AVR based Fire Fighting Robot

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Abstract - From the recent years, robotics has turned out to be ingredient over which peoples shown their interest. Robotics has gained popularity due to advancement of many technologies of computing and nanotechnologies. So we decided to make human life easier and reduce the efforts taken by them. Our review is to make fully automated fire fighting robot which deals with the fire problems in household, laboratories, small scale industries. This robot follows the predefined path and performs the various tasks. We can use this robot to perform those tasks that may be harmful and dangerous to human. The Fire sensors equipped fixed in the rooms where there will be a possibility of fire is to be occurred. When it senses fire the address of location received by robot and accordingly it will reach to the destination and extinguish fire immediately.

Index terms - Robotics, AVR Microcontroller, Fire Sensor, RF Module, GSM Module, Obstacle Sensor.

I. INTRODUCTION

The word 'robot' originates from the Czech word for forced labor, whose fictional robotic inventions was much like Dr. Frankenstein's monster- creatures created by chemical and biological, rather than mechanical methods, introduced it. But the current mechanical robots of popular culture are not much different from the fictional biological creations. Systems that processes sensory input in the devices current situation and instruct the device to perform actions in response to the situation in the manufacturing field, robot development has focused on engineering robotic arms that perform manufacturing processes. In the space industry, robotics focuses on the highly specialized, one kind of planetary rovers. Currently, robotic competitions are held periodically both in national and international levels. Many robots designed for fire detection, fire extinguishing. Some of them are controlled by human. So if every time fire occurred the robot for extinguishing the fire there is always a need of human to move robot to the place where fire occurred, from this we see that the process becomes so lengthy and time consuming, so there is need to create the fire fighting robot which required to be self controlled, also it have a both capability of fire detection as well as fire extinguishing**.** So here we are going to design AVR based fire fighting robot [3].

We are using Atmega16 microcontroller. For robotic motion we are using DC motor driven car. The main areas of our project are: Fire Sensor operation (IR Sensor), Microcontroller operation, RF transmitter and receiver operation, Robot movement operation, Sprayer operation [3].

Block diagram implementation are described in the second section. Hardware required for project and its details are also described after it.

II. LITERATURE REVIEW

From the recent years, robotics has turned out to be ingredient over which peoples shown their interest. Robotics has gained popularity due to the advancement of many technologies of computing and nanotechnologies. In earlier fire fighting robots, the mobile operated robots which are used for navigation and obstacle avoidance technology [2]. Mobile robot use GPS and SONAR sensor to detect obstacle so mobile robot make system cost sensitive and of high risk [5].

In some projects a black line path is assigned so by following those path robots were extinguish fire. Also robots are designed as tank robot with flame, ultrasonic, thermal array, and compass sensor. Its simulation area is designed in miniature, its miniature equipped with furniture, sound damper and uneven floor. But the use of various sensors make the design complicated, there will be a possibility of messing up of the output. Our review is to make fully automated fire fighting robot which deals with the fire problems in household, laboratories, small scale industries [3]. This robot follows the predefined path and performs the various tasks. We can use this robot to perform those tasks that may be harmful and dangerous to human. That's why Autonomous fire fighting robot is best to show the feature of robot intelligence in robot world [4]. In order to solve problems created while operating the robot manually or through mobile, an intelligent design made which constitutes addresses of various locations. This makes human life easier and reduces the efforts taken by them [6].

This system composed of IR sensor to detect the flame from surrounding environment based on the data from sensors, because its speed and accuracy is better than gas and smoke sensor [1]. In this project robot also detect the obstacle in its path. When obstacle is present it stop and resume its running then start ringing the buzzer. It involves predefined computation of obstacle free path, which controller guides the robot. There is a provision for sending message to fire brigade, also to the person close

the room where the fire has been occurred through GSM. It alerts the peoples in industry, lab, and mill that fire has occurred by using buzzer. This robot can avoid obstacle with a better security path to overcome problem of mobile robot intelligent obstacle avoidance system [5].

