SMOKE DETECTOR AND FIREFIGHTING SYSTEM

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Abstract. The project deal with the concept of developing a software and a hardware system for industries to provide security in case of fire and smoke detection. During normal condition, the smoke detector provides no signal to the control system. In case of smoke or fire detection, the detector provide high signal to the microcontroller unit in order to activate its output ports.
The circuits connected to the output ports, which are alarm circuit, water pump, system display and an SMS unit, will run immediately to give an alarm and stop the smoke or fire and send an SMS to the property owner.

Keywords. Smoke, Alarm, Detection, Microcontroller.

INTRODUCTION

Security is primary concern everywhere and for everyone. Every person wants his home, industry etc to be secured. This project describes a security alarm system that can monitor an industry and home. This is a simple and useful security system and easy to install. This fire / smoke detector is realized using readily available, low cost components.
A smoke detector also known as a smoke alarm is a device that detects smoke, typically as fire indicator [1].

A smoke detector's purpose is a simple one, to give you ample notification in case of a fire in the house, industry or in any property where the security is required. Without a smoke detector, by the time that there is a fire, the house could be so badly engulfed and a safe exit cannot be found easily. Beside that the smoke can be so overwhelming that the habitant suffocates when trying to get out.

There are two famous types of smoke detectors, ionization smoke detector and photoelectric smoke detector. The ionization detector contains radioactive material that ionizes the air resulting in an electrical path for the current to flow. While the photoelectric detector contain a light source at one side and a photocell in the opposite side. The principle of operation of this type depend either on the light scattering technique by which a small amount of smoke can be detected. The other use the technique of light obscuration in which the source of light and the photocell are in line of sight. An a laser technique is used in smoke detection using laser as a source of light , optical amplifier in order to be sensitive and fast in detection and the photo-receiver.

There are specialised smoke alarms available for people who are Deaf or have a hearing impairment. These have a flashing strobe light and/or a vibrating pad that can be placed under the pillow which activate when the smoke alarm sounds and are designed to interconnect with conventional audible alarms in different locations within the home. If one of the alarms senses smoke, all alarms will sound, the strobe will flash and the vibrating pad will operate. [2]

SYSTEM BLOCK DIAGRAM
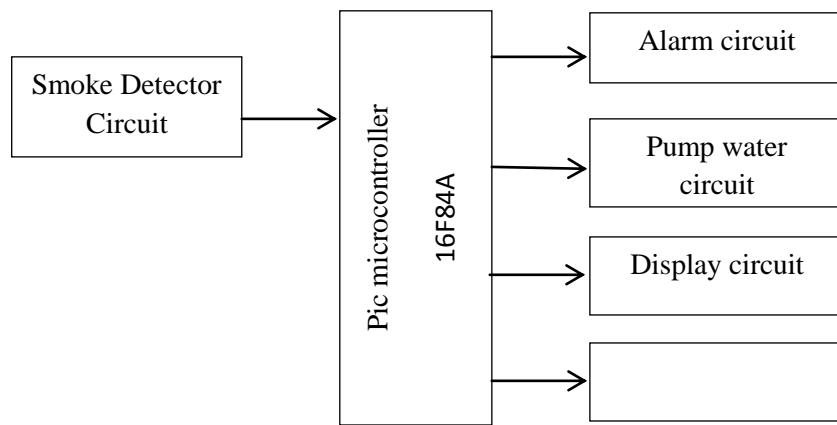
Figure 1. System Block Diagram

