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Automatic Fire Fighting System

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ABSTRACT : *Automatic fire-fighting systems are installed in buildings and rooms where the fire hazard is comparatively high. This paper deals with the design and implementation of a firefighting system based on a Microcontroller. The system implements an early fire detection mechanism, and communicates with its owners wirelessly over GSM networks. It should also be capable of putting out fire by means of a firefighting pump, and to justify the status of the indicator panel that provides visual feedback of the current status of the monitored environment at any given time . According to the methodology, the Wireless Firefighting System uses temperature sensors to monitor its surrounding environment and alert the system owner in case it detects smoke, fire or that the temperature has gone outside the normal parameters. The sensor signals are fed to, and processed by (ATmega32) microcontroller program by BASCOM language which polls the sensors to monitor environment and shows its status on LED status indicator panel. The ATmega32 also connects to SIM900 GSM/GPRS module which enables the system to communicate their owners over long distances and notify them the status of their protected environment. The system has a firefighting pump on standby to operate in case fire has been detected through flaming sensors.*

KEYWORDS *: fire-fighting system , Bascom , GSM system , LED ,ATmega 32 .*

I. INTRODUCTION

Fire fighting System is used to prevent, extinguish, localize, or block fires in enclosed spaces. Automatic fire-fighting systems are installed in buildings and rooms where the fire hazard is comparatively high. A distinction is made between systems that are actuated automatically and operate according to a predetermined program and those that are actuated by an operator; the former are called automatic fire protection systems, the latter fire protection units. An automatic fire-fighting system includes a sensor capable of detecting combustion, alarm signaling devices, fire-extinguishing equipment, starting and stopping devices, and feeders for the fire-extinguishing substance. Atomizers, foam generators, and pipe nozzles form and direct the stream of the fire-extinguishing substance, which may be a liquid, foam, powder, or gas. Fire-extinguishing substances are fed into the system from a centralized supply, such as a water supply, or from self-contained or combined feeders.The most widely used systems employ water (sprinkler and drencher systems), carbon dioxide, aerosols, or powders. A sprinkler system consists of a grid of pipelines located on the ceiling of the room, with sprinkler heads attached to the pipes by threaded connections. The opening of a sprinkler is kept closed by a disk held in a closed position by a thermal lock. If the room temperature rises to a specified point, the lock is destroyed and the disk opens, admitting water to the room.

Drencher systems, which use nozzles without thermal locks, are actuated either by a sprinkler installed in a trigger air line or by a cable-type thermal lock. Automatic fire protection systems are classified according to the time elapsed between the start of the fire and the actuation of the system as ultrahigh-speed (to 0.1 second), high-speed (to 3 seconds), and standard (to 180 second). The fire-extinguishing substance can be applied for periods ranging from 30 second to 3600 second .

II. METHODOLOGY

The system is divided into parts; hardware and software. In the hardware, a large and complex sensor circuitry is to be designed to develop system awareness and capability to detect over-temperature, smoke and flame. A microcontroller (ATmega 32) is used to process the various sensor signals and control the system actuators accordingly. A firefighting pump will be interfaced to the microcontroller through a relay, and a GSM module (SIM900) will be interconnected to the system and used to send SMS indicating the system and environment status.A software code is developed to control the overall system functions. The code is written in BASIC language using Basic Compiler for AVR (BASCOM-AVR).

III. SYSTEM LAYOUT

The block diagram of the hardware implementation of the entire system is shown in Figure (1).The aim of the design is to illustrate the usage of the fire fighter and its applications and the minimum equipment required to construct the fire fighting system is a microcontroller, pump water, smoke sensor, temperature sensor, flame sensor, led's, GSM modem.

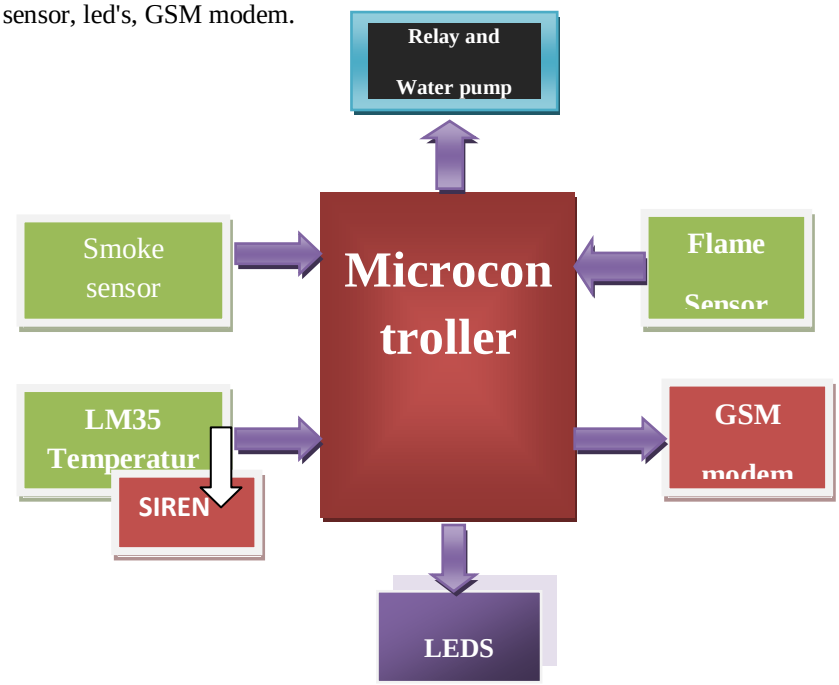

Figure (1) Block diagram of the wireless fire fighting system

The input system consists of three sensors. The mechanism of the system operation is based on equations (1) to (7);

