FOREST FIRE DETECTION USING RASPBERRY PI CONTROLLER

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Abstract : Conventional fire alarms are based on smoke detection. Nevertheless, in some fire scenarios volatiles are released before smoke. Fire detectors based only on chemical sensors have already been proposed as they may provide faster response, but they are still prone to false alarms in the presence of nuisances .These systems rely heavily on pattern recognition techniques to discriminate fires from nuisances. In this context, it is important to test the systems according to international standards for fires and testing the system against a diversity of nuisances .In this work, an investigation is made on the the behavior of a gas sensor array coupled to sensor fusion algorithms for fire detection when exposed to standardized fires and several nuisances .This application is used to find or detect fire in forest .Results confirmed the ability to detect fires (97% Sensitivity), although the system still produces a significant rate of false alarms (35%) for nuisances not presented in the training set .This system uses raspberry pi 3 and Arduino controller. The controller is used to give the analog input to the Raspberry pi as this controller only reads the digital signals .The Arduino board will get the analog input from the sensor and gives the digital output to the raspberry pi 3.If the fire is detected, the alert message will be send to the user through the GSM.

IndexTerms **- Raspberry pi 3, Arduino UNO, GSM.**

I. INTRODUCTION

Trigger the alarm until smoke or combustion particles are produced in fires. Nevertheless, in certain types of fires ,volatiles appear before smoke. Actually, most of the fatalities elated to fires in buildings are caused by toxic emissions that conventional fire alarms are unable to detect. Chemical gas sensors are able to detect gas emissions produced in fire sand, therefore, could provide faster response and detect the emission of toxic compounds.

For many years fire detectors based on chemical sensors have been explored. In the decade of the 80's, Pfister et al. studied the sensitivity of different chemical sensor technologies to detect volatiles released in fires. Their work confirmed the feasibility of gas sensors to detect fires.

However, gas sensors also respond to many other stimuli that may lead to false alarms. To obtain reliable fire detection needs to counteract cross-sensitivity of sensors to environmental conditions and nuisances. This can be achieved by taking advantage of the different chemical signatures that fires and nuisance induce to the sensors and making use of machine learning algorithms .Different strategies have been proposed to build classification models to detect fires and reject nuisances. For example, a reference work was published by Rose-Pehrsonetal. They compared responses of 17 different sensor technologies to 24 fires and 12 nuisances.

Additionally, they developed pattern recognition algorithms based on probabilistic networks that reached 94% of correct classification for fires. A series of interesting works were developed by researches of Saarland University . They designed a sensing system for fire detection in coal mines .They proposed a hierarchical strategy based on Linear Discriminant Analysis (LDA) to discriminate fires from non fire scenarios. Moreover, authors analyzed differences between signals taken in real conditions and signals from laboratory conditions. Nevertheless, since developed algorithms are data driven, it is of utmost importance the calibration/test datasets. To build reliable systems large number of conditions (fire and nuisances) need to be presented to the detector. In view of system commercialization, it needs to be tested under standardized conditions. However, most of the previously published research does not use standard fire rooms due to the high associated costs of generating many conditions in large test rooms.

This work targets the detection of fires originating from overheated electronics and connections. Today there is large interest in those type of fires due to the increasing number of data centers spread all over the globe.

II. BLOCK DIAGRAM AND ITS EXPLANATION

The Block diagram consists of the following sensors as shown in Figure.1.

TEMPERATURE SENSOR

The temperature sensor sense the various temperature, our process to use the LM35. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the centigrade temperature.

HUMIDITY SENSOR

The humidity sensor(or hygrometer) senses, measures and reports the relative humidity in the air. It therefore measure both moisture and air temperature. Relative is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature.

GAS SENSOR

The sensor sense the various gases, to use the MQ6(LPG Gas sensor) is a simple to use liquefied petroleum gas (LPG)sensor It can be used in gas leakage for detecting LPG, iso-butane, propane, LNG.

ARDUINO UNO

The Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world.

RASPBERRY PI

The Raspberry pi is a tiny credit card size computer. Just add a keyboard, mouse, display, power supply, micro SD card with installed Linux Distribution and you'll have a fully fledged computer that can run application from word processor and spreadsheets to functions.

