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Fire monitoring system using RF module

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ABSTRACT

The objective of this project is to design and monitor system for the fire alerts in the surrounding environment using the Flame sensor. It is transmitted wirelessly using an RF module. The output is displayed in the LCD and Lab-VIEW GUI.

Keywords— *Open-source platform, Flame sensor, Lab-VIEW.*

1. INTRODUCTION

The objective of this project is to design and monitor system for the fire alerts in the surrounding environment. The system is designed in two categories one is transmitter section and other is receiver section. It is designed in such a way that it senses the fire in surrounding environment assisted with a fire sensor at the transmitter end and communicates with the receiver section at the other end. The signal is transmitted in a wireless manner with a 433MHz RF module. At the other end of the receiver, a Lab-VIEW GUI is designed to study the system. For the design of the project, the Arduino and RF module is used along with the Lab-VIEW platform. The LCD display and Lab-VIEW software display the condition of a fire alert.

2. HARDWARE COMPONENTS

2.1 Arduino Board

The Arduino which is an open-source platform has become well acquainted with people into electronics. Unlike most previous programmable circuit board the Arduino doesn't have a separate part of hardware to load new code on to the board. We can use a USB cable to upload the new code and the Arduino also uses a version of C++ which is easier to program.

The Arduino Board has two parts:

2.1.1 Hardware: The hardware part of the Arduino Board consists of many components. Some of the main components are explained here.

- **Power Supply:** The power supply is used to power the board. The internal power supply which is inbuilt with the board is 3.3V and 5V. The external power supply given to the board is about 9 to 12V.
- **Reset Button:** This button is used to reset the Arduino when any other command is uploaded.
- **USB Plug:** This plug is used to dump the program to the microcontroller and it also provides 5V power supply externally to the board.
- **Analog Pins (0-5)**: In the Arduino board the analogue input pins are from A0 to A5.
- **Digital I/O Pins:** The digital input, output pins are from 2 to 13.
- **Microcontroller:** The Arduino has microcontroller of ATmega328 which is to receive and send information or command to the circuit.

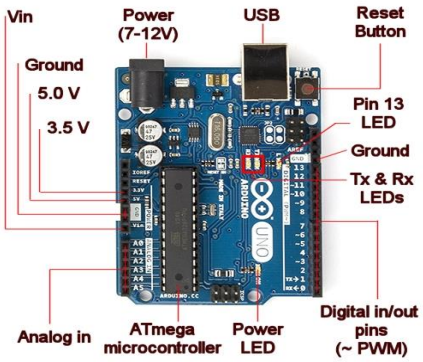

Fig. 1: Arduino Board

2.1.2 Software (Arduino IDE): This software provides a set of information that instructs the hardware of what to do and how to do. The Arduino IDE (Integrated Development Environment) has three parts:

- **Command area:** This is the area which contains a list of menu items used for sending and receiving data between the Arduino and IDE.
- **Text Area:** In this area, we need to write our code in the form of C++ and it is also known as a sketch.
- **Message Window Area:** This area shows message from IDE in the blank area.

2.2 Flame Sensor

The Flame Sensor is used to detect the presence of flame or fire. This sensor responds faster and more accurate than the smoke or heat detector. It detects by the IR ways released from the flame within 3-5 seconds. It can detect the flame or wavelength of light within 760nm to 1100nm around the distance of 80cm in an angle of 60 degrees. It is very sensitive to the flame spectrum. This system has a sensitive range of approximately about 4.3 to 4.4micro meters that cover the resonance frequency of carbon dioxide which is generated in large amount by burning of hydrocarbon materials such as wood and fossil fuels.

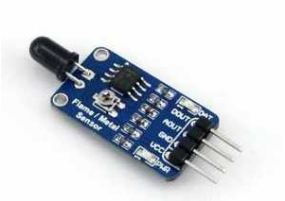

Fig. 2: Flame sensor

The IR flame detectors detect the hot Carbon Dioxide gases from fires produce a peak in total radiation, also a specific spectral pattern in the infrared range.

2.3 LCD

The Liquid crystal display (LCD) used here is 16*2 line LCD display which contains 2 horizontal lines and for compressing the space of 16 display characters. It uses the property of light monitoring. They don't emit the light directly. The LCD is a flat panel or electronic visual display. It consists of low information, contents of the LCD are obtained in the fixed image or arbitrary image which can be displayed or hidden like present words, digits or seven segment display. Arbitrary images are made up of many small pixels and the element has larger elements.

