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Microcontroller Based Automatic Flame Suppression System

Phyu Phyu Shein [1], Kyi Kyi Khaing [2]

[1] ITSM Department, University of Computer Studies(Dawei), Myanmar

[2] FCST Dept. MIIT(Mandalay),Myanmar

Abstract - The microcontroller based flame suppression system's purpose is to control or extinguish a fire. It is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Flame detection systems provide very rapid detection times and ideally suited to cover large high-hazard volumes. It can include sounding an alarm, and activating the water pump and then responses to a detected flame. The ability to detect the presence of fire is a vital part of an overall fire safety strategy. The detection of fires involves a whole range of fundamental scientific principles as well as the application of advanced technological developments. This article examines the various types of technology used in modern buildings, tunnels, vehicles etc. Without a means of detection we are unable to alert occupants, activate many other fire safety measures or summon the fire service.

Keywords - microcontroller, flame suppression, flame Sensor, security.

I. INTRODUCTION

Security is a prime concern in our life. Security of buildings is almost standardized nowadays. Safety from leaking of gas and fire are the most important requirements of home and factory security system for people. A conventional security system gives the alert signals in terms of higher buzzer sound. There are various AT mega microcontroller In this paper, we are going to use AT mega 328 microcontroller. AT mega 328 microcontroller has different numbers of analogue and digital inputs used for many applications. [1]

Flame sensor module consists of a photodiode (IR receiver), resistor, capacitor, potentiometer, and a comparator in an integrated circuit. There are different types of flame detection methods. Some of them are: Ultraviolet detector, near IR array detector, infrared (IR) detector, Infrared thermal cameras, UV/IR detector etc. [2] In this project we are using an IR based flame detector sensor. It is based on a high speed and high sensitive NPN silicon phototransistor.

II. METHODS AND MATERIAL

This design is based on both hardware and software. For the design to be implemented, we will be using an AT mega32 microcontroller, interface with some other hardware components. The functional block diagram of the system is shown in Figure 1.

2.1 General Description of Equipment

2.1.1 Flame Sensor

A flame detector is a sensor designed for detecting and responding to the existence of a flame or fire. It can detect ordinary light source and the distance of detection is up to 100 cm. A flame detector can usually respond faster and more accurately than a smoke or heat detector owing to the mechanisms it uses to detect the flame. The flame sensor can produce digital or analog signal. It can be used as a flame alarm or in firefighting robots. [3] Flame sensor used in this project is shown in Figure 2.

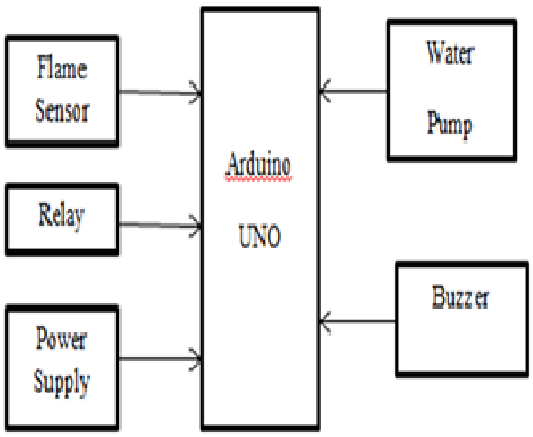

Figure 1: Functional Block Diagram of the System

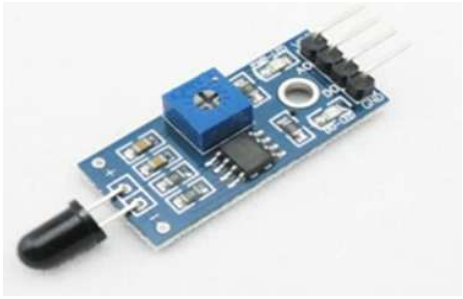

Figure 2: Flame Sensor

2.1.2 Microcontroller

It's an open-source physical computing display place based on a simple microcontroller board involves an ATmega328 microcontroller and a development environment for writing soft-ware for the board. Arduino can be used to develop communicating objects, taking inputs from a selection of switches or sensors and controlling a selection of lights, water pump and other physical outputs.[4]

Arduino Uno is microcontroller board and based on the Atmel's AT mega 328 microcontroller. "Uno" means one in Italian and the uno board is the latest in a series of USB (Universal Serial Bus) .The Arduino Uno board has a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button, 6 analog inputs and 14 digital input/output pins (of which 6 can be used as PWM outputs). The board has 32 KB flash memory of which 0.5 KB is used by boot-loader, 2 KB of SRAM, 1 KB of EEPROM and 16 MHz clock speed. [5] The Arduino Uno board of microcontroller AT mega 328 is shown in Figure 3.

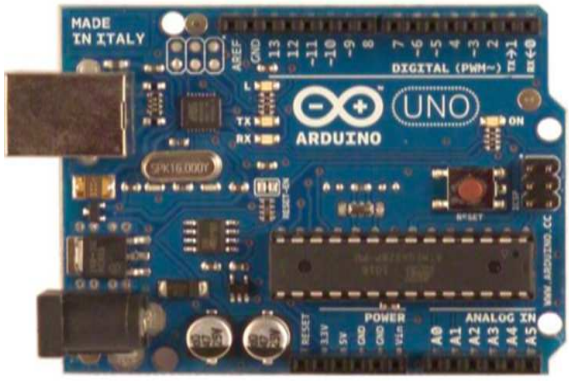

Figure 3: AT mega 328 microcontroller Arduino Uno Board

2.1.3 Relay

Relay module is an electrically operated switch. It is an electromagnetic device, which consist of solenoid, moving contacts (switch) and restoring spring and consumes relatively large amount of power. It is used for the function of isolating the controlling and the controlled device. Hence it is possible for the interface IC to control the relay contentedly. To enable this, a driver circuitry, which will operate as a dielectric circuit, is to be combine between them.[6] The driver circuitry senses the presence of a "high" level at the input and drives the relay from another voltage source. Therefore the relay is used to switch the electrical supply to the appliances. It is used to allow the opening and closing the circuit depending on the voltage or/and current to ensure the safety device in the event that the voltage or current is greater than the ability of Arduino to handle. [7] The relay switch is shown in Figure 4.

