Automatic Smoke Detector and Fire Alarm System

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Abstract

Now-a-days fire disaster is a great threat to human lives and properties. Automatic fire alarm system provides a real-time surveillance, monitoring and automatic alarm. It sends early alarm when the fire occurs and helps to reduce the fire damage. In this paper the proposed work is designed to monitor the smoke and heat and to activate the speaker by using the light dependent resistor(LDR) based on PIC microcontroller. It is comprised of a combination of electrical/electronic devices/equipment's working together to detect the presence of fire and alert people through audio or visual medium after detection. These alarms may be activated from smoke detectors which, when detects fire. Then, it automatically operates a relay which can be used to switch on a motor which is started to pump the water to spray on fire. Test results from the proposed system show that the automatic fire alarm system achieves the design requirements. In this paper, the simulation work is carried out with PROTEUS software and programming has been done with C coding.

Keywords: *Fire alarm, LDR, PIC microcontroller, Smoke detector and Proteus software.*

1.0 Introduction:

Now a days automatic fire detection and control is becoming very essential to reduce the fire in the building and industry. Monitoring commercial and residential areas all-round is an effective method to reduce personal and property losses due to fire disasters. Automatic fire alarm system provides real time surveillance, monitoring and automatic alarm. A key aspect of fire protection is to identify a developing fire emergency in a timely manner, and to alert the building's occupants and fire emergency organizations. This is the role of fire detection and alarm systems. Generally fire detectors are designed [1] to respond at an early stage to one more of the four major characteristics of combustion such as heat, smoke, flame or gas. No single type of detector is suitable for all types of premises or fires. Heat detectors respond to the temperature rise associated with a fire and smoke detector respond to the smoke or gas generated due to fire. Large numbers of small fire detectors should report their information to the control center of a building or a block. But the cost of wiring is very high in traditional wired fire alarm systems.

This paper is entitled automatic smoke detector and fire alarm. This proposed work is to provide best security from fire asserts by using new technology. A smoke detector is strictly a sensing device, which senses the smoke and sends a signal to a buildings fire alarm system to activate an audible and sometimes visual warning or alarm and simultaneously to switch on the motor to pump the water to spray on fire automatically. It operates by using light dependent resistor which can be used as a sensor to create a smoke detection alarm systems and can be

used in industries, residential, universities, offices and different companies to protect the goods, security ware houses etc.

A fire alarm circuit is very useful for security reasons. Equipment specifically manufactured for these purposes are selected and standardized installation methods are anticipated during the design. The key advantage of smoke detectors is its ability to identify a fire while it is still in its incipient. As such, they provide added opportunity for emergency personnel to respond and control the developing fire before severe damage occurs. They are usually the preferred detection method in life safety and high content value applications.

2.0 Recent Research Works:

Lei Zhang et al. [2] have explained an automatic fire alarm system based on wireless sensor networks, which is designed for high-rise buildings. In order to provide early extinguishing of a fire disaster, large numbers of detectors which periodically measure smoke concentration or temperature are deployed in buildings. Those scattered detectors report their monitoring information to the surveillance center via the self-organizing hierarchical wireless sensor networks.

Noora Al Hadhrami et al. [3] have dealt 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 such as 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.

Hussam Elbehiery et al. [4] have suggested the technique in fire alarm system used the addressable detectors units besides using the wireless connection between the detector in zones as a slave units and the main control unit as the master unit. The system shall include a control panel, alarm initiating devices, notification appliances, and the accessory equipment necessary for a complete functioning fire alarm system. In the wireless fire alarm, individual units are powered by primary & secondary batteries for the communication.

Toufiqul Islam et al. [5] have described the design and engineering of a wireless control system for smoke and fire detection with alarming provision, SMS sending and fire extinguishing by a vehicle. The SMS sending feature included in the design increases the reliability of the system so that it can notify the fire hazard when there is no person available nearby. The fire extinguishing vehicle is a unique feature and it gives a provision to extinguish fire during its very early stage.