The smoke detector circuit is designed as an input for the system. It is designed with using an opto-coupler as smoke sensor. The Opto-coupler consists of an IR diode and a photodiode with a small gap in between [3]. During normal condition the photodiode receives the IR signal from the IR diode and indicate that there is no detected smoke. If there is any smoke, the smoke interrupts the light signal from reaching the photodiode which in turn activate a control circuit in order to generate high signal to indicate that there is a detected smoke. At that time the pic microcontroller starts to activate the output ports to which the alarm, display, pump and SMS activation units are connected. This mechanism of operation is summarized in the flowchart presented in figure 2.
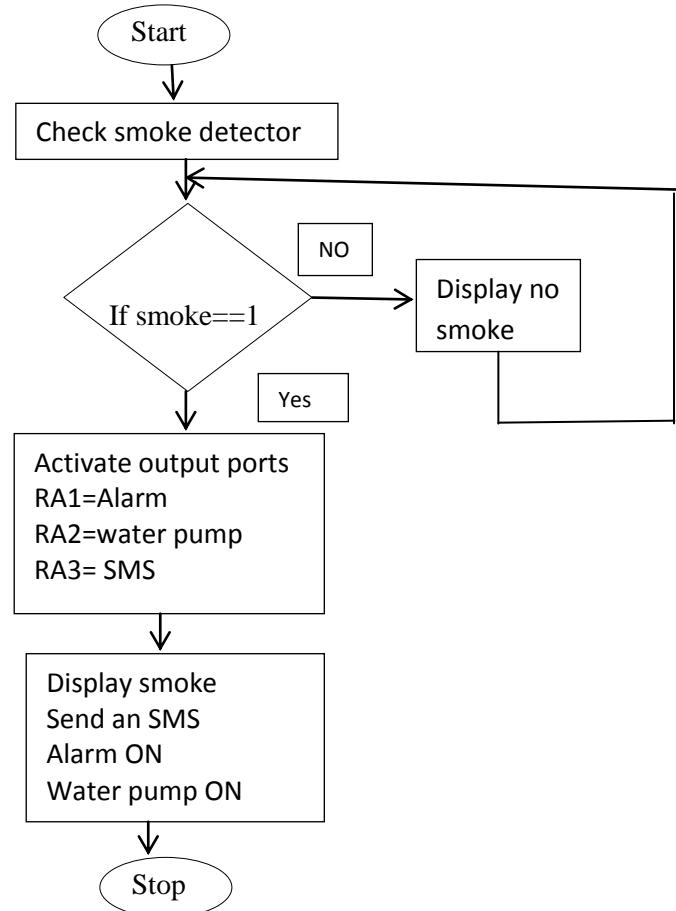
Figure 2. System flowchart

METHODOLOGY

The project consists of four sections. This first section includes searching information about the smoke detector and firefighting system. The second section includes the design and built the circuits which fit the system function. The third section is to simulate the function of all the designed electronic circuits using MultiSim software, in order to verify the proper function of the circuits before the practical implementation which is considered as that last section of this project.

In this project the smoke detector checks the case .If there is any smoke, the 16f84a pic microcontroller is initialized and start to activate the output ports in order to run the alarm system, the water pump and to send an SMS to the owner. In case of there is no smoke the pic microcontroller leaves the output ports off and in standby condition.

The PIC16F84A is an 8 bit microcontroller which means that it is capable of processing only 8-bits at a time. It also comes in various packages. In this project the only concerned microcontroller is the PDIP (Plastic Dual Inline Package)microcontroller which is largely used in many electronics and system applications, refer to figure 3,[4].
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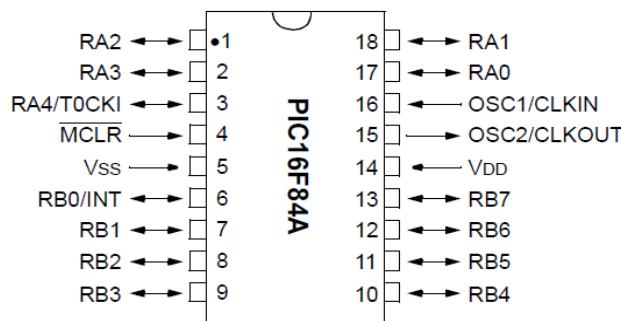
Figure 3. 16f84a pic microcontroller