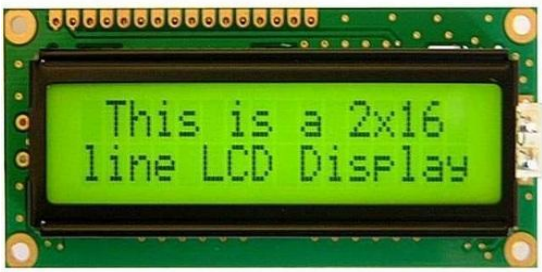

Fig. 3: Liquid Crystal Display

The LCD contains two registers in inbuilt they are:

- **Command Register:** It is used to insert a special command which is a set of data in the LCD. It gives the internal command to the LCD like clear screen, setting the cursor and etc.
- **Data Register:** This register is used to enter the line in LCD.

2.4 RF Module

The Radio Frequency Module is a small electronic device to transmit/receive radio signals between two devices. It is used to communicate wirelessly with another device. This is accomplished through radio frequency communication. Many applications use RF since it doesn't require line of sight. This module contains a transmitter and a receiver of various types and ranges. It is used in the difficulty of designing radio circuit. The RF communication circuit means careful monitoring to ensure that it is not affected. This module very small in dimension and it operates in a voltage range of about 3-12v. The RF module used here is 433MHz in both transmitter and receiver part. Transmitter and Receiver are interfaced to Arduino for data transfer.

2.4.1 Transmitter: The RF transmitter receives the data from the microcontroller and it transmits wirelessly through RF through its antenna is connected in pin 4. Here the transmission occurs at the rate of 1-10kbps.

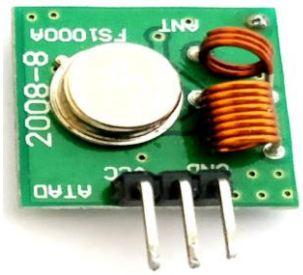

Fig. 4: RF Transmitter

This transmitter module is a small size Printed Circuit Board (PCB) which is used to transfer radio way to carry the data.

2.4.2 Receiver: The RF receiver receives the data from transmitter wirelessly. There are two types of RF receiver module they are a super regenerative receiver and superheterodyne. Super regenerative modules have low power designs and low cost. These modules are generally inaccurate because the operation of frequency is significant with power supply voltage and temperature. The superheterodyne receiver has high performance than a super regenerative receiver. They have increased stability over large temperature and voltage range.

Fig. 5: RF receiver

The RF module is used with a pair of encoder and decoder. The encoder is used for encoding the parallel data for transmission. Reception is decoded by the decoder. Some of the commonly used encoder and decoder pairs are HT12E-HT12D, HT640-HT648 etc.., In this system, digital data is represented in the form of variations in amplitude of carrier wave. This kind of modulation is called Amplitude Shift Keying.

3. SOFTWARE COMPONENTS

3.1 LabVIEW

LabVIEW program was developed using a graphical programming language called "G". It is a system design platform for a visual programing language from national instruments. It was initially released in 1986. It is written in C, C++, .NET. It is used in an operating system such as windows, macOS, Linux. LabVIEW is used for data acquisition, instrument control, and industrial automation on the operating systems. Some of the latest versions of LabVIEW are LabVIEW 2018, LabVIEW NXG 3.0. It is supported by the visual package manager (VIPM) and it contains tools and kits which improve the LabVIEW. Virtual instruments are used here because of their appearance and operation which is exactly like physical instruments. They are analogous to main programs, functions from the programming languages like basic C. LabVIEW program is always called as VI.

4. WORKING

The transmitter section consists of a flame sensor which is used to detect the presence of fire or flame based on the Infrared (IR) wavelength emitted by the flame. The output of the flame sensor is in the form of logic 0's and 1's. The Arduino UNO which is an open source microcontroller used here to check the logical output from the output pin of the sensor. The data is transmitted from transmitter Arduino to the receiver Arduino by the use of an RF module. LCD is used in both the transmitter and the receiver section to display whether the flame is detected or not by the simulation model showing "FLAME DETECTED" or "NO FLAME". LabVIEW GUI is designed to monitor system for the fire alert. The front panel contains two LEDs which are placed as an indicator, red LED indicates "FIRE DETECTED" and the green LED indicates "NO FLAME". There is a serial COM port to access data from PC port where the baud rate is set as "9600", which is the same as "Zigbee" to receive data. The data bits given here is "8". Parity used here is "none". The stop bits here are "1" and the serial count is "100", flow control is "none". Serial_read_buffer to receive the data from the sensor. Graphical programming is done to make the front panel and the block diagram.

5. CONCLUSION

This project is a simple system which presents a low cost and low power. This system has a high application in large industries, houses for safety measures. In future, there can be the addition of GSM module for the SMS system.

6. REFERENCES

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