DETECTION OF FIRE AND GAS USING ARDUINO AND BLUETOOTH MODULE

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Abstract - This paper describes the design of a home fire alarm with Arduino based system by means of Bluetooth Module. The paper purposely is for house safety where the main point is to avoid the fire accidents occurred to the residents and the properties inside the house as well. It utilizes Arduino Uno board in conjunction with ATmega328 chip. The main controller used is certainly the ATmega328 which controls the home fire alert subjected to the temperature sensor. An MQ 5 sensor is used to detect the heat from the fire. An alert message will be sent to the user via short message service (SMS) via Bluetooth module. When the system detects the gas percentage, it will immediately display an alert notification on LCD display and simultaneously sending an SMS alert to the users upon the high raise temperature in the house. Results from the test are documented and discussed. Through this system, it can help users to improve their safety standards by having immediate response in preventing accidents. This will eventually allow the users to protect their lives and the properties as well from the disaster

Key Words: Arduino, ATmega328, MQ5 Sensor, Bluetooth Module, Uno board.

1. INTRODUCTION

Fire is an undesirable event. Forest fire also known as bush fire or hill fire is an uncontrolled fire occurring wild or forest areas. It is very important to detect these kinds of fire as early as possible so as to prevent the damage from it to ecological system. Every year millions of acres of forest are burnt down. The land where forest is burnt it becomes impossible to grow vegetation over there. This is because soil becomes water repellant and accepts no more water, leading to reduction in ground water level. The global warming report 2008 mention forest fire as one of the major cause behind increase in global warming. In recent year 2016 more than 4000 hectares of forest were burnt in the hills of Uttarakhand. This shows that these fires cause a great loss to social wealth as well as human life. So there is an urgent need of the hour to develop a system that could detect and alert the concerned authorities about the fire as early as possible [11]. The fire alarm system proposed in this paper integrates the use of affordable instruments, connectivity and wireless communication. The system has lower power consumption and faster processing ability at a lower cost. Already many solutions has been proposed and implemented for this problem. These systems make use of one of the following techniques: video surveillance system, video camera sensitive to smoke in day time, cameras sensitive to fire flame at night, detection of heat flux using IR thermal imaging cameras and LIDAR system which detects the smoke particles by backscattering of laser light. All this system has some limitations due to atmospheric conditions such as dust particles, fog, shadows etc[12]. Another method is the use of Visual Cameras that take snapshots of the forest to detect the fire. These cameras were mounted on the top of communication towers [2, 3]. A rotating motor is installed to provide a full round view of the forest. The images obtained from the camera are processed using program or MATLAB code and are compared with the reference images taken at initial stage.

This system also had limitation of high false alarm rate. Also the cost of installation of visual cameras on communication towers was very high. Another method is the use of satellite system to detect the forest fire. The main components of the system are satellite(s) and the base station that collects the data send by the satellite(s) and runs the analyzing algorithm. The raw data from the satellite(s) is processed and then Advanced Very High Resolution Radiometer (AVHRR) instrument is used to detect presence of Hot Spots. However the clouds greatly affect the system [4, 5]. Forest Fire Surveillance System which consists of WSN was also proposed for detection of forest fires in South Korea. The WSN determines the temperature and humidity after which middleware program and web application analyzes the collected data. However in this approach of detection of forest fire there was some loss of data during communication [6]. WSN consisting of temperature sensor setup and GPS module was also proposed for detection of forest fire. In this temperature data was transmitted to base station via primary and main antenna using satellite. Some of the limitation of system was installation of too many antennas; continuous power was required to both temperature sensor setup and antennas. In addition to this climatic/seasonal changes can affect the system.

2. PROPOSED SYSTEM

The proposed solution presents a prototype for early forest fire detection. In this system the alert is send to the main headquarter module via SMS whenever the value of any sensors exceeds its threshold value. Another SMS is also send to the

mobile so that he/she can take necessary action for preventing the fire from spreading[10]. The block diagram of our proposed solution is explained in next section in this section we have explained all the basic components used in our prototype including sensors and microcontroller.

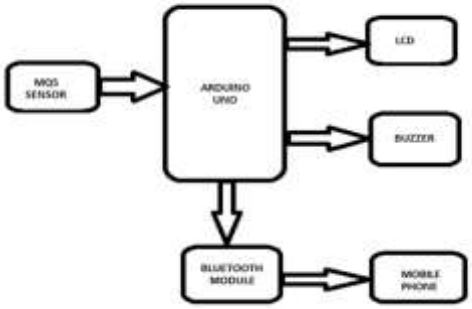

Fig: 1: Block diagram of proposed method

Hardware components

ARDUINO UNO

Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328.First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world. The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output. It allows the designers to control and sense the external electronic devices in the real world[8]. This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller using IDE (Integrated Development Environment) software, mainly developed to program Arduino.

