International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
(Vol. 31, Issue 01) and (Publishing Month: June 2016)
(An Indexed, Referred and Impact Factor Journal)
ISSN: 2319-6564
www.ijesonline.com

Design and Implementation of Wireless Fire Fighting System

Ahmed Abdelrahman[1] and Abdalbagy Ahmed M[2]

[1]Department of Electrical and Computer Engineering, Omdurman, Sudan
[2]College of Post Graduate Studies, Karary University, Omdurman, Sudan

Publishing Date: June 28, 2016

Abstract

In this work a review of existing fire-detector types has been carried out along with the development of a low cost, portable and reliable microcontroller based automated fire alarm system for remotely alerting any fire incidents in household or industrial premises. The aim of the system designed is to alert the distant property-owner efficiently and quickly by sending short message (SMS) via GSM network. A Linear integrated temperature sensor detects temperature beyond preset value whereas semiconductor type sensor detects presence of smoke or gas from fire hazards. The sensor units are connected via common data line to ATMega16 AVR microcontroller. A SIM9001 GSM kit based network module, capable of operating in standard GSM bands, has been used to send alert messages. The system is implemented on printed circuit board (PCB) and tested under different experimental conditions to evaluate its performances.

Keywords: *Microcontroller, GSM, Wireless, SMS, Fire Fighting.*

I. Introduction

The wireless firefighting system is controlled by a microcontroller unit that regularly examines the six sensors temperature, smoke and flame sensors allocated in each room. The system uses an independent set of LEDs to indicate the presence of smoke, over temperature or fire in any room, and a firefighting pump on standby to put out the flames when needed. It also has an interconnected quad-band GSM/GPRS module that enables the system to wirelessly alert a certain someone by texting their predefined numbers and inform them with the current status of their controlled environment. The flame sensor YG1006 is an NPN Phototransistor that comes in a standard 5mm package, it is characterized with an incredibly fast response time and high photo-sensitivity. It's sensitive to infrared radiation and is capable of detecting fire sources and other light sources that have a wavelength in the range of 760nm–1100nm.

II. Previous Work

As mentioned earlier in the project objectives that, one of the main reason of this fire alarm system is the cost factor. Subsequently to design system that can achieve this objective some studies have been carried out those involving three main subtopics such as previous case study on fire alarm system, studies of hardware and software.

Smart Fire Fighting Project

The research plan will focus on three tasks: smart building technology and robotics, smart fire fighter equipment and robotics, and smart fire department apparatus and equipment. Successful implementation will require a coordinated systems approach with clear overarching objectives to ensure alignment across tasks. Each task will have a distinct impact on fire losses, but will be fully integrated with the other tasks. Each of the three tasks is briefly described below, with emphasis on both short-term and long-term objectives by FY15 and FY18, respectively [4].

Smart building technology and robotics
Smart fire fighter equipment and robotics
Smart fire fighting apparatus and equipment

Development of Fire Detection Systems in the Intelligent Building

Fire detection and its corresponding safety systems are crucial parts of an intelligent building. This paper reviews the current state of development of fire detection and alarm systems in the intelligent building. New technologies and concepts developed in intelligent buildings, such as advanced multi-function sensors, computer vision systems and wireless sensors, real-time control via the Internet, and integrated building service systems, have also been reviewed and discussed. These new technologies and concepts will improve the capability of fire detection systems to discriminate between fire and non fire threats and will increase the time available for property and life protection. However, much effort is still[5].

System Design

Most Automatic fire fighting Systems contains a processing element (a microprocessor or microcontroller), sensors, actuators, and monitoring devices such as a mobile phone or a display screen and in modern Automatic fire systems may include devices to be linked to the network. This system is built up using the following hardware. The block diagram of the hardware implementation of the entire system is shown in figure (1) via a data input line to the control unit. So whenever any of the sensors detects any anomaly, the control unit starts its action. It activates the local siren and the GSM module. Thereby, an alarm message in the format of Short Message Service (SMS) will be rendered at the same time through the GSM network to the authority and the fire station nearby shown in figure(2) .

