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Design and Implementation of the Mobile Fire Alarm System Using Wireless Sensor Networks

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ABSTRACT

The surveillance of home or industrial places through sensors and the prevention of problems via prediction are of vital importance for the safety of these areas. It shows how to increase wireless sensor network (WSN) techniques by composing new design methods and improved a low-cost industrial and home safety systems. So as to guarantee and present accurate solutions to the system, not only temperature and humidity sensors but also flame and gas sensors were used here. The design of simple hardware circuit allows every user to utilize this wireless home safety system. A notification was used as a method of informing users related to system. The installed Arduino device which was programmed with Android Studio takes received gas, flame, the temperature, and humidity signals from the sensors. In order to pre-monitor the capability of occurrence of a fire, when it detects that the collected data with control levels exceed a predefined threshold it will enable the communication with GSM network and send the notification alarm message to the mobile users.

Key words: Fire Alarm system, GSM, Notification, WSN.

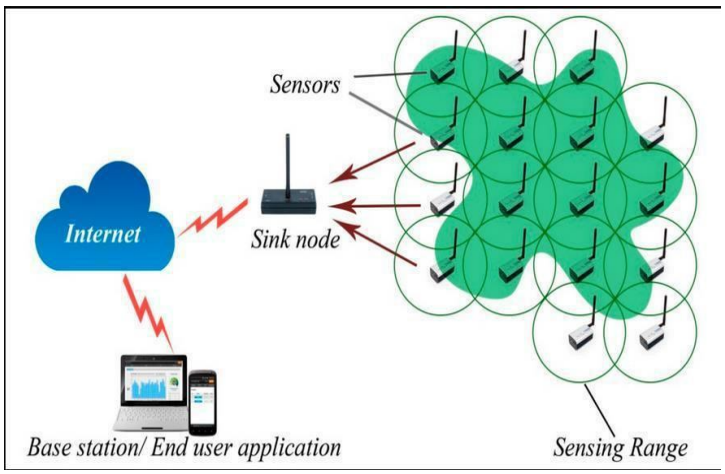
1. INTRODUCTION

Research on WSN's began sometime in the 1980s, and only since 2001 wireless sensor networks generated an increased interest from industrial and research perspectives. This is as the current availability of inexpensive miniature components, with little power supplied as processors, radios and sensors that were often integrated into a single chip. (SoC – system on one chip) [1]. Today WSN technology has become an integral part of any developing country as it is being used nowadays as the primary monitoring system in various applications. WSN eliminate the hazards associated with the wiring systems and make data measurement and monitoring process much easier and cost effective [2]. Today our homes become more and more digitized, people being outdoors need more monitoring and control of electronic household items or of a surrounding environment. Using WSN technology for data transmission, we can measure automatically different environments and access remotely from Internet to have actual time data of sensor nodes, so for a low cost we can have access on stored data which are measured and saved on different environments.

The main purpose of sensor networks is to collect the raw data and provide basic information and decision support for base station. Wireless sensor technology enable to make life easy and interact with the physical environment. In the not remote future, tiny, dirt-cheap sensors can be orderly deploy into the roads or machines, creating a digital output that senses a variety of physical events, detecting forest fires to help rapid emergency response.

There are four basic components in a sensor network:

- an assembly of deployed or localized sensors;
- an interconnecting network
- a central point of data collecting;
- a set of computing resources at the central point to handle data correlation, event trending, status querying and data mining



Wireless Sensor Network is a set of sensors which are used in the transmission or physical or chemical phenomenon given such as temperature, humidity, magnetic field, pressure etc....) and then move the information on the wirelessly to the data processing station to take usefulness of them without human intervention in the location of the physical environment.

Sensor components consist of the following modules:
1. Sensor Module
2. The unit of data storage and micro-controller for processing.
3. Unit transmission and reception
4. Power supply unit.

Monitoring node includes a sensor module, displaying and an alarm module microcontroller module, wireless transmission module and power module. Microcontroller module adopts NodeMCU ESP8266 microprocessor, which can accelerate of data processing and data obtain precision and reduce power losing.