GSM (SIM900)

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface,

TheSIM900deliversGSM/GPRS850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption.

BUZZER

The buzzer is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzer include alarm devices, timer, and confirmation of user input such as a mouse click or keystroke.

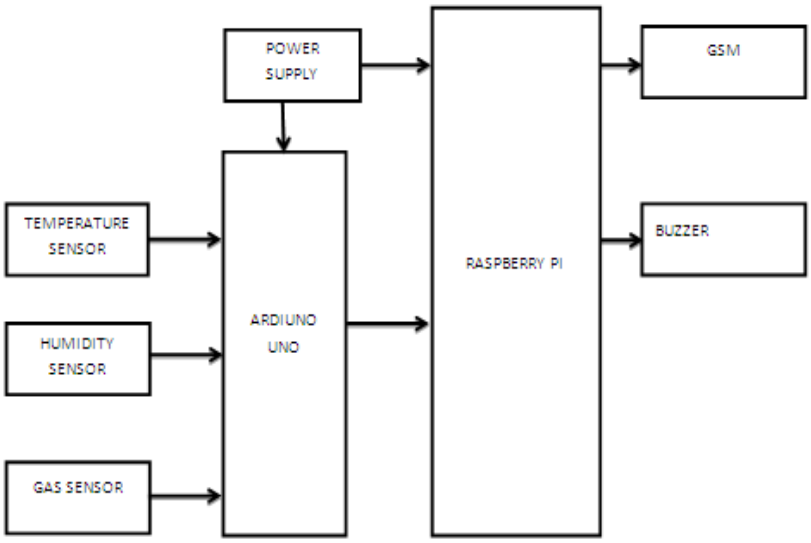

Fig.1. Block diagram of the proposed system

WORKING:

- Three sensors are used to measure the atmospheric temperature, smoke and humidity to detect the presence of fire.
- Since there is no signal converter in Raspberry pi, so Ardiuno is used as signal converter while other may not have accurate output the signal converted by the arduino and is given to Raspberry pi for signal processing .
- Based on the temperature the fire is detected and the sms is send to fire fighter using GSM module.
- Thus the occurrence of the false alarm can be neglected.

III. INTRODUCTION TO RASPBERRY PI

The Raspberry Pi is a series of credit card-sized single-board computers as shown in Figure.2 developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. Peripherals (including keyboards, mice and cases) are not included with the Raspberry Pi. Some accessories however have been included in several official and unofficial bundles.

Fig.2. Raspberry Pi 3

Raspberry Pi Despite being relatively new, is already an established embedded Linux platform, well known for its credit card size and low cost. Affordability of this single-board computer and maturity of the supported operating system make it suitable for a wide range of use cases. This project aims to evaluate the performance and overall suitability of Raspberry Pi as a mobile wireless AP.

IV. ARDUINO UNO

An ATmega328 in DIP package, pre-loaded with the Arduino Opti boot (Uno 16MHz) Boot loader. This will allow you to use Arduino code in your custom embedded project without having to use an actual Arduino board. To get this chip working with Arduino IDE, you will need an external 16MHz crystal or resonator, a 5V supply, and a serial connection. If you are not comfortable doing this, we recommend purchasing the Arduino Uno board that has all of these built into the board. Atmel's ATMega328 8-Bit Processor in 28 pin DIP package. It's like the ATmega168, with double the flash space. 32K of program space. 23 I/O lines, 6 of which are channels for the 10-bit ADC. Runs up to 20MHz with external crystal. Package can be programmed in circuit. 1.8V to 5V operating voltage!

This is the new Arduino Uno R3. In addition to all the features of the previous board, the Uno now uses an ATmega16U2 instead of the 8U2 found on the Uno (or the FTDI found on previous generations). This allows for faster transfer rates and more memory. No drivers needed for Linux or Mac (in file for Windows is needed and included in the Arduino IDE), and the ability to have the Uno show up as a keyboard, mouse, joystick, etc.

The Uno R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Uno R3 works with all existing shields but can adapt to new shields which use these additional pins.

