Smart Fire Alarm System Using IOT

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The research paper proposes the "Smart Fire Alarm System Using IOT" in smart building by integrating IOT devices, including fire alarm devices (smoke and temperature detectors), Arduino and other complementary equipment. The idea of the research paper is when a fire occurs, the sensors will send a message to the security of the building and the official, and this massage includes location and time. The internet of things is predicted to provide businesses and people with better visibility and has the power to control 99% of environments and available objects that are at this time out of reach of the internet. So therefor, IOT make opportunity to people and businesses to be attached with the outside world even more than before that will achieve more meaningful work in higher levels. The traditional fire alarm system contains several types of devices each has a specific role in system operation to detect people and worn them through visual and audible devices if there is a fire, smoke, carbon monoxide or any other emergencies. This type of alarm can automatically have activated from heat and smoke detector and it could be activated by manual fire alarms such us manual focal point or intake station. Alarms can come as a motorized bell; horns or wall-mounted speaker they can also be luminous sound for speakers that actually sound an alarm, and add an audio evacuation message that for example will warn people against using elevator.

Introduction

Internet of things can be anything in the world that are actually connected to the internet so if a person at this moment is reading a book or some article from a mobile phone or laptop it will definitely being connected to the internet. IOT is simply means gathering or collecting everything in our world to basically connect all things to the internet (Sengupta, Sawant, Dhanawade, Bhosale, & Anushree, 2019).

The concept of IOT is all about the internet and how power extended it is in the specific area beyond the mobile phones and computers to contain an entire group of things, environments and processes. All connected things are then being used to make a group of information or sending information or it can be for both processes.

The internet of things is predicted to provide businesses and people with better visibility and has the power to control 99% of environments and available objects that are at this time out of reach of the internet. So therefor, IOT make opportunity to people and businesses to be attached with the outside world even more than before that will achieve more meaningful work in higher levels (Sengupta et al., 2019).

In addition, we will try to add some ideas for example the main door opens automatically and smart lightning to guide you to the safe exit (Lee & Lee, 2015).

In this research paper aims to design a Smart Fire Alarm System using IOT which will speed of evacuation from the building, control and prevent the spread of the fire, provide a direct method to contact the building administrator and security and guide people to the safe and fast way out (Kang et al., 2017)

Problem statement

There are no IOT devices with sensors at Middle East College building

There are only traditional fire alarms located in some pints inside the building which can be very useful to keep the students' lives but still not enough because it is now have become an old system and can made mistakes sometimes and that can be not save or will make bushing for nothing and it may cause study lateness (Kang et al., 2017).

Don't know the location of the fire when it happens

One of the disadvantages to use some un improved system is that it will not show you all the aspects some them will not appear like needed information of the exact location of the starting point of fire. It is very important to have a device provides you the location otherwise no one will nowhere to go or how they should act against this situation they will simply try to exit from the exit doors but the way to the exit door must be clear and save to all people in the building.

There is no direct contact with the security of the building we need to make a connection with the person who's job is to keep his eyes on the place all the time and obviously we need to associate all security members to the system by having a massage when a fire is accidentally happened to reduce the time of evacuation when a security guard receives a message he will immediately worn every one near that area and each security will do the same in every point.

Literature Review

The traditional fire alarm system contains several types of devices each has a specific role in system operation to detect people and worn them through visual and audible devices if there is a fire, smoke, carbon monoxide or any other emergencies. This type of alarm can automatically have activated from heat and smoke detector and it could be activated by manual fire alarms such us manual focal point or intake station. Alarms can come as a motorized bell; horns or wall-mounted speaker they can also be luminous sound for speakers that actually sound an alarm, and add an audio evacuation message that for example will warn people against using elevator. Fire alarm speakers are always being sit up at a certain frequency with low, medium or high tones and that is being defined according to country and device manufacturer (Pandey, Kazmi, Hayat, & Ahmed, 2017).

Internet of things is known as a network of this things or devices through which physical objects are able to exchange information by software, sensors, electronics and communication. This process doesn't depend on human interaction.