III. BLOCK DIAGRAM

Figure 1. Shows the block diagram of transmitter unit for AVR based fire fighting robot and Figure 2. Shows the receiver unit respectively. It consists of two parts: Transmitter part and Receiver part. Transmitter part consists of fire sensor, HT 12 encoder, RF transmitter. Receiver part consists of RF receiver, HT 12 decoder, AVR controller, display unit, Fire extinguisher and motor driving unit [3].

The main unit AVR performs following tasks:

1. It will detect the address of location where the fire is occurred.
2. It display location and send message to fire brigade.
3. It alerts the peoples in industry, lab, mill, by starting buzzer.
4. It detect obstacle in path.

In fire fighting robot, when fire occurs, the fire sensor sense the fire. Fire sensor used is IR sensor which works on the principle of
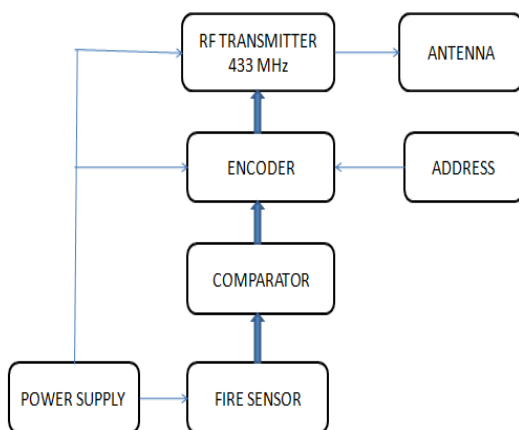

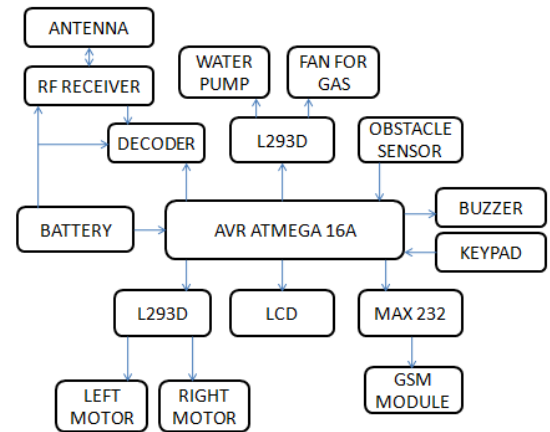Figure 1. Transmitter unit [2]

Figure 2. Receiver units [2]

photoemission. Then its output is given to comparator. Comparator compares sensed output with predefined threshold level and accordingly it sends output to encoder. Encoder is used here for addressing also for speed limitation. It is capable of encoding information which consists of N address bits and 12-N data bits. It used for parallel to serial conversion. RF module uses Radio Frequency (RF) transmitter which is single bit transmitter. It works on 433MHz frequency.

With the help of antenna, RF transmitter convert electrical signal into electromagnetic signal. The antenna used is wired loop antenna. At the receiver side, RF receiver used to convert Electromagnetic (EM) signal into electrical signal. Decoder is used for address separation as well as serial to parallel conversion. The encoder, decoder series used here is compatible with RF module. Then when signal go to Advance Virtual RISC (AVR) first it send SMS, display location, start buzzer, find path. AVR used here because it is open source system. The path given through address then AVR start pump and fan for extinguishing fire. We use GSM module for sending SMS and LCD to display location. Buzzer used in this project is piezoelectric buzzer to alert peoples in industries, labs, mills. If the location is detected, then according to programming, the robot finds its path and finally it reaches to its destination. If within its path, obstacle is present then it is detected by obstacle sensor. After extinguishing fire, robot is returned back to its original position through keypad [5]