Arduino as shown in Figure.3 is an open-source physical computing platform based on a simple i/o board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer (e.g. Flash, Processing, MaxMSP). The open-source IDE can be downloaded for free (currently for Mac OS X, Windows, and Linux).

Fig.3. Arduino Board

Features:

- ATmega328 microcontroller
- Input voltage - 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed

V. GSM:

GSM/GPRS TTL UART MODEM as shown in Figure.4 is built with dual band GSM/GPRS engine- sim900, works on frequencies 900/ 1800 mhz. the level baud rate is configurable from 9600-115200 through at command. the GSM/GPRS modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. it is suitable for SMS, voice as well as data transfer application in M2M interface.

GSM/GPRS Modem Features

- High Quality Product
- Dual-Band GSM/GPRS 900/ 1800 MHz
- Configurable baud rate
- SIM Card holder.
- Built in Network Status LED
- Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
- Audio interface Connector
- Normal operation temperature: -20 °C to +55 °C
- Input Voltage: 3.6- 4.5 VDC

Fig.4. GSM/GPRS TTL UART MODEM

VI. RESULTS AND DISCUSSION

Based on the working principle discussed in section II, the Raspberry pi kit is tested for its efficiency on a proto type model as shown in Figure.5

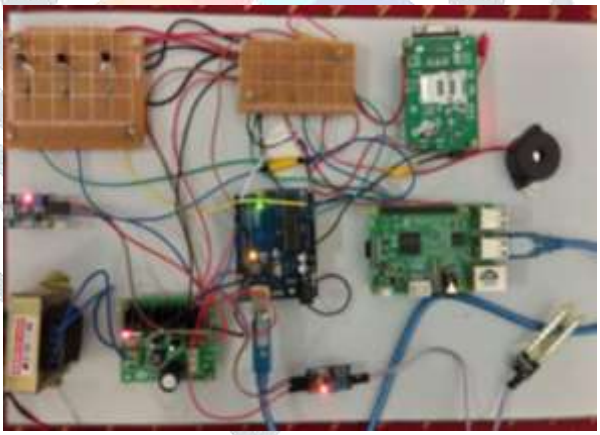

Fig.5 Hardware Implementation of the proposed system

The temperature, smoke and humidity detected by its respective sensors are displayed. If the sensor values are increased above the limit the GSM message is sent to the mobile as shown in Figure.6.

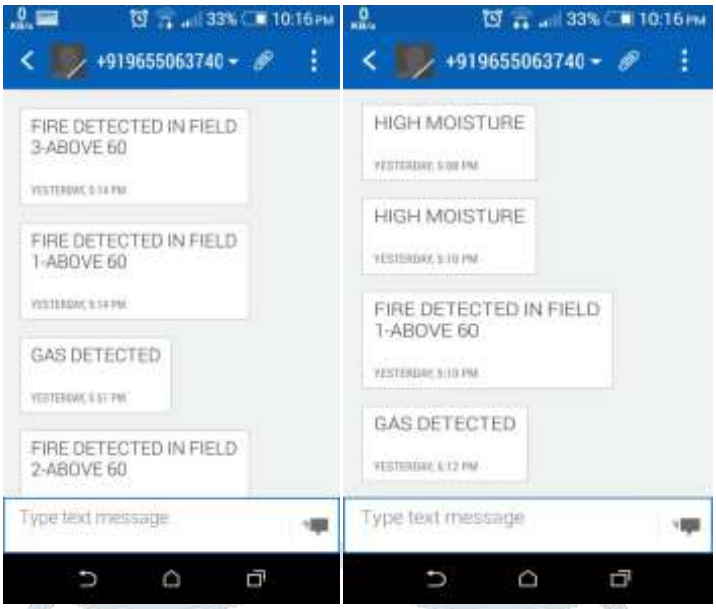

FIG.6 GSM Output

VII. CONCLUSION

The presented models are able to detect fire and trigger fire alarm accordingly. However, in some cases when models are evaluated with nuisances not presented in calibration, false positives were produced. Nowadays this system can be implemented in forest to avoid the unwanted loss of human life. By implementing this system the temperature and the other details of the sensor location can easily located by naming the sensors. Thus the human life from endanger can easily be saved.

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