IDE is equally compatible with Windows, MAC or Linux Systems, however, Windows is preferable to use. Programming languages like C and C++ are used in IDEApart from USB, battery or AC to DC adapter can also be used to power the board. Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality; however, Uno boards don't come with FTDI USB to Serial driver chip. There are many versions of Uno boards available, however, Arduino Nano V3 and Arduino Uno are the most official versions that come with Atmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.When nature and functionality of the task go complex, Micro SD card can be added in the boards to make them store more information It is an open source platform where anyone can modify and optimize the board based on the number of instructions and task they want to achieve. This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device [1].

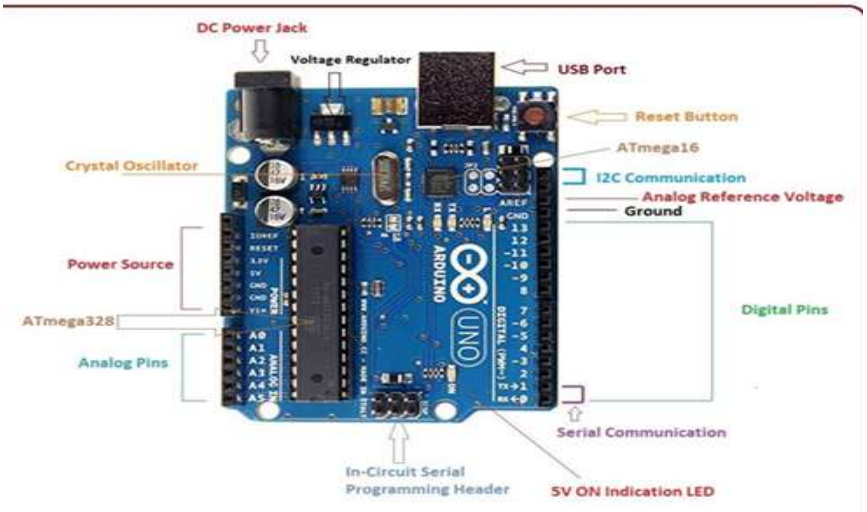

Fig: 2: Arduino Uno

BLUETOOTH MODULE

HC05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04 External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Fig: 3: HC05 Bluetooth module

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices[3]. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

MQ5 SENSOR

The concentration of the gas can be determined by measuring the current discharge in the device. The MQ-5 gas sensor detects the presence of various gases such as hydrogen, carbon monoxide, methane and LPG ranging from 100ppm to 3000ppm. When a gas interacts with this sensor, it is first ionized into its constituents and is then absorbed by the sensing element. This absorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. This changes the resistance of the sensing element which alters the value of the current going out of it[4].

Fig: 4. MQ5 Sensor

LIQUID CRYSTAL DISPLAY (LCD)

LCD Displays are dominating LED displays, because these displays can display alphabets, numbers and some kind of special symbols, whereas LED's (seven segment display) can display only numbers. These LCD displays are very useful for displaying user information and communication. LCD displays are available in various formats. Most common are 2 x 16, is that two lines with 16 alphanumeric characters. Other formats are 3x16, 2x40, 3x40 etc. In recent years LCD is finding widespread use replacing LED's, because of the ability to display numbers, characters, and graphics. Another advantage is, because of its compactness and ease of programming for characters and graphics, more information in the form of text message or graphics can be displayed. Generally, the LCD modules have an 8-bit interface, besides the 8-bit data bus; the interface has a few other control lines. The 8-bit data bus is connected to port '0' and the control lines are connected to port '2'. The default data transfer between the LCD module and an external device is 8-bits, however it is possible to communicate with the LCD module using

only four of the 8-data lines. The R/W line is connected to ground and hence the processor cannot read any status information from the LCD module, but can only write data to the LCD[5].