IV. IMPLEMENTATION

A. HARDWARE DESCRIPTION

Components of this project are:
  i. IR Fire sensor
  ii. RF Module transceiver set
  iii. GSM module
  iv. DC motor
  v. ATMEGA16A AVR Microcontroller

i. IR Sensor

An infrared sensor is an electronic device that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring heat of an object and detecting fire. Infrared waves are not visible to the human eye [1].

ii. RF module

An RF module (radio frequency module) is a small electronic circuit used to transmit and/or receive radio signals on one of a number of carrier frequencies. RF modules are always used in electronic design according to the difficulty of designing radio circuitry. Transmitter modules are usually implemented alongside a microcontroller which will provide data to the module which can be transmitted. The transmitted data is received by RF receiver operating at the same frequency as that of the transmitter An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The RF receiver in the robot receives the information and decodes it and gives information to the microcontroller about which fire sensor is activated [3].
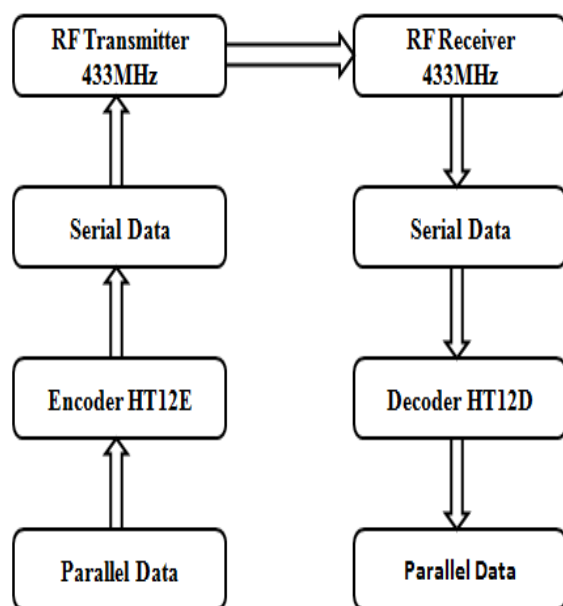

Figure 3. Block diagram of RF Transmission   system [7].

Several carrier frequencies are commonly used in commercially-available RF modules, including 433.92 MHz, 868 MHz and 915 MHz [1].

iii. GSM Module

GSM is designed as data communication equipment. GSM modem requires SIM card from wireless carrier in order to operate. GSM Modem needs 5V DC supply. The modem needed only 3 wires (TX, Rx and GND) except Power supply to interface with Microcontroller/Host PC. Receiver pin connected to AVR Microcontroller. It will receive the data from this AVRs controller [2].

iv. DC Motor

A DC motor is a mechanically commutated electric motor powered from direct current (DC). DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux). The speed of a DC motor can be controlled by changing the voltage applied to the armature. Modern DC motors are often controlled by power electronics systems called DC drives [1].

v. ATMEGA16A

The ATMEGA16A is a low power CMOS microcontroller based on AVR enhanced RISC architecture. In RISC architecture the instruction set of the computer are not only fewer in number but also simpler and faster in operation. The other type of categorization is CISC (Complex Instruction Set Computers).

AVR microcontrollers are available in three categories:

1. Tiny AVR – Less memory, small size, suitable only for simpler applications

2. Mega AVR – These are the most popular ones having good amount of memory (up to 256 KB), higher number of inbuilt peripherals and suitable for moderate to complex applications.

3. X Mega AVR – Used commercially for complex applications which require large program memory and high speed.

A. Special about AVR

They are fast: AVR microcontroller executes most of the instructions in single execution cycle. AVRs are about 4 times faster than PIC & 10 times faster than 8051. They consume less power and can be operated in different power saving modes [2].