CIRCUIT SIMULATION

Figure 4, represent the smoke detector circuit simulation, the obtained signal from the sensor compared with reference voltage (from voltage divider formed from R2 and R5). The Op-Amp output will be either 5V or Zero volt depending in the existence of the smoke or not respectively. The result of the simulation is shown in figure 5. [5].
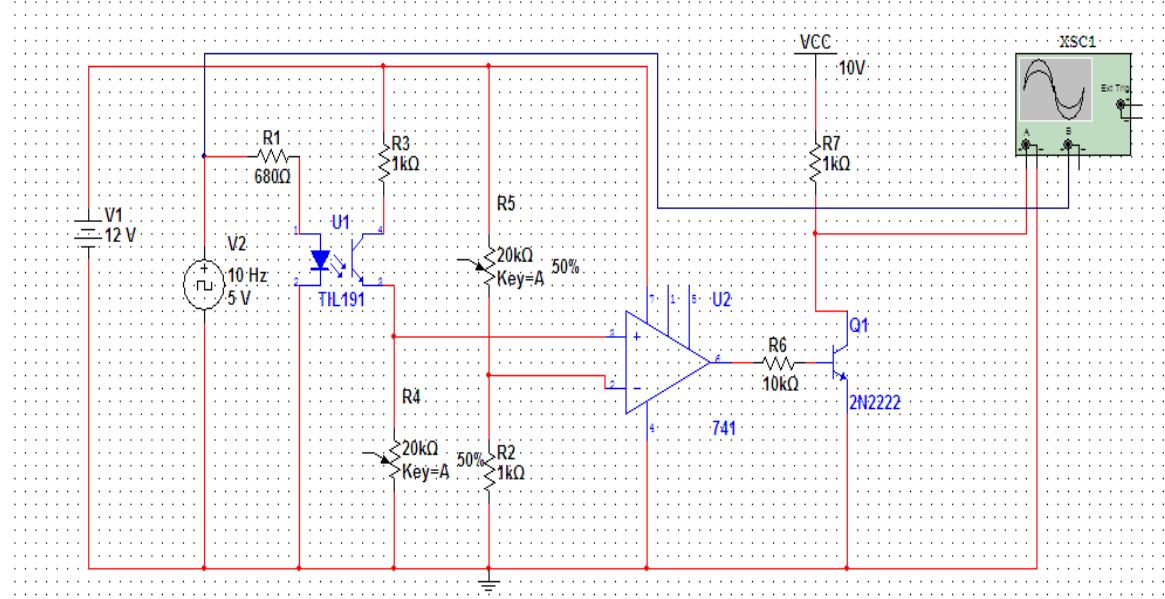
Figure 4. Smoke detector circuit simulation
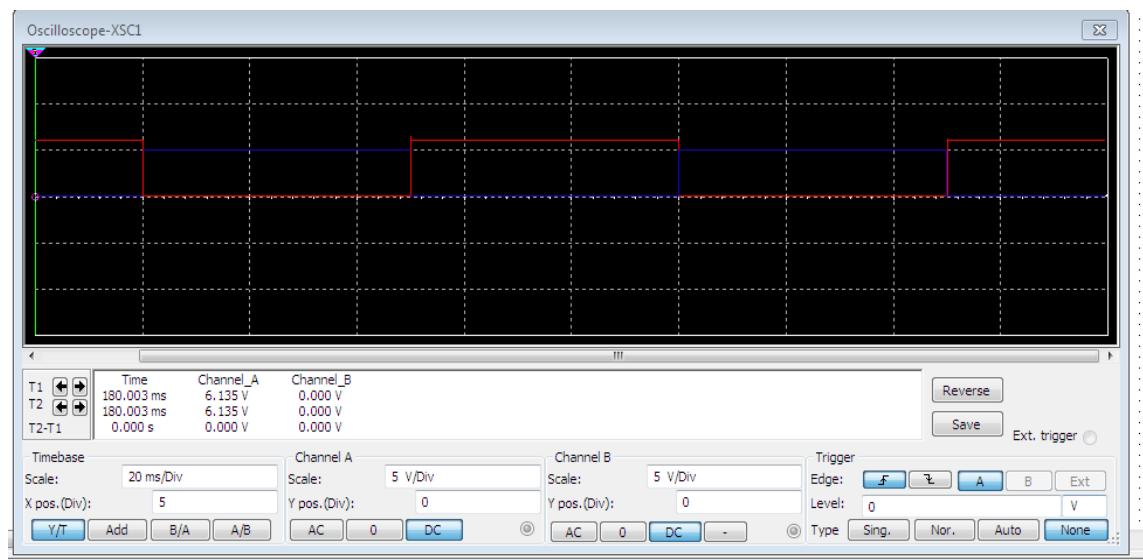
Figure 5. Simulation results of the Smoke detector circuit.