The fire alarm system by using Arduino on IOT with temperature and smoke sensor as shown in figure (1) can be used in order to send direct information such as smoke or temperature detected value using a specific device wright strait to the fire department (Pandey et al., 2017).

The IOT based fire alarm system commonly has two sensors one is activated when temperature changes and other one start operates when it senses a smoke. The ADC adapter works on converting the received signal at the end of the sensor from analog to digital signal and then sends this information to the microcontroller (Arduino). The micro control unit is programed to operate the bell whenever a smoke or temperature reaches a certain value called the threshold value.

The Arduino will start on transmitting data to the Wi-Fi module ESP8266. This module is a small chip used for making connection between microcontroller and Wi-Fi Network. ESP8266 is then sending the collected data to the website, where authorized persons can take an action and take appropriate measures to reduce the fire (Al Mamari, Al Mamari, Kazmi, Pandey, & Al Hinai, 2019).

To identify the location device ID is used which is a unique identifier given to this device that will

definitely provide opportunity for personnel to be aware of location information, where detection of fire is detected (Ahmed, Kazmi, & Pandey, 2018).
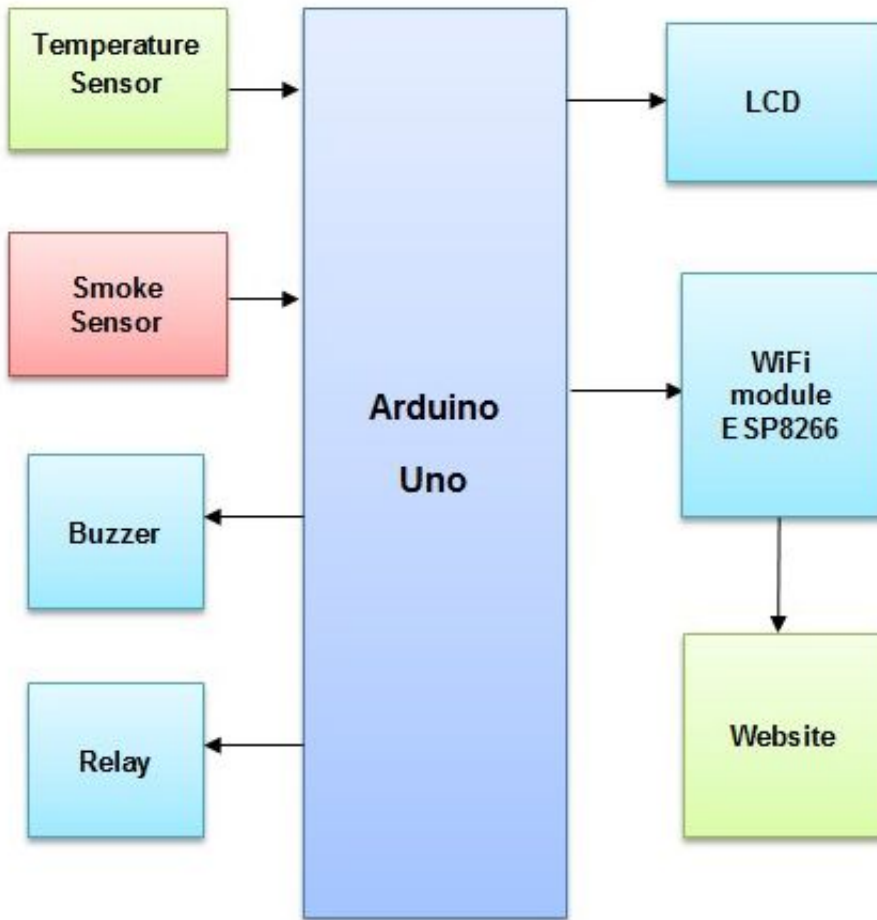
Figure 1. *block diagram of IOT based alarm system*

Previous work done

China is one of the developed countries uses different methods related to the current world development. The GSMA has declared that Chinese mobile operators is now a country that leads the world in deploying IOT conversion solution. Trough connecting for about 960 million devices over cellular networks, the state recognizes the value of the internet of thing and transforms society by large-scale smart home, city or smart industry solution. China is considered as the largest IOT market in the world it owns for about 64% of cellular connection which is 1.5 billion in the world, in addition to a rapidly licensed LPWA technologies in mobile IOT2 (Minoli, 2013).

