSTEMS

The system can be divided into two units
1) Robot Unit and
2) Control Unit

Unit:
This processing unit consists of ATMEGA328 Microcontroller, L293D Motor Driver IC, ZigBee Module, motors of the robot & various sensors for detection of human presence as shown in the block diagram.
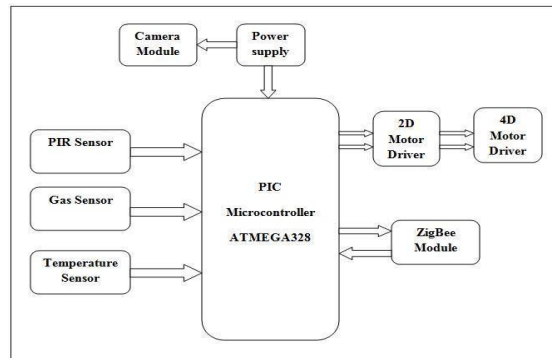
Control Unit:

Fig 1: processing Unit

The control unit consists of PC/Laptop, ZigBee Module, USB Module, Wireless Camera receiver & TV Tuner card as shown.
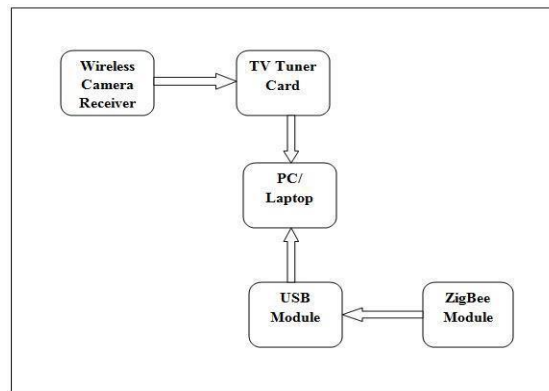

Figure 2: Power Supply

Power supply:
Power supply is necessary in both; unit as well as Control unit. So it is the most important part of system. For our project we require +5V regulated power supply with maximum current rating 500Ma. It consists of Step-down transformer, Rectifier, Filter circuit & Voltage re gulator as shown below.

Step-down transformer:
Step down transformer is the first part of regulated power supply. To step down the mains 230V A.C. we require step down transformer. Following are the main characteristic of electronic transformer.
•   Power transformers are usually designed to operate from source of low impedance at a single freq.
•   It is required to construct with sufficient insulation of necessary dielectric strength.
•   Transformer ratings are expressed in volt–amp. The volt-amp of each secondary winding or windings is added for the total secondary VA. To this are added the load losses.
•   Temperature rise of a transformer is decided on two well-known factors i.e. losses on transformer and heat dissipating or cooling facility provided unit.

Rectifier:
Rectifier unit is a circuit which converts A.C. into pulsating D.C. Generally semi-conducting diode is used as rectifying element due to its property of conducting current in one direction only. Generally there are two types of rectifier.
•   Half wave rectifier
•   Full wave rectifier.
In half wave rectifier only half cycle of mains A.C. is rectified so its efficiency is very poor. So we use full wave bridge type rectifier, in which four diodes are used. In each half cycle, two diodes conduct at a time and we get maximum efficiency at output. Following are the main advantages and disadvantages of a full-wave bridge type rectifier circuit.
Advantages:
•   The need of center tapped transformer is eliminated.

- The o/p is twice that of center tap circuit for the same secondary voltage.
- The PIV rating of diode is half of the center tap circuit.

Disadvantages:

- It requires four diodes.
- As during each half cycle of A.C. input, two diodes are conducting therefore voltage drop in internal resistance of rectifying unit will be twice as compared to center tap circuit.