The designed circuit which is used in order to simulate the function of the water pump is shown in figure 6. Under the reception of the signal from the microcontroller in case of smoke detection, the transistor switch interface will activate the relay which makes the motor run, and this clear from the simulation results in red color which indicate that the ac voltage is applied to the water pump, as shown in figure 7.
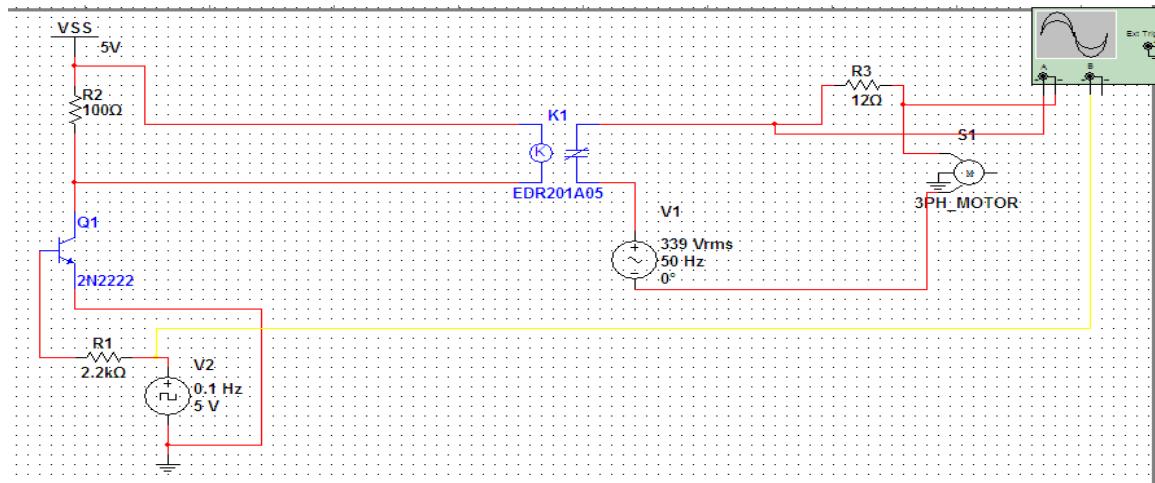
Figure 6. Water pump circuit simulation
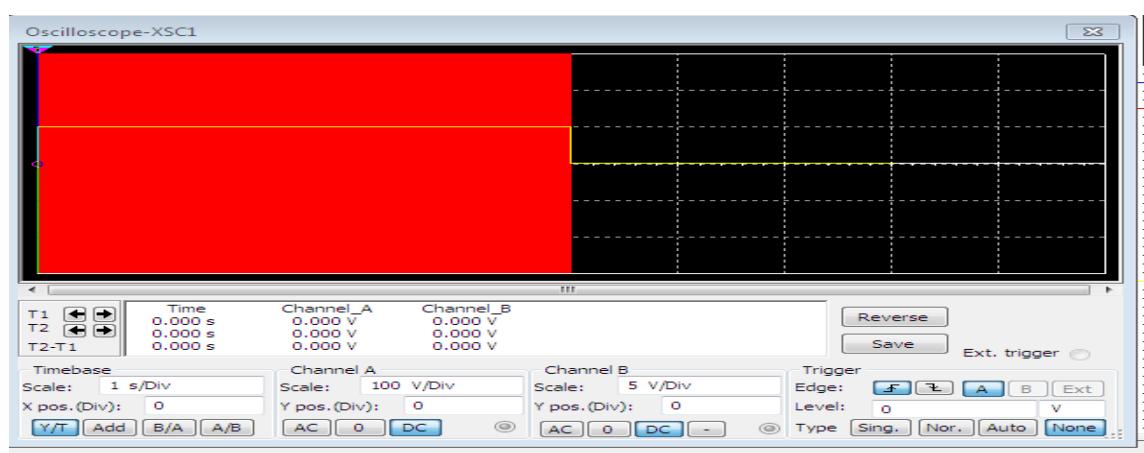
Figure 7. Simulation results of the water pump circuit