temperature alarm = (temperature sensor)**ON**..… …… **(1)**
flame alarm = (flame sensor)**ON** ..……..…… **(2)**
smoke alarm = (smoke sensor)**ON** ..…… **(3)**
temperature-flame alarm= [(temperature sensor)**ON** AND
(flame sensor)**ON]** …… **(4)**
temperature-smoke alarm= [(temperature sensor)**ON** AND
(smoke sensor)**ON]** …… **(5)**
flame-smoke alarm= [(flame sensor)**ON** AND
(smoke sensor)**ON]** …… **(6)**
temperature-flame-smoke fire = [(temperature sensor)**ON** AND
(flame sensor)**ON** AND (smoke sensor)**ON]** …… **(7)**

The hardware components are :

Smoke Sensor : A smoke detector is a device that detects smoke, typically as an indicator of fire. Commercial, industrial, and mass residential devices issue a signal to a fire alarm system, while household detectors, known as smoke alarms, generally issue a local audible or visual alarm from the detector itself. Smoke detectors are typically housed in a disk-shaped plastic enclosure Most smoke detectors work either by optical detection (photoelectric) or by physical process (ionization), while others use both detection methods to increase sensitivity to smoke. Sensitive alarms can be used to detect, and thus deter, smoking in areas where it is banned such as toilets and schools. Smoke detectors in large commercial, industrial, and residential buildings are usually powered by a central fire alarm system, which is powered by the building power with a battery backup. However, in many single family detached and smaller multiple family housings, a smoke alarm is often powered only by a single disposable battery .

LM35 Temperature Sensor : These sensors use a solid-state technique to determine the temperature.. They use the fact as temperature increases, the voltage across a diode increases at a known rate. (Technically, this is actually the voltage drop between the base and emitter - the Vbe - of a transistor). By precisely amplifying the

voltage change, it is easy to generate an analog signal that is directly proportional to temperature. There have been some improvements on the technique but, essentially that is how temperature is measured. Because these sensors have no moving parts, they are precise, never wear out, don't need calibration, work under many environmental conditions, and are consistent between sensors and readings. Moreover they are easy to use .

Flame Sensor : This Flame Sensor can be used to detect fire source or other light sources of the wave length in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation.

Microcontroller: It is the heart of the system which controls all the activities of transmitting and receiving. A microcontroller (also MCU or µC) is a functional computer system-on-a chip. It contains a processor core, memory, and programmable input/output peripherals.Microcontrollers include an integrated CPU, memory (a small amount of RAM, program memory, or both) and peripherals capable of input and output. The IC used is ATmega 32. It is an 8-bit microcontroller with 32 Kbytes of In-System Programming Flash Memory.The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be or programmed in-system or by a conventional nonvolatile memory programmer. BASCOM_AVR programmers Notepad is used. The code after compilation generates '.hex' file which is a hardware level code.

Relay : A relay is an electrically operated switch. Many relays use an electromagnet to operate a witching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits).

Pump water : Pump is a device used to move fluids (liquids or gases) or sometimes slurries by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid direct lift, displacement, and gravity pumps.

Pumps must have a mechanism which operates them, and consume energy to perform mechanical work by moving the fluid. The activating mechanism is often reciprocating or rotary.

Light Emitting Diode (LED) : A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic pn-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by at least the LED's forward voltage drop, current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

GSM (**Global System for Mobile Communications) :** GSM (Global System for Mobile Communications), is a standard developed by the European Telecommunications Standards Institute (ETSI). It is controlled via AT commands. Figure (2) illustrates the GSM modem.

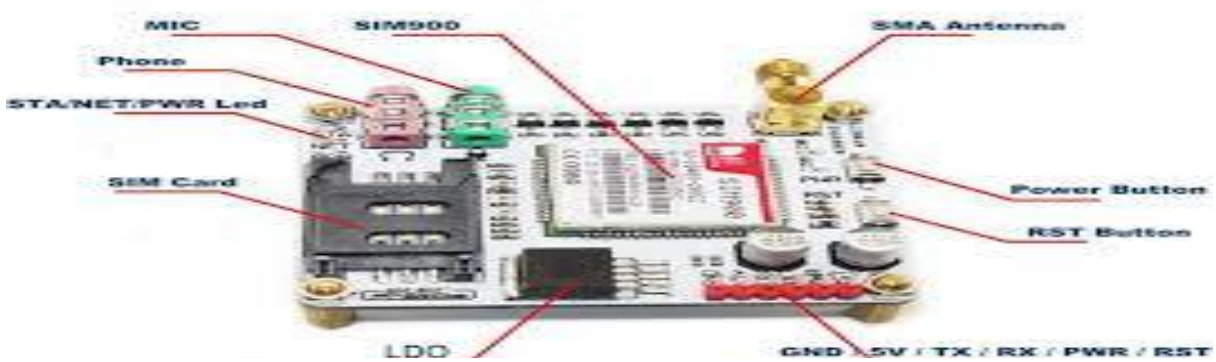

Figure (2) GSM Modem

Siren : It is used to generate alarm sound whenever any of the sensors become active.