Filter circuit:

Generally a rectifier is required to produce pure D.C. supply for using at various places in the electronic circuit. However, the o/p of rectifier has pulsating character i.e. if such a D.C. is applied to electronic circuit it will produce a hum i.e. it will contain A.C. and D.C. components. The A.C. components are undesirable and must be kept away from the load. To do so a filter circuit is used which removes (or filters out) the A.C. components reaching the load. Obviously a filter circuit is installed between rectifier and voltage regulator. In our project we use capacitor filter because of its low cost, small size and little weight and good characteristic. Capacitors are connected in parallel to the rectifier o/p because it passes A.C. but does not pass D.C. at all.

Voltage Regulator:

A voltage regulator is a circuit. that supplies constant voltage regardless of change in load current. IC voltage regulators are versatile and relatively cheaper. The 7800 series consists of three terminal positive voltage regulator. These ICs are designed as fixed voltage regulator and with adequate heat sink, can deliver o/p current in excess of 1A. These devices do not require external component. This IC also has internal thermal overload protection and internal short circuit and current limiting protection. For our project we use 7805 voltage regulator IC.

3. PIR SENSOR:

Working Principle:-

- PIR sensor is the abbreviation of Passive Infrared Sensor. It measures the amount of infrared energy radiated by objects in front of it. They do not emit any kind of radiation but senses the infrared waves emitted or reflected by objects.
- The heart of a PIR sensor is a solid state sensor or an array of such sensors constructed from
- pyro-electric materials. Pyro-electric material is material by virtue of it generates energy when exposed to radiation. Gallium Nitride is the most common material used for constructing PIR sensors. Suitable lenses are mounted at the front of the sensor to focus the incoming radiation to the sensor face. Whenever an object or a human passes across the sensor the intensity of the incoming radiation with respect to the background increases.
- As a result the energy generated by the sensor also increases. Suitable signal conditioning circuits convert the energy generated by the sensor to a suitable voltage output. In simple words the output of a PIR sensor module will be HIGH when there is motion in its field of view and the output will be LOW when there is no motion.
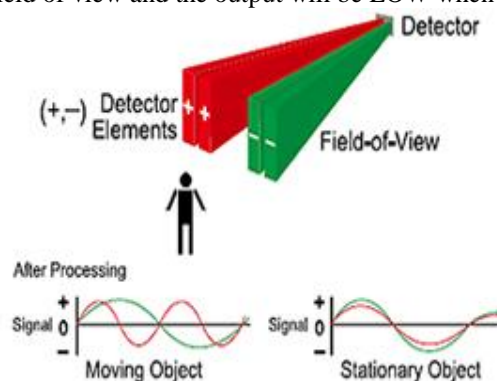

Fig 3: PIR detection diagram

Temperature Sensor-Thermistor:

A **thermistor** is a type of resistor with resistance varying according to its temperature. The word is a portmanteau of *thermal* and *resistor*. Samuel Ruben invented the thermistor in 1930, and was awarded U.S. Patent No. 2,021,491.Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements.Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then:

$R = k*T$

Where R = change in resistance,T = change in temperature,k = first-order temperature coefficient of resistance.

Thermistors can be classified into two types depending on the sign of k. If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (**PTC**) thermistor, or **posistor**. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (**NTC**) thermistor. Resistors that are not thermistors are designed to have a k as close to zero as possible, so that their resistance remains nearly constant over a wide temperature range.

Wireless Camera Module:

•   Super mini wireless color camera and wireless receiver set for wireless transmission and receiving of video.
•   This is a great low priced option for covert surveillance and security, as well as, with a little moddling, an excellent choice for sending video direct from your model as it is being used.
•   It features an excellent wireless transmission range, broadcasts on 1.2 GHz to avoid interference, and a receiver with Video OUT so it can easily and quickly
•   Be set up with a TV for viewing the images from the camera as they are being sent. This product uses the PAL color system.