The designed circuit which is used in order to simulate the function of the alarm circuit is shown in figure 8. Under the reception of the signal from the microcontroller in case of smoke detection, the 555 IC generate signal which will activate a sonnet to be on and off according to the frequency and the duty cycle of the generated signal from the 555 IC. The simulation results are shown in figure 9.
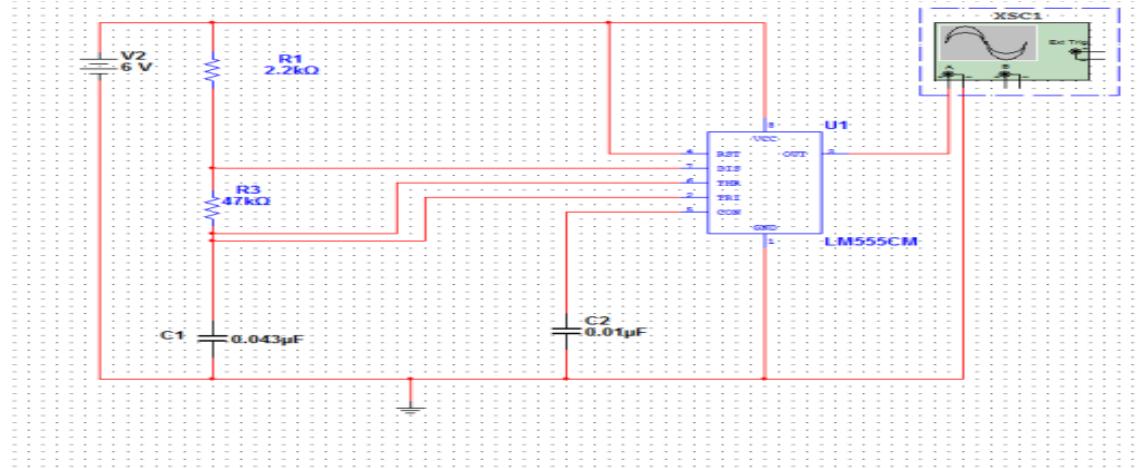
Figure 8. Alarm circuit simulation
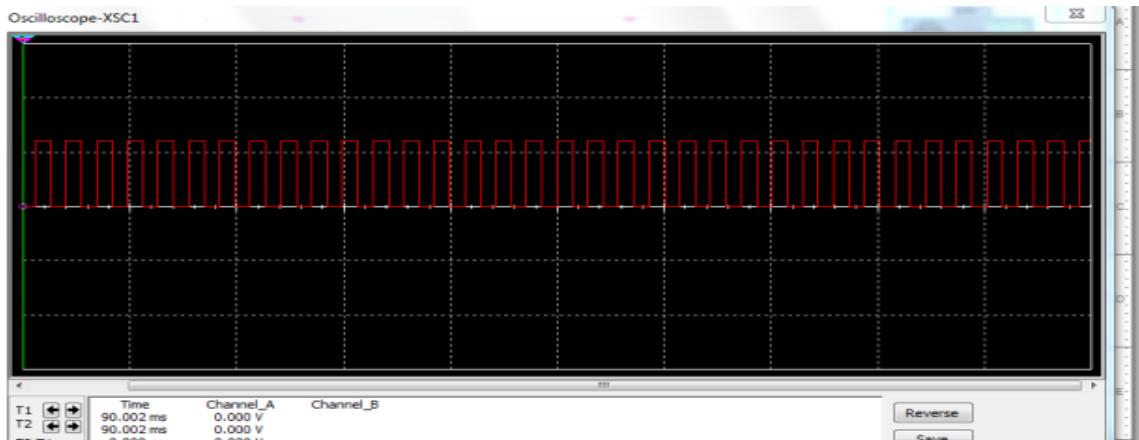
Figure 9. Simulation results of the alarm circuit

The circuit used to send an SMS is activated by the output port pin which will be connected to the TX (transmit terminal of the used modem for this purpose) the text of the message which is already uploaded in the microcontroller will be transmitted to the assigned mobile number to indicate that there is a smoke in the concerned home or industry.

RESULTS AND DISCUSSION

The result obtained from the circuit simulation conform the result obtained from the practical testing of the circuit . In smoke detector circuit simulation the result was either "0" that means no smoke or "5" that means there is a smoke. In alarm circuit simulation pulse signal indicates the alarm was activated that means there is a smoke. As well as in the case of water pump circuit simulation , the high voltage which use AC voltage (240V) indicates the pump was activated and under running condition when there is a smoke and it returns to stop condition when there is no smoke.