2. IMPLEMENTATION OF THE SYSTEM

Implementation of the mobile fire notification system for measuring some physical data with gas, flame and temperature and humidity sensors in the home or buildings where people live. Figure 2 shows the design of the mobile fire alarm system. Thanks to the self-organization manner sensor nodes form the network and the nodes collect information such as temperature, humidity, gas, flame or other fire monitoring arguments, and sent the data to the cluster head which are responsible for the data aggregation and the data packets transmission. Finally, data is wirelessly transmitted.

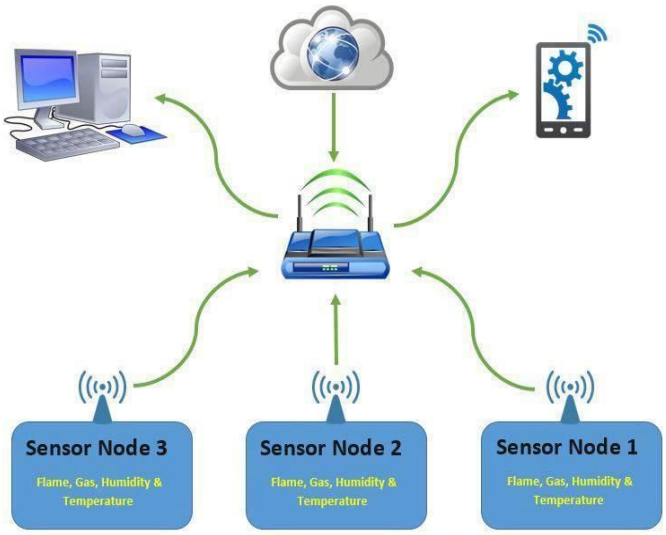


Figure 2: Design of Mobile fire alarm system.

The sensor modules which are used in this work, can be explained in briefly as follows:

Flame Detection Sensor Module:

This sensor is sensitive to the flame, but also can detect ordinary light. The sensor module usually is used as a flame alarm. It can measure the heat of an object as well as detects the motion. The purpose of flame sensor is to confirm to the system that whenever gas valve is open, a fire is actually present.

Gas Sensor MQ-6:

It has high sensitivity to LPG, iso-butane, propane and small sensitivity to alcohol, smoke. In homes and industry, this sensor module is suitable for detecting of LPG, ISO-butane, propane, LNG so as to avoid from the noise of alcohol and cooking fumes and cigarette smoke.

Humidity and Temperature DHT11:

This DHT11 Temperature and Humidity Sensor consists of a temperature and humidity sensor complex with a calibrated digital signal output. It consist of four main components
1. A resistive type humidity sensor.
2. A NTC(Negative Temperature coefficient).
3. Thermistor.
4. 8-bit microcontroller.

NodeMCU ESP8266:

It's a microcontroller with an integrated Wi-Fi, which means that there is no need for an additional Wi-Fi chipset. The design of the system on chip (SoC) allows communication through the GPIOs by connecting to the Internet and transmitting data over the Internet. This is the perfect connection of IOT. It has physical size 49 x 24.5 x 13mm, and provides 0.00026W – 0.56W consumption of power. This is the best hardware around when compare with his cost and this chip is the future of IOT. NodeMCU is easily usable board and it has a variety of pins. It has a USB connection port to connect to the computer.

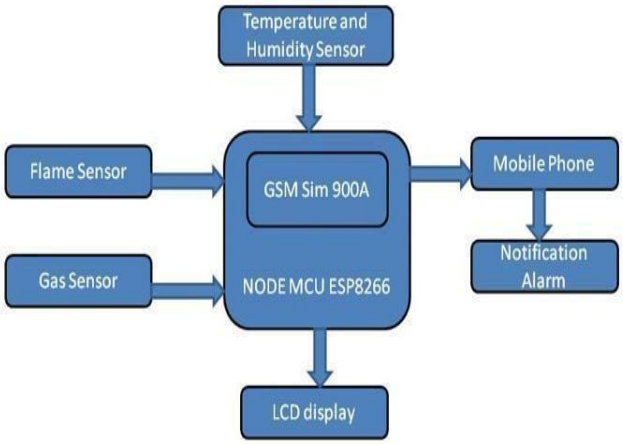


Figure 3: Block diagram of fire alarm system

Three integrated sensor modules were utilized in the board. Figure 4 demonstrates the hardware design of the fire alarm system. As shown in Figure 4, it has been used three sensor modules and between WIFI and NodeMCU board. The programming was performed as follows: Sensor nodes flame, gas and temperature and humidity would send their values These values are transferred to the mobile device via network connection installed.