Zig Bee /IEEE 802.15.4 - General Characteristics:
•   Dual PHY (2.4GHz and 868/915 MHz)
•   Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz)
•   Optimized for low duty-cycle applications (<0.1%)
•   CSMA-CA channel access
•   Yields high throughput and low latency for low duty cycle devices like sensors and controls
•   Low power (battery life multi-month to years)
•   Multiple topologies: star, peer-to-peer, mesh
•   Addressing space of up to:
•   18,450,000,000,000,000,000 devices (64 bit IEEE address)

4. OTHER SENSOR CLASSIFICATION FOR HUMAN BODY DETECTION:

On basis of many different human traits that can be used for identifying human presence large no. of sensors are available. Of which we limit ourselves to a selection of approaches which are either the most useful, the most ubiquitous, or the most ingenious. We discuss these in the context of similar solutions to illustrate the advantages and disadvantages of each.

Binary Sensors:
A variety of sensing modalities can be grouped into the broad category of **"**binary sensors". In the context of human-sensing, binary sensors are those that return logic 1 if human presence is detected within a certain sensing area, otherwise returning logic 0. The modality of binary sensors includes sensors such as break-beams, contact sensors, PIRs, and binary Doppler-shift sensors, all of which are currently used in resource-constrained scenarios. In single-node configuration, binary sensors can only be used to detect presence, and nothing more.

Vibration Sensors:
Various commercial heartbeat detection systems employ a set of vibration or seismic sensors to detect the presence of a person inside a vehicle or container by sensing vibrations caused by the human heartbeat. This technique can also be used in our system for detecting alive human.

Gas Sensors:
           Another commercial product uses infrared light to detect the level of carbon dioxide in an enclosed space, from which it infers the presence of humans or other living creatures