B. Software Requirement

The software for the robot was coded in embedded C, because of compiler availability, our familiarity with the language, as well as the greater control of the system offered as compared to other high level languages. While our Microcontroller supports ASM language, it was avoided because it is a difficult to maintain, and varies largely from processor to processor. C allows us to easily break apart the components of software design so that different members of the team could code the system due to its properties of easy understanding and not variant from system to system. [4]

V. RESULTS AND EXPERIMENTATION

The prototype of FFR system has been shown in figure 4. This system has been tested by igniting candle near to sensor, Fire sensor at transmitter detect the flame and send signal to microcontroller through RF receiver then microcontroller send an active signal to other externally connected devices. As a result message is send by GSM module. In experimentation, results for LCD Display are observed below:
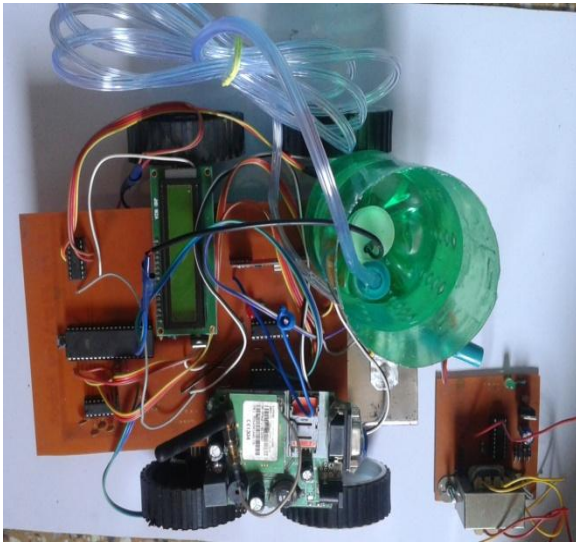LCD display –

"FIRE OCCURS AT PHYSICS LAB"

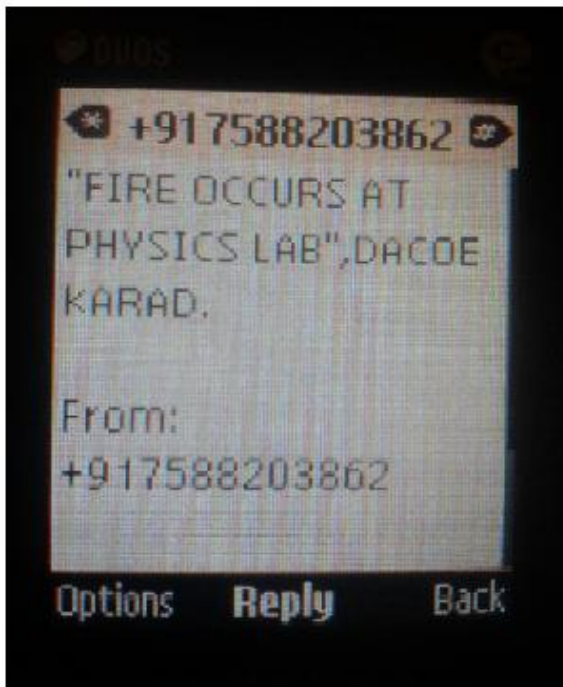Figure 4.The prototype of FFR system

Figure 5. Image of Message Send by GSM

After this buzzer rings and when robot reaches to lab it sprinkles water with the help of water pump. If any obstacle present in path, then also robot start ringing buzzer.

VI. CONCLUSION

Using the proposed technology, the robot can detect and extinguish fire. Robot can be act as automatic location finder and path tracer. It provides greater efficiency to detect the flame and it can extinguish fire before it become uncontrollable and threat to life [4]. This project will be complete addition of electronic circuits, hardware designing and software knowledge. Less human intervention is needed for the operation of the robot. It stops the spreading of fire effectively by the use of water sprinkler. The robot can be designed to avoid obstacles in its path by using IR obstacle detection sensor [3].

It can be reprogrammed easily to add modifications. It can extinguish or fight fire for a small amount of time until human fire brigade arrive. It can detect fire only in certain locations. It will be a safest mode of operation by which many disasters can be prevented without damage. [3].

VII. ACKNOWLEDGMENT

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