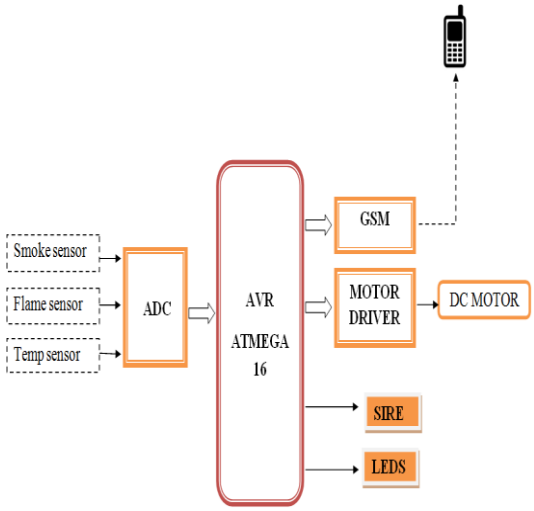

Figure 1: Block Diagram of the Hardware

Input Unit

This unit concerns how to get the information to be deal with it. It consists of two units transmitting unit and receiving unit

System Processor

A system processing unit is an important unit in any system hardware being the heart of system because it is processing and response to events in the system they are controlling it content micro controller atmega 16

Output Unit

An output device is any piece of hardware equipment used to communicate the results of data processing carried out by an information processing system (such as a microcontroller) which converts the electronically generated information into human-readable form.

III. Experiment and Results

The hardware of the system mainly comprises sensor section, control unit, network module, and power supply PCB board shown in figure 2.

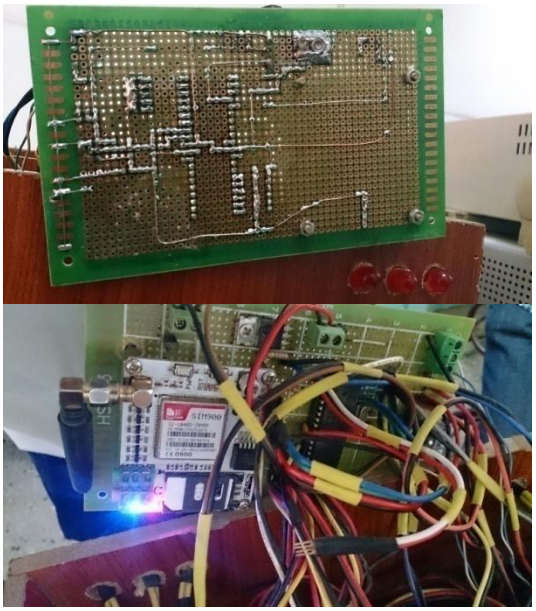

Figure 2: PCB Board

(i) Power Supply

A 12 ensures uninterrupted power supply to the entire system. A LM7805 voltage regulator regulates the voltage at 5V to power up the microcontroller and sensor units and 12 vdc of motor driver. ADC channel of the MCU resaved analogue signal from sensors. A pair of green and red LEDs indicates the power connected and system on by using switch. If power connected red LED on. So, the system would activate the green LED on.

(ii) Sensor Section

It comprises of a smoke/gas, temperature sensors, comparators and variable resistors. MQ2 is a semiconductor Type sensor, which can aptly sense presence of smoke, LPG, methane, butane, propane and other hydrocarbon combustible gases. The sensitive material in this sensor is Tin dioxide (SnO2). When comes in contact with the gas to be monitored, the electrical resistance of the sensor decreases, enabling the microcontroller. The output voltage of smoke sensor shown in figure 3 to respond to the situation, the analogue voltage from the sensor is applied to the input of the comparator while its reference input voltage comes from a variable resistor to adjust the sensing intensity Figure 3. The output of comparator has been connected to the MCU via single data line. In case of detection of smoke or gas, the LM35 temperature sensor is an integrated circuit sensor. Here the output voltage is linearly proportional.

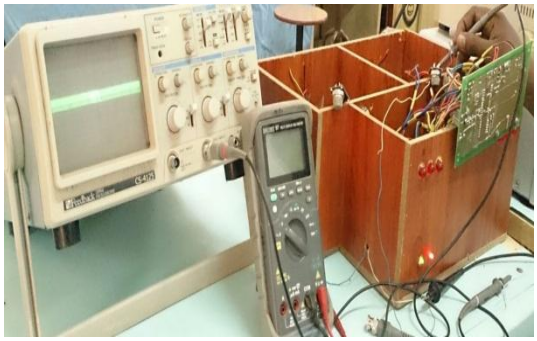

Figure 3: Output signal of smoke sensor at (Vdiv=20mv)

The output will be high or 5vDC, and the indicator LED and buzzer will glow shown in figure 4.