Sensors evaluate the existence and absence the physical measurements and sensations as logical 1 and logical 0, respectively

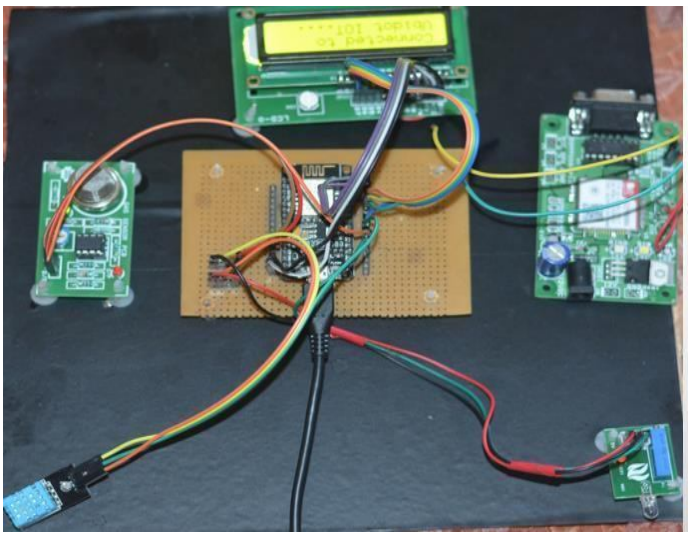


Figure 4: Design of fire alarm system

In the measurements performed with designed sensor nodes in different home rooms, therefore, temperature has ranged between 26°C and 29 °C and humidity ranged between 28 and 29 %, 30 °C and 30% as average values were selected as threshold values for temperature and humidity in this study, respectively. If flame sensor senses presence of flame or gas sensor senses the presence of gas or temperature indicate 30 °C or above or humidity is 30% or above, system will alarm as "FIRE DETECTED" message to the users.

//CODE FIRE SENSOR

```
void FIRE_sensor()
{
 if(digitalRead(FIRE)==HIGH)
  {
   gFIRE        =        1;
   lcd.clear();
   lcd.print("FIRE");
   lcd.setCursor(0 , 1);
   lcd.print("DETECTED    ");
   message2();
   delay(1000);
  }
 else
  {
   gFIRE = 0;
   lcd.clear();  lcd.print("FIRE
   NOT "); lcd.setCursor(0,1);
   lcd.print("DETECTED");
   delay(1000);
  }
```

//CODE FOR GAS SENSOR

```
void GAS_sensor()
{
 if(digitalRead(GAS)==HIGH)
  {
   gGAS        =        1;
   lcd.clear();
   lcd.print("GAS");
   lcd.setCursor(0 , 1);
   lcd.print("DETECTED    ");
   delay(1000);
   message1();
   delay(1000);
  }
 else
  {
   gGAS  =  0;
   lcd.clear();
   lcd.print("GAS   NOT    ");
   lcd.setCursor(0,1);
   lcd.print("DETECTED");
   delay(1000);
  }
```

3. ADVANTAGES

- Flexible if there is a random situation when additional workstation is needed.
- It avoids plenty of wiring.
- It can be accessed through centralized monitor.
- Wireless sensor nodes are easily deployed without any hustle.
- Small sized hardware components.

4. DRAWBACKS

- Less secure because intruders can enter the access point and obtain all the information.
- Sensor nodes are more prone to failure and energy drain and their battery sources are usually not replaceable or rechargeable.
- It may not have unique global identifiers so unique addressing is not feasible.

5. CONCLUSION

Wireless sensor networks play significant role in real environment. It presents a preliminary study of a smart WSN able to detect fire alarm. It has been set up useable a wireless sensor network with these three sensors. It has been designed a

system with NodeMCU hardware which consists of three sensors (flame, gas, heat) in home rooms. If these sensor readings values exceeds the pre-defined threshold level, the application system of the sensor network interface on mobile phone can be visible to users as notification form whenever they want. In this sense, they can be informed if the temperature rises, can be ready to prevent the possible fire disaster. This means that the application sends a piece of alarm as notification to the personal mobile in case of any alarm activity has been detected at home or office or build, etc. So, the users will be able to keep track of their safety within the limits of the presence of the router connected between mobile phones and devices.

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