R.O.Okeke et al. [6] have designed and implemented a Fire and Gas Detection System with water sprinkler using SMS Feedback. They explained the use of a microcontroller along with sensing circuit which will detect gas leakage and fire and with the help of an alarm system the system gives alert about fire or gas leakage and with the installation of a GSM modem SMS can be sent to notify the user if there is fire or gas leakage and if the fire occurs the water sprinkler sprinkles water on the affected area to reduce the effect of the fire.

Alexander Fischer [7] has focused the application of simulation techniques to the detection part of fire detection system. He explained this proposed work to the behavior of detection algorithm to fire and non fire situations. He used multi sensor detection technology in his proposed system. His results were the detection times and probabilities for fire case and false alarm rate in the non fire case.

Qin Wu et al. [8] have introduced an intelligent smoke alarm system that uses Zig Bee transmission technology to build a wireless network, uses random forest to identify smoke, and uses E-charts for data visualization. By combining the real time dynamic changes of various environmental factors, compared to the traditional smoke alarm, the accuracy and controllability of the fire warning are increased, and the visualization of the data enables users to monitor the room environment more intuitively. The proposed system consists of a smoke detection module, a wireless communication module, and intelligent identification and data visualization module.

Juan Aponte Luis et al. [9] have presented a novel sensing device for fire detection in domestic environments. The fire detector uses a combination of several sensors that not only

detect smoke, but discriminate between different types of smoke. This feature avoids false alarms and warns of different situations. Power consumption is optimized both in terms of hardware and software, providing a high degree of autonomy of almost five years. Data gathered from the device are transmitted through a wireless communication to a base station.

The disadvantage of smoke detectors is that they are usually more expensive to install, when compared to thermal sensors, and are more resistant to inadvertent alarms. However, when properly selected and designed, they can be highly reliable with a very low probability of false alarm. This proposed work is to provide best security from fire asserts by using new technology. A smoke detector is strictly a sensing device, which senses the smoke and sends a signal to a buildings fire alarm system to activate an audible and sometimes visual warning or alarm and simultaneously to switch on the motor to pump the water to spray on fire automatically. It operates by using light dependent resistor which can be used as a sensor to create a smoke detection alarm systems.

3.0 Description of Fire alarm system:

Figure 1 is a simple fire alarm circuit based on a Light Dependent Resistor (LDR) and LED pair for sensing the fire. The alarm works by sensing the smoke produced during fire. The circuit produces an audible alarm when the fire breaks out with smoke. When there is no smoke the light from the LED will be directly falling on the LDR. The LDR resistance will be low and so the voltage across it. The transistor will be OFF and nothing happens. When there is sufficient smoke to mask the light from falling on LDR, the LDR resistance increases and so do the voltage across it. Now the transistor will switch to ON. Then diode (D1, D3, D4, D5, D6, D7) connected to the transistor gives pulse (glow red) this drive the speaker motor start pumping the water to stop the fire. Invertor is used to reset manually off. Manual switch (the lower switch) is used to off false alarm and the upper switch is used to reset to its normal condition.