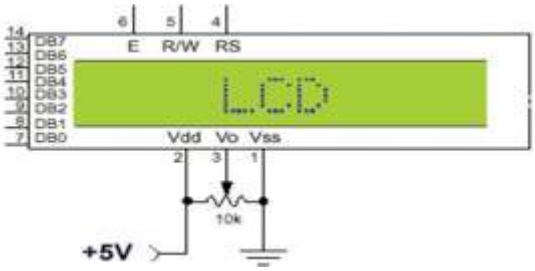

Fig:5. Typical LCD Connection

3. FLOWCHART

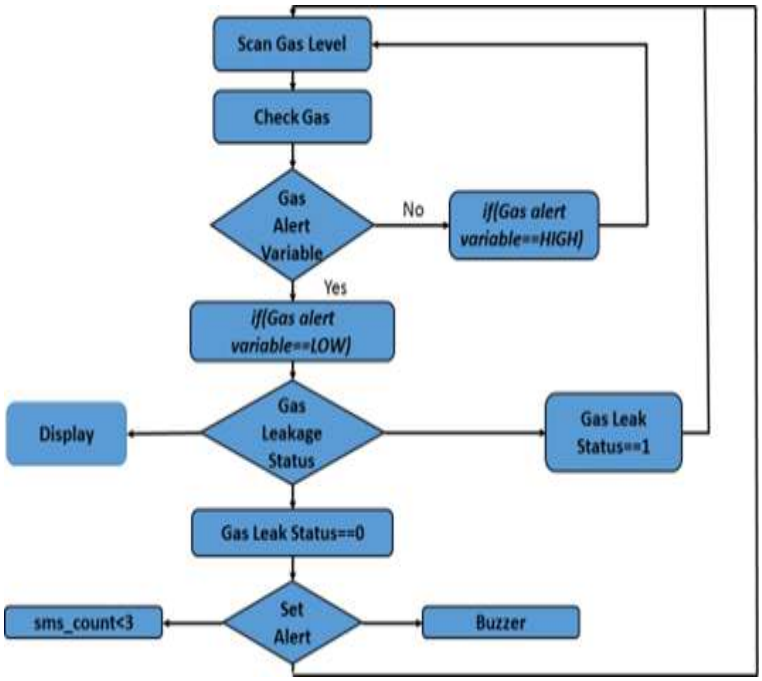

Fig: 6. Flowchart

The system is designed for homes, offices, industries etc. In this system, there will be an alert system for every individual floor. It is designed to detect sudden gas leakage. It will contain necessary sensors for detecting gas leakage. When the system will detect gas leakage for a room it will take following steps.

●Scan Gas & Display in LCD

After activation, the device will continuously scan gas and show the result in the LCD display. If there is no gas, then the display will show - 'No Gas Leaking'. If there is any gas found, the display will show - 'Gas leaking'.

●Detection of Gas

If there is presence of any gas the display shows 'Gas Alert'. Start Alarm

●when the sensor finds any gas leakage in room or where the device is installed, it immediately sends notification on mobile. There will be an automatic messaging system which will send SMS to two different cell phone numbers.

●Stop Alarm & Reset

If the gas sensor cannot find any gas leakage, then it shows that there is no gas leaking and keeps on scanning for gas.

4. RESULTS

The developed Prototype has been tested to evaluate performance analysis as well as to demonstrate the ability to extinguish the fire. The Proto type has shown quite good performance to detect and extinguish the fire using MQ5 sensor and developed fire extinguishing unit.

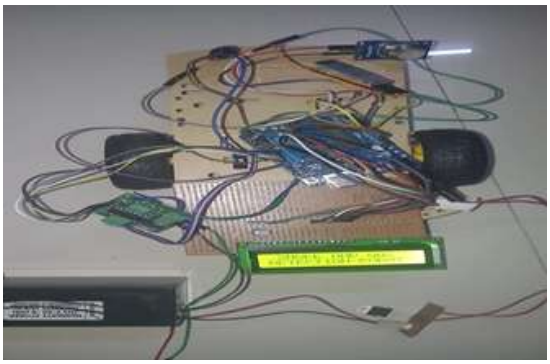

Fig: 7: Output

Test case 1: When the Prototype is turned ON

When the Prototype is turned on it displays "SMOKE AND GAS DETECTION –ROBOT "and when blue tooth is connected to smart phone the led on blue tooth module blinks twice. After that the commands are given from the smart phone such as "FRONT","BACK","LEFT","RIGHT", the robot moves in respective directions.

- When power supply turn on the LCD display

Fig: 8: When the prototype is on

Test case 2: When the sensor detects gas or smoke

When the sensor detects gas or smoke the LCD will display level of gas detected and the buzzer starts buzzing once the gas level is above 300 and blue tooth module will send message to connected smart phone stating "smoke and gas detected"

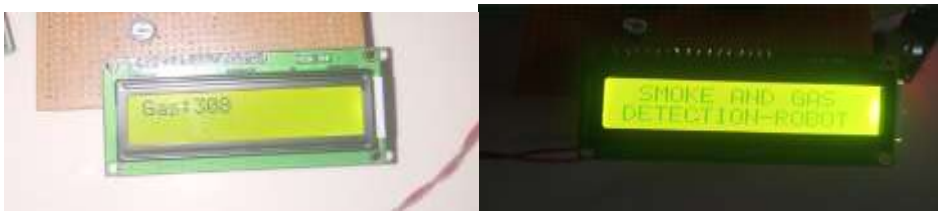

Fig: 9: When the Sensor Detects

5. CONCLUSION

Gas leakage detection system is not used much in Bangladesh. But day by day, its necessity is increasing. Gas leakage detection system is commonly use in home, commercial and industrial sectors and high raised buildings also. In this system, we have described a new approach for gas leakage detection system at a low concentration. The leakage is detected with the help of gas sensors. It also sends notification SMS to the users which can alert the users that there is gas leakage in the floor. In the other view of point, a gas leakage detection system with SMS and alarm is costly device. Some people imported this kind of device from abroad which is much costly. But the designed project is an Arduino Based Gas Leakage Detector with Short Message Service and Sound Alarm which is very cost effective and can be made easily.

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