Thermo graphic Camera:
Originally developed for military use during the Korean War, thermo graphic cameras have slowly migrated into other fields as varied as medicine and archeology. More recently, the lowering of prices have helped fuel the adoption of infrared viewing technology.
Advanced optics and sophisticated software interfaces continue to enhance the versatility of IR cameras and are best suited for Night Vision. SO they are also best suited in our system for detection of human under debris. Instead we also can use low-cost web camera in order to confirm the existence of a human shape.
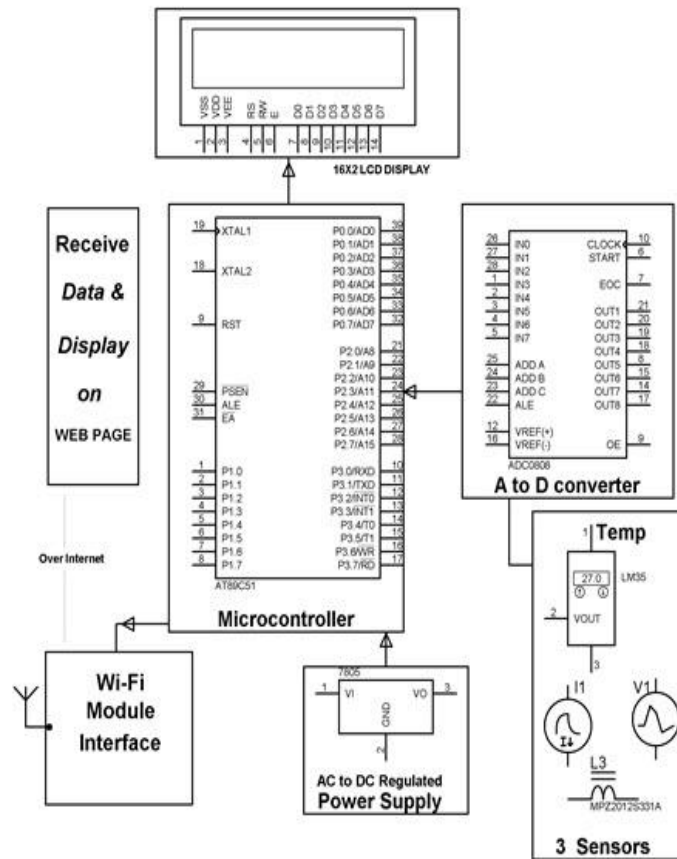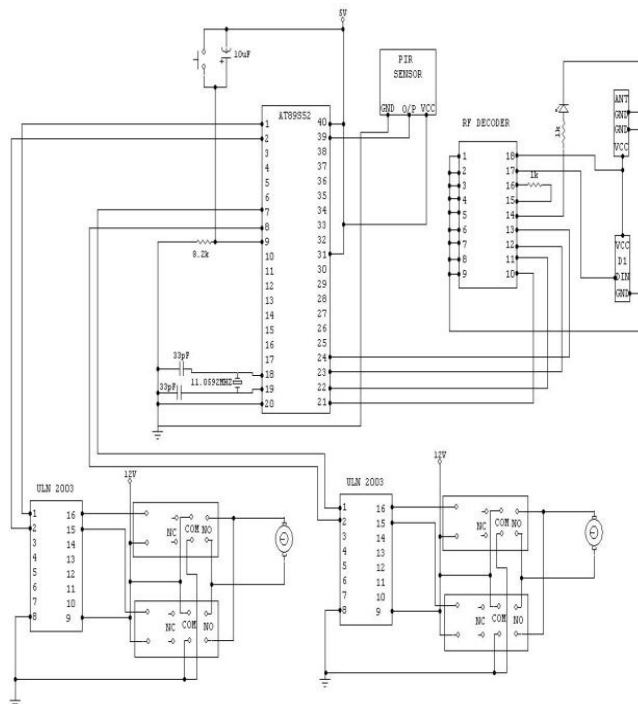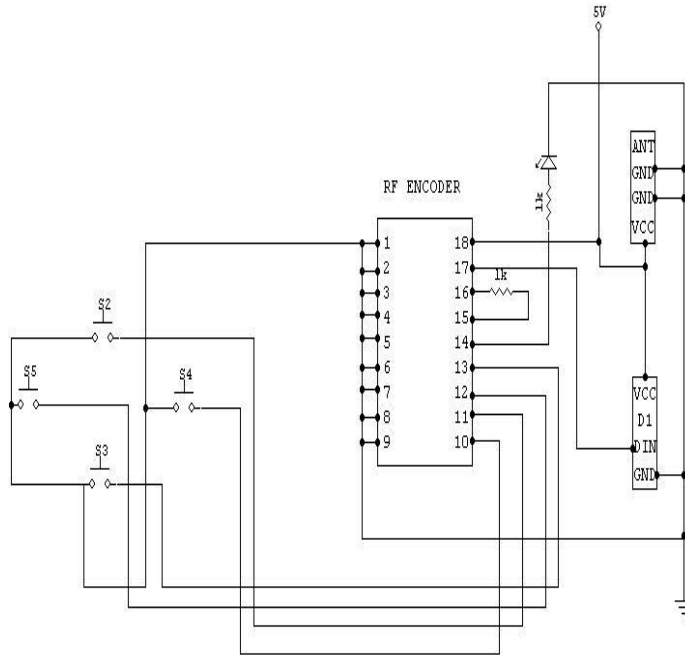
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Fig 4:Circuit Used