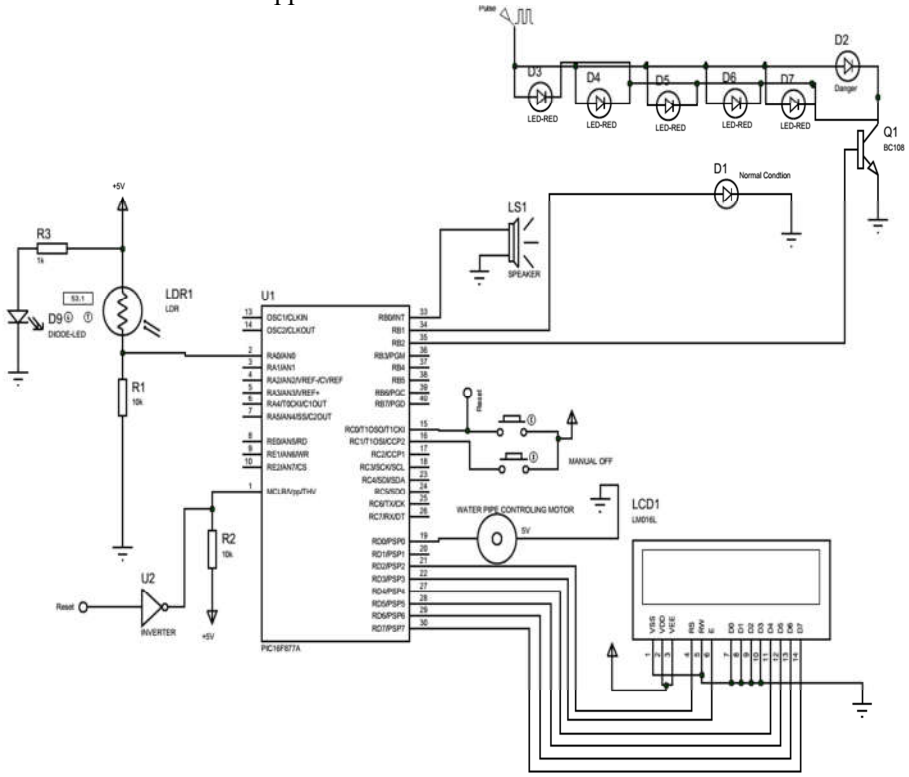

Figure 1. Circuit diagram of PIC microcontroller based smoke detector fire alarm

4.0 Results and Discussion:

4.1 When smoke detects:

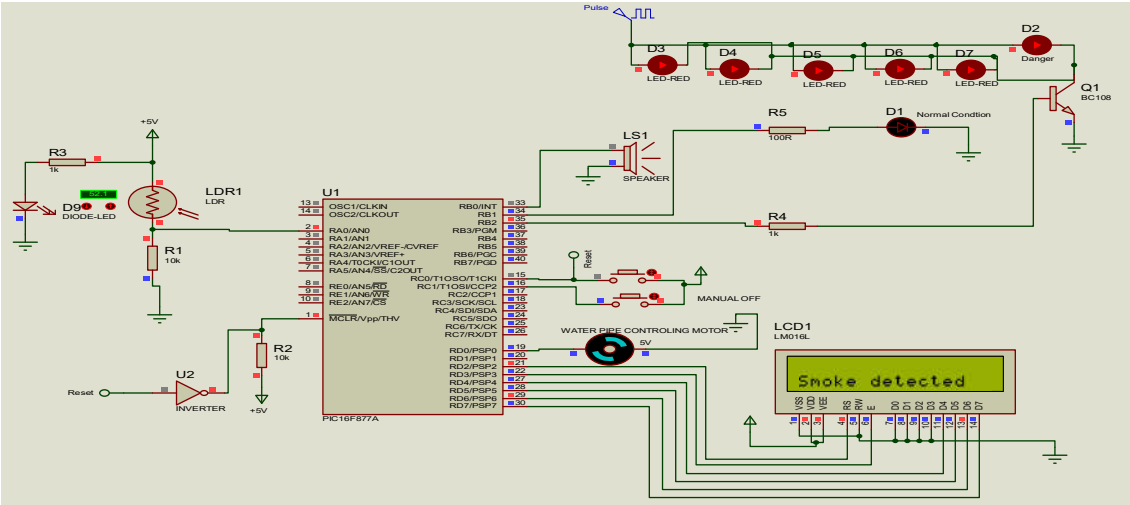

Figure 2. Simulation result when smoke detects

Figure 2 shows a simulation result when smoke detects in the building. When the light from LED fall on LDR masked by sufficient smoke, the light intensity (LUX) fall on LDR decreases and the voltage across the LDR will be increases. When the voltage across LDR reach 3.5volt and above this value the microcontroller output PORT RBO, RB2 will be activated. Then the water pipe controlling motor start running and the LCD display smoke detected. Since PORT RBO is connected to the speaker, the sound generated by microcontroller at frequency 120Hz. Then drive the speaker when PORT RB2 is activated positive voltage is given to transistor Q1 which uses as switch in this case. The transistor switched on and the LEDs (D2 to D7) supplied by pulse source starts to give blinking light.