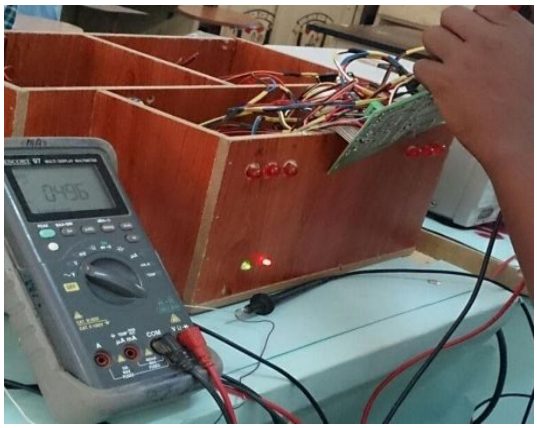

Figure 4: Voltage Response of alarm

When the flame sensor activated then pump is operated by 12 V dc from driver as shown in figure (5).

Figure 5: Output signal of Flame Sensor at (Vdiv=20mv)

IV. Results and Discussion

During the tests, the time taken from fire detection to alert message (SMS) delivery via GSM network by the system has been noted down as well. These time responses have been plotted in. The maximum time taken by the system to deliver alert SMS was 15 seconds and the minimum time was 12 seconds As it is seen, on an average, the developed system takes 12-15 seconds to deliver alert SMS to the concerned authority, which is quick enough to undertake necessary measures to avert the fire hazard as shown in table below.

Table 1: System Time Response

Sensor Type	System Response Time(sec)		
	Alarm (Buzzer & LED)	SMS	DC Motor
Temperature Sensor	4	12	—
Smoke Sensor	5	13	—
Flame Sensor	4	15	5

V. Conclusion

The designed fire alarm system is simple but it has wide area of application in household and industrial safety, especially in developing countries. Using this system, quick and reliable alert response is possible to initiate preventive measures to avert danger of fire hazards and minimize losses of life and property. This is a cost effective fire alarm system which performs reliably to ensure safety from fire, and can be installed in houses, industries, offices, ware-houses etc. very easily. It can be used to detect burnable gas like methane, LPG etc. as well. The designed systems have coverage up to 100 square meter area by using a category-6 cable as data line. Large industrial or residential area can be monitored through the proposed system installing multiple modules, each for one floor or unit. The project is developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and connected carefully thus contributing to the best working of the unit. The system is simulated and then it is tested and showed a perfect result that the fire fighting works with better response time to the sensors and in a smooth way. The firefighters can monitor the state of the home by the incoming SMS's from the system. By this system, we can do and control our daily activities with little energy. The project is flexible and any attempting to add new devices to be controlled by the system is succeed.

References

[1] Zhang, L. and Wang, G. (2009) Design and Implementation of Automatic Fire Alarm System Based on Wireless Sensor Networks. Proceedings of the International Symposium on Information Processing (ISIP'09), Huangshan, 21-23 August 2009, 410-413.

[2] Kwon, O.H., Cho, S.M. and Hwang, S.M. (2008) Design and Implementation of Fire Detection System. Advanced Software Engineering and Its Applications, Hainan Island, 13-15 December 2008, 233-236.

[3] Li, J.H., Zou, X.H. and Lu, W. (2012) The Design and Implementation of Fire Smoke Detection System Based on FPGA. Proceedings of the 24th Control and

Decision Conference, Taiyuan, 23-25 May 2012, 3919-3922.

[4] BBC News Asia (25 November 2012) Dhaka Bangladesh Clothes Factory Fire Kills more than 100. http://www.bbc.com/news/world-asia-20482273

[5] The Guardian (4 June 2010) Dhaka Fire Kills up to 150 in Bangladesh. http://www.theguardian.com/world/2010/jun/04/dhaka-fire-bangladesh

[6] Cote, A. and Bugbee, P. (1988) Ionization Smoke Detectors. Principles of Fire Protection. National Fire Protection Association, Quincy, 249.

[7] Northeast Document Conservation Center, Nick Artim, an Introduction to Fire Detection, Alarm, and Automatic Fire Sprinklers. http://www.nedcc.org/free-resources/preservation-leaflets/3.-emergency-management/3.2-an-introduction-to-fire-detect ion,-alarm,-and-automatic-fire-sprinklers

[8] Safelincs-Fire Safety Products. http://www.safelincs.co.uk/

[9] National Fire Protection Association, Ionization vs. Photoelectric. http://www.nfpa.org/safety%20information/for%20consumers/fire%20and%20safety%20equipment/smoke%20alarms/ionization%20vs%20photoelectric.aspx

[10] Bukowski, R.W., Peacock, R.D., Averill, J.D., Cleary, T.G., Bryner, N.P., Walton, W.D., Reneke, P.A. and Kuligowski, E.D. (2007) Performance of Home Smoke Alarms Analysis of the Response of Several Available Technologies in Residential Fire Settings. NIST TN 1455-1; NIST Technical Note 1455-1; p. 396. http://fire.nist.gov/bfrlpubs/fire07/art063.html