Transmitter
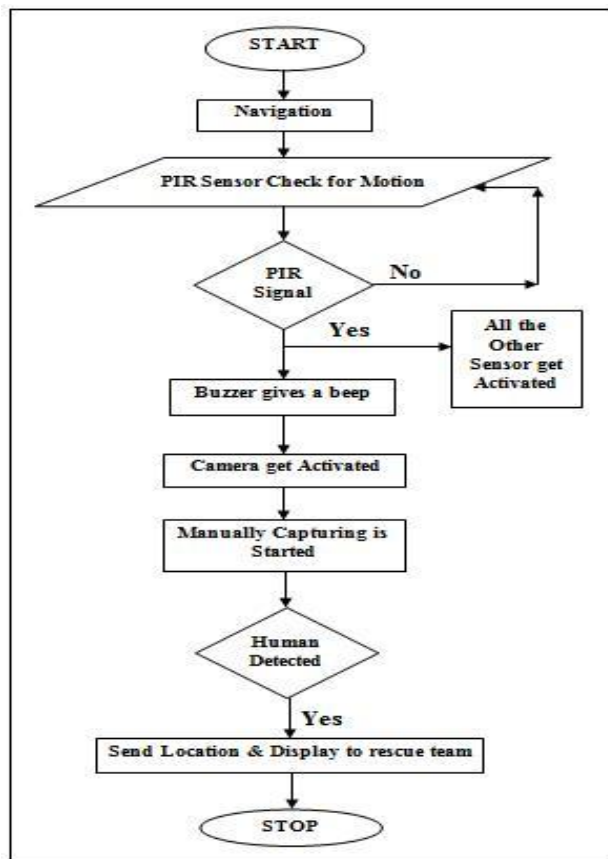
Receiver

Flow chart

Fig 5: Rescue Robot

In the fig 5, it shows structure of mobile rescue robot & assembly of hardware on the top of conveyer belt mobile robot. Hardware contains LCD which shows real time data of the entire sensor.

SAMPLE PROGRAM
Example :

```
org 00h
// Starting Of The Program From 00h memory
mov P1,#55h
//Move 55h to Port1
acall delay
// Call Delay Function
mov P1,#0AAh
//Move 55h to Port1
lcall delay
// Call Delay Function
sjmp back
mov r5,#30h
djnz r5,again
// Generating delay
ret
// Return Of Loop
end
// End Of Program
```
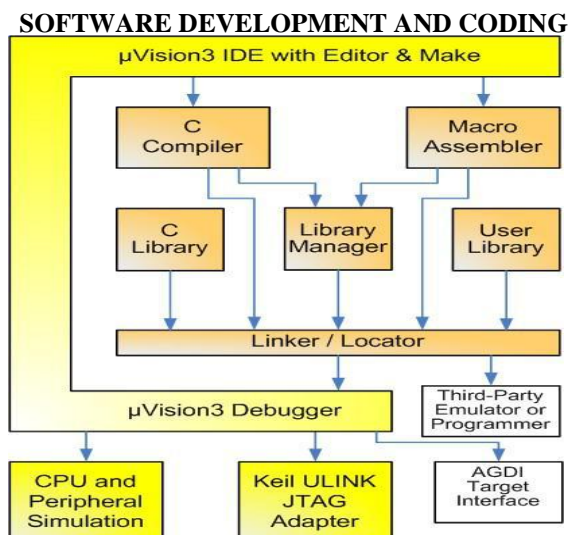
SOFTWARE DEVELOPMENT AND CODING

Fig 6: Keil Software- internal stages

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Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications

Source files are created by the μVision IDE and are passed to the C51 Compiler or A51 Macro Assembler. The compiler and assembler process source files and create replaceable object files.

The Keil C51 Compiler is a full ANSI implementation of the C programming language that supports all standard features of the C language. In addition, numerous features for direct support of the 8051 architecture have been added.

RESULT ANALYSIS OF SENSOR USED

During detection synchronization of sensor is vital part therefore it becomes important to draw attention toward sensor performance with synchronization. In given table sensor performance is evaluated

List of sensors with functions and performance

Sensor name	Function	Performance
PIR	IR based	satisfactory
Vibration	Heartbeat detection	Fair
Binary	Attached device with other sensor	Fair
Thermistor:	Heat sensing	Conditionally good at low temperature
Thermo graphic Camera	Night vision	satisfactory
Gas Sensors	CO_2 Detection	Satisfactory

In this table we have compared the performance of sensors during disaster to detect human body .Results may vary during detection depending upon the disaster site and system performance on an average we can sum up their performance on the basis of received data.

5. CONCLUSION

The "Human Body Detection in Rescue Operation in Disaster by automation" 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, thermal sensor and CO2 sensor to sense the human being and give us an alert indication. A wireless camera module is also used which provides live footage of the field where rescue operation for determining human presence is performed. Also ZigBee has been used for wirelessly transmitting and receiving data for controlling the units and identifying variations in sensed values. Hence this provides best solution for the human to detect the humans while they are trapped under the building because of natural calamity like earthquake more quickly.

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