C-program is as follows when the smoke detects;

```
If (VO <= 3.5)
{
 LCD Out (2,1,"Smoke detected"); //(row, column, "text");
 Sound Play (402, 1000); // (frequency, time)
 Delay ms (10);
 PORTD.F0=1;// motor
 PORTB.F2=1; // red blinking led
 PORTB.F1=0;// green led
}
```

4.2. When no smoke:

When there is no smoke the light from LED D9 falls directly on LDR this means the light intensity (LUX) which fall on LDR is high and LDR resistance will be low and so the voltage across it. When the voltage across LDR below 3.5 volt port RB1 of microcontroller will be activated and the LED (green) connected to it stats to glow which is to indicate normal condition. And the LCD display “safe”. Figure 3 shows that the simulation result when there is no smoke.

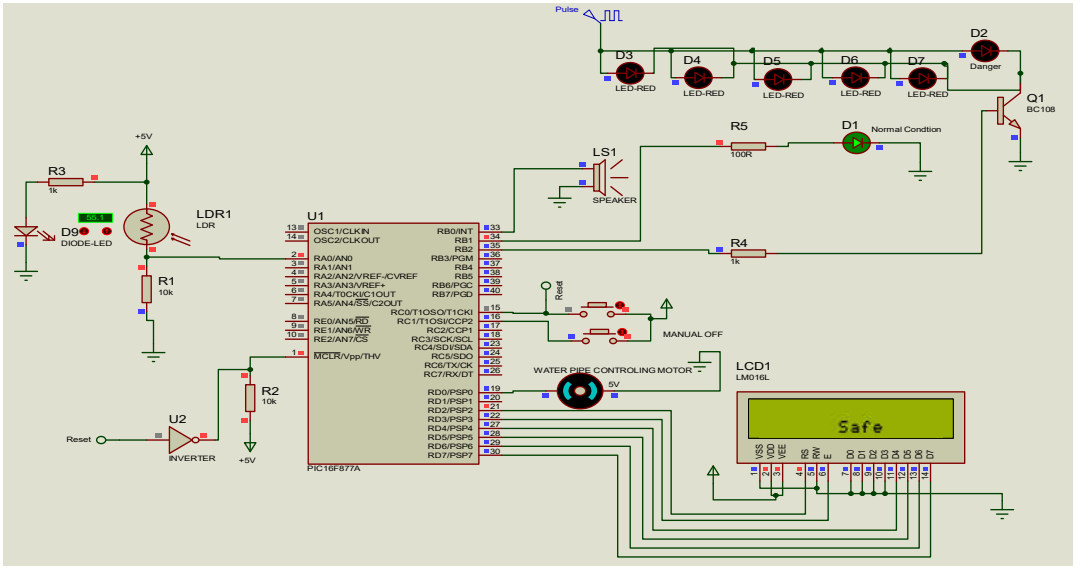

Figure 3. Simulation result when no smoke detects

The C- program is as follows;

```
else
    {
      PORTD.F0=0;
      PORTB.F2=0;
      PORTB.F1=1;
      LCD_Out (2, 1,"      Safe      ");
    }
```

4.3. When manually turned off:

Figure 4. shows that the simulation result when the system is manually turned off.