In this country we find that examples of large-scale deployment are so many across a group of different sectors. China telecom and Sunsea AIOT companies has worked together to install more than 500,000 NB-IOT sensors that covers more than 37Km in Jing'an, turning the region in to a really intelligence community. These devices work on monitoring sensor of fire hydrant water, smoke and gas detector and monitoring of environmental purposes. For more improvements in the real-time there is an integrated platform focuses all data by monitors and analyzes them frequently (Nair, Abu-Mahfouz, & Lefophane, 2019). China mobile has already installed more than 100,000 NB-IOT smart fire alarm system which consist of fire alarm, gas detector and smoke and temperature sensors throughout China; on the other side China Unicom has made installation of more than 25,000 meters of gas and water using a solution of NB-IOT, which combines the internet of things

with a huge amount of data to achieve intelligent energy management (Nair et al., 2019).

Cellnex Telecom is one of the companies which is the main operator known as independent infrastructure in Europe for wireless telecommunication. They work on projects of developed solutions in smart infrastructures and deploying a robust IOT ecosystem by the LPWA wireless network, depending on developed SIGFOX technology, which is made specially to be used beside internet of things.

This company is now doing them researches through collaborating with various stakeholders in order to make IOT services more developed in the world and next years. It is designed to specifically to be implemented in individual sites located in forest in particular. This fire detection designed by them will provide more improvement in early detection and quick response as well.

Proposed system /architecture

to make it easier for sensors installation at the remote site, a communication link has to be done in advance. This is created through internet of things platform by GSM network. Our system includes two sides of subsystem the first one is the transmission (Tx) subsystem and the second one is the reception (Rx) subsystem and there is a processing unit for each subsystem. At the Tx subsystem, the available sensors located their will gather the real-time information allocated for physical quantity to transmit them to the Tx processing unit. Tx processor has an Intel Galileo Gen 2 motherboard that features a 256MB and DDR3 Intel Quark processor that runs at speed up to 400MHz with the child of GSM SIM800HV1.0. All information collected in this process will be sent to Rx remote subsystem by using the GSM network. In Rx subsystem a connection between Rx processor unit and an actuator as shown in figure (2)
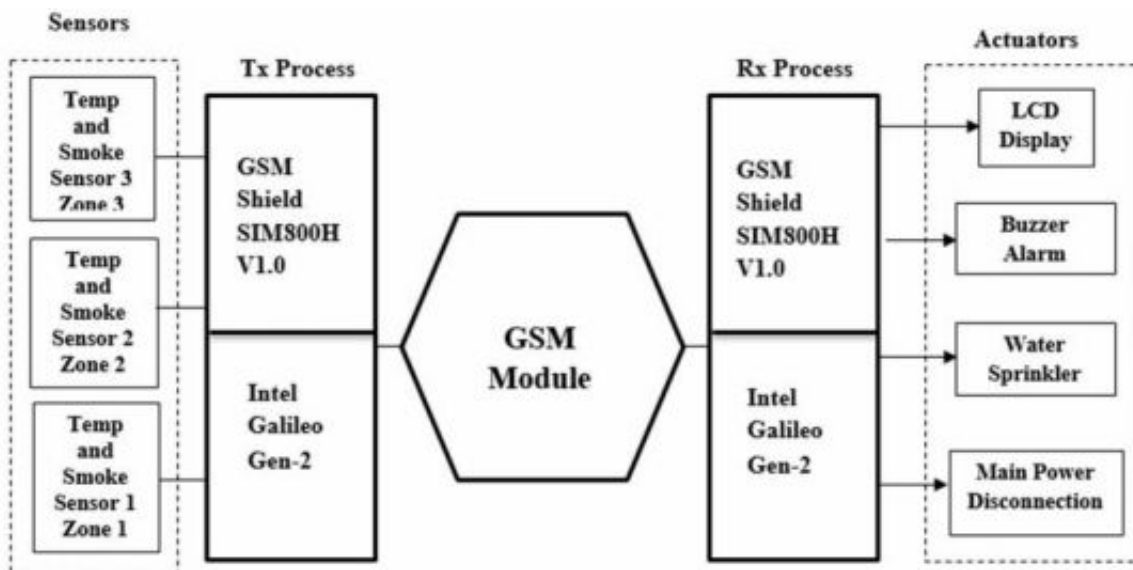
Figure 2. *Block diagram of Fire alarm and monitoring system*