Figure 4: Relay switch

3. Operation of the System

According to the circuit diagram in Figure 5, the connections are done by connecting the flame sensor with the microcontroller interfaced by the relay and the buzzer. Input and the output connections are properly done and therefore the connections are to be made easier by connecting using jumper cables. Program has been uploaded in the microcontroller. The

power supply 5V is connected to the whole part of the circuit.

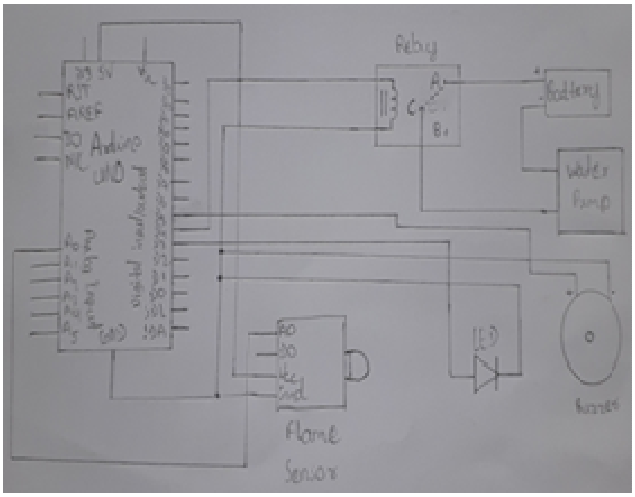

Figure 5: Circuit Diagram of the System

Flame detectors comprise an electronic circuit with an electromagnetic radiation receiver. They are activated when they receive electromagnetic radiations from one or more defined wavelengths according to infrared spectrum. It is used to detect fire and provide the signal upon the detection. The microcontroller's analog pin reads the signal on the output pin of the sensor. It gives logic 1 as output if flame signal is detected with analog pin, otherwise it gives logic 0 as output. Arduino Uno checks the logic level on the output pin of the sensor and performs further tasks such as activating the buzzer and LED, sending an alert sound. When the microcontroller gives logic 1 output from the digital output pin, it turn on the relay switch. And then the relay immediately drives the water pump to response with water to a detected flame. The functional flow chart of the system is shown in Figure 6.

3.1 Burning the Code

The hex file is generated with the same name as program using an AT mega 328 microcontroller. This program is transferred to flash memory of microcontroller. A programmer can be used to burn the program. The program is burnt into microcontroller. The burner uses SPF port of microcontroller to load the program.

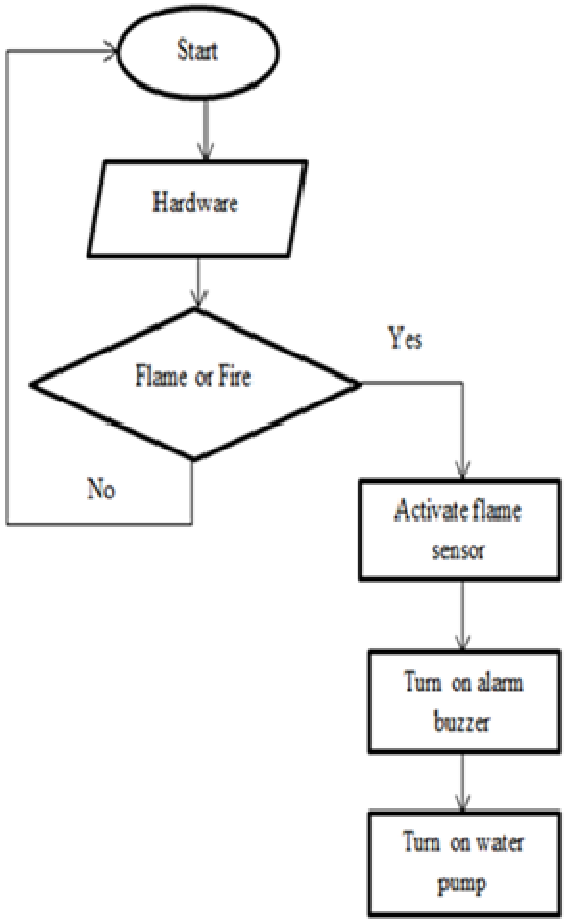

Figure 6: Flow Chart of Flame Suppression System

Open Atmel studio. Copy the program source code along with its attachment libraries and headers. Save and build the main program source code in Atmel studio. To set board and frequency go to Project- Configuration options in Atmel studio. Select device as AT mega 328 and set frequency as 8MHz. Connect USB programmer to AT mega328 board. Open AVRdude software. In configuration settings, select AT mega 328 as microcontroller. In memories section of AVR dude, browse for hex code generated for the main source code. Also, check if the write button is ticked. If not, tick it. After uploading hex code. Press executes to burn the code into AT mega 328 board.

III. Conclusion

Sensor directs a signal to microcontroller. In the next step, microcontroller directs an active signal to other externally connected devices buzzer, relay switch and via water pump. The proposed system can be used in any place like homes, hostels, industries, vehicles with low power consumption. Fire has always been a potential threat to humans

(and most land-based creatures), so the ability to detect a fire is something that has been part of our evolution.

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