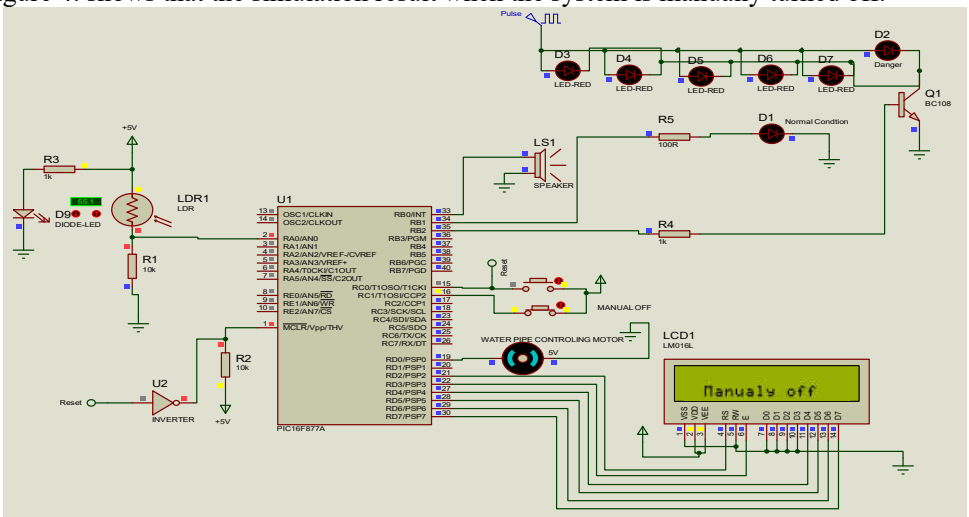

Figure 4. Simulation result when manually turned off

When the system senses false alarm the system can be turned off manually by push button (S2). When push button (S2) switched off the smoke detected showing system will turned off and LCD display manually off. And its c-program code is as follows:

```
    {
      if(PORTC.F1==1 && s2==0)
```

```
{
s2=1;
pb1=1;
}
 If (PORTC.F1==0 && s2==1)
{
s2=0;
}
if(pb1==1)
{
 LCD_Out (2, 1," Manually off    ");
PORTD.F0=0;// motor off
PORTB.F2=0; // red blink LED
}
```

4.4. When reset:

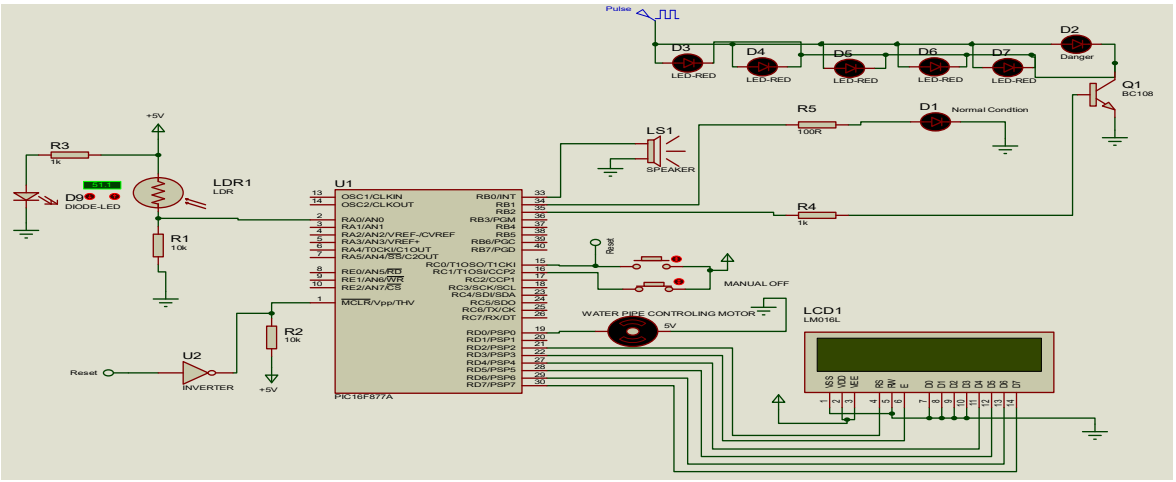

Figure 5. Simulation result when system is reset.

Figure 5. shows that during the reset of the system. After the alarm turned off, the system can reset the alarm by pressing push button 1, the inverted value of push button is given to pin 1 of microcontroller which is MCLR/Vpp/THV and clear the memory so that the PIC microcontroller starts the operation from the beginning.

5.0 Conclusion:

This proposed work was designed to monitor the smoke and heat and to activate the speaker by using the light dependent resistor(LDR) based on PIC microcontroller. It comprised of a combination of electrical/electronic devices/equipment's working together to detect the presence of fire and alert people through audio or visual medium after detection. These alarms will be activated from smoke detectors which, when detects fire. Then, it automatically operated a relay which can be used to switch on a motor which is started to pump the water to spray on fire. Test results from the proposed system show that the automatic fire alarm system achieves the design requirements. In this paper, the simulation work is carried out with PROTEUS software and the coding has done with C programming. This proposed work has proved that the smoke detector fire alarm technology is better suited when compared with ionization technology.

References:

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