PRACTICAL RESULT

To test the practical function of different parts of the system, a practical implementation of the display circuit and alarm circuit is done. During normal condition if the IR of opto- coupler was not interrupted by presence of the smoke, the output will be "0" in seven segment that means there is

no a smoke (figure 10). But if the smoke interrupt the IR of opt-coupler sensor, the display circuit will works as indicator to smoke by give "**S**" in seven segments that mean there is a smoke. (Figure 11). In alarm circuit the alarm circuit will get alarm when the smoke interrupts the IR signal of opt-coupler (figure 12) and same procedure will be done for the water pump and SMS system.
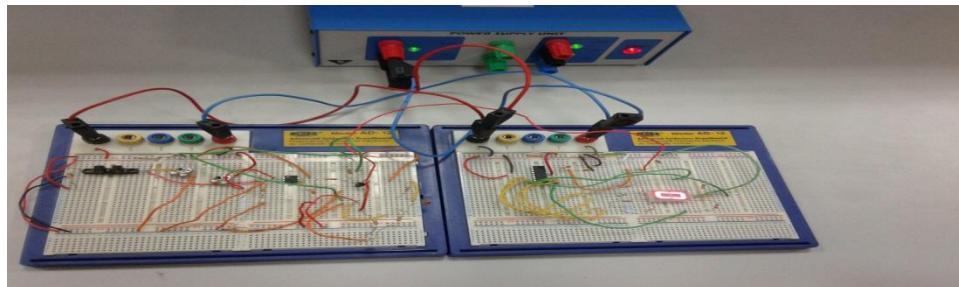
Figure 10. Display no smoke
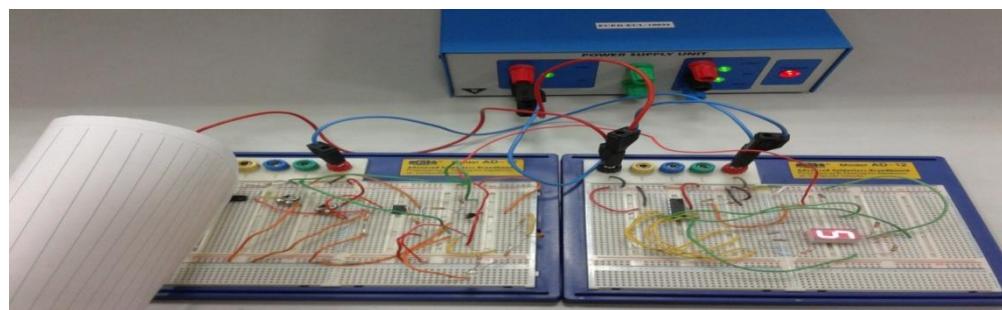
Figure 11. Display smoke
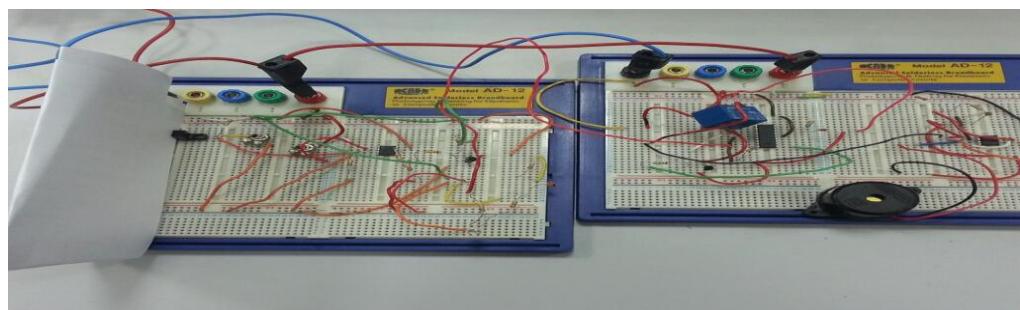
Figure 7. Activation alarm circuit

CONCLUSION

Smoke/fire alarm system is designed to be composed from hardware and software. The part software program control the function of pic microcontroller, in case of smoke alarm and water pump and display the state of the system.
Computer simulation was done to verify the correct function of the designed system.

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