IV. ALGORITHM

The microcontroller algorithm is based on performing the following steps :

- Polling the sensors .
- If the temperature sensor gives high reading , it is an indication of possible fire. .
- If the flame sensor gives abnormal reading , it is an indication of possible fire.
- If the smoke sensor gives a smoke alarm , it is an indication of possible fire.
- If the two sensors give abnormal readings , it is an indication of high possibility of fire.
- If the .three sensors gives abnormal readings , it is a definite indication of fire. .

Bascom programming language is used in programming the microcontroller The algorithm for the system is :

Start
Initialization :
Put Relay OFF. (i,e. firefight pump is OFF).
Display GREEN LED ..

Poll the sensors:
If (temperature > 50) , then call temperature subroutine..
If (flame = ON) , then call flame subroutine..
If (smoke = ON) , then call smoke subroutine..
If [(temperature > 50) AND (flame = ON)] , then call temperature-flame subroutine..
If [(temperature > 50) AND (smoke = ON)] , then call temperature-smoke subroutine..
If [(flame = ON) AND (smoke = ON)] , then call flame-smoke subroutine..
If [(temperature > 50) AND (flame = ON) AND (smoke = ON)] , then call temperature-flame-smoke subroutine..
Go to Poll the sensors.

Temperature :
… Put temperature LED ON.
.... Activate siren for 10 seconds.
Return.
Flame :
… Put flame LED ON.
.... Activate siren for 10 seconds.
Return.
Smoke :
… Put smoke LED ON.
.... Activate siren for 10 seconds.
Return.
Temperature-flame :
… Put temperature LED ON.
… Put flame LED ON.
.... Activate siren for 20 seconds.
Return.
temperature-smoke :
… Put temperature LED ON.
… Put smoke LED ON.
.... Activate siren for 210 seconds.
Return.
flame-smoke :
… Put flame LED ON.
… Put smoke LED ON.
.... Activate siren for 20 seconds.
Return.
Temperature-flame-smoke :
… Put temperature LED ON.
… Put flame LED ON.
… Put smoke LED ON.

… Activate the relay.
.... Activate siren for 30 seconds.
Return.

V . RESULTS

The system performs two types of tasks. The first type is that the system gives alarm for a possible fire occurrence The second type is the automatic fire fighting task when the system assures the fire occurrence .Table (1) below shows the results when operating the system .The table indicates the action taken for each happening.

Table (1) The results when operating the system

Temp. sensor	Flame sensor	Smoke sensor	LED's	ACTION
1	0	0	Temp. ON	Siren ON (10s.)
0	1	0	Flame ON	Siren ON (10s.)
0	0	1	Smoke ON	Siren ON (10s.)
1	1	0	Temp+flameON	Siren ON (20s.)
1	0	1	Temp+smokeON	Siren ON (20s.)
0	1	1	flame+smokeON	Siren ON (20s.)
1	1	1	Temp+flame+ smoke ON	Siren ON (20s.) + Relay ON

NOTE : Logic 1 = sensor is activated , Logic 0 = sensor is idle (not activated).

VI . CONCLUSION

The circuit that enabled the firefighting system to detect and deal with over-temperature, smoke and flame was designed, developed and tested. The Wireless firefighting System has successfully completed the tasks as expected .The system is capable of indicating its status on LED indicator panel, detecting and putting out fire. It's also capable of communicating over GSM network through SMS. The ATmega32 microcontroller is used to process the sensor circuitry input and control the indicator panel, and interface the system to GSM network to enable wireless communication. It is also used to control a firefighting pump to put out flames when detected. A model of the system is constructed and its operation is satisfactory.

REFERENCES

[1] http://encyclopedia2.thefreedictionary.com/FireFighting+System,+Automatic, [2]https://www.eagle.org/eagleExternalPortalWEB/ShowProperty/BEA%20Repository/Rules&Guides/Current/141_FireFighting Systems/Pub141_FireFighting, [3]http://www.en.wikipedia.org/wiki/smoke_detector,accessed 05/04/2014.
[4] Steven Steven Frank Barrett, Daniel J. Pack, "Atmel AVR Microcontroller Primer: Programming and Interfacing", Morgan & Claypool Publishers, 2008
[5] http://www.en.wikipedia.org/wiki/smoke_relay.
[6] http://www.en.wikipedia.org/wiki/pump,.
[7] h ttp:// elecfreaks.com/wiki/index.php?title=EFCom_pro_GPRS/GSM_module,