Installation of group of sensors is divided into three zones. We have zone1, zone2 and zone3 under monitoring case and each group consists of MQ02 and LM35 for smoke and temperature sensing respectively. the selected sensors are then connected to the board of Intel Galileo Gen2 analog pins. There is a threshold value for each sensor therefore the Galileo board are examining the pins continuously so if it receives any signal coming from one of the sensors it will immediately compared that signal value with the threshold value which was been selected before. If we got a signal value more than threshold value, the system will generate logic 1 which indicate the fire status or generating logic 0 if the situation is stable. Rx process unit also has similar board of

Galileo Gen 2 to which the drivers are connected in the digital output pin. The hole action of this system is initiating according to the information accessed to the Tx subsystem.

The information that we have now from Tx to Rx is transmitted over a GSM network; the main enabler is the GSM child SIM800H V1.0 including GSM module, full-size SIM card slot, quad-band GPRS and a build-in antenna. Each is connected to Galileo Gen 2 at either end.

This smart system can speed up the process of evacuation from the building through the GSM module which is the main operator of the connection between the devise and a person.

The LED as shown in the block diagram are being places in the pathways according to exit path of the middle east collage building so that the stuff and students can find out the exit path easily and because at the moment the fire is brock out there is a big prospect that the electricity will be catted off and here comes the benefit of the light that will going to turn on automatically.

Figure 3. *Intel Galileo Gen 2*

Intel Galileo Gen 2

Intel Galileo Gen2 was designed based on the system of 1000 x Quark SoC, known as the 32-bit Intel Pentium (SoC) as the class system on chip. This board is the first one based on Intel architecture consist of compatible with software and hardware pin along with Arduino Uno R3 shield design (De Luca, Carnuccio, Garcia, & Barillaro, 2016).

The Galileo board is compatible with software when dealing with the software of Arduino

Development Environment, which makes the startup fast.

The Galileo board has more features than compatibility with Arduino hardware and software, the Galileo board has a different number of inputs/outputs ports of PC industry standard to extend local usage and capability that can reaches beyond the Arduino shield system in this board there is a 100 MB Ethernet port, USB client port, full-size mini-PCI Express card, USB TTL UART header, 8MB flash memory, USB host port and Micro-SD slot.

**Figure 4.** *Smoke detection*

Smoke detection

Smoke detectors are found in plastic bottles, usually are in the form of a disk with a diameter of about 150 mm (6 inches) and a thickness of 25mm (1 inch), the size of the detector or the shape can vary. Any kind of smoke can be sensed either visually (photoelectric) or can be detected by physical process (ionization); detector may follow method of either or both of them.

Condition	Result		Command
	Fire Area	Save Area	
Temp>=50 Sensor 1	Zone:1	Zone:2,3	Start Alarm 1,Power supply 1, cutoff and water sprinkler 1
Temp>=50 Sensor 2	Zone:2	Zone:1,3	Start Alarm 2,Power supply 2, cutoff and water sprinkler 2
Temp>=50 Sensor 3	Zone:3	Zone:1,2	Start Alarm 3,Power supply 3, cutoff and water sprinkler 3
Temp>=50 Sensor 2,3	Zone:2,3	Zone:1	Start Alarm 2,3,Power supply 2,3, cutoff and water sprinkler 2,3
Temp>=50 Sensor 1,3	Zone:1,3	Zone:2	Start Alarm 1,3,Power supply 1,3, cutoff and water sprinkler

			1,3
Temp>=50 Sensor 1,2	Zone:1,2	Zone:3	Start Alarm 1,2,Power supply 1,2, cutoff and water sprinkler 1,2

Table 1.

Alarms which are sensitive can be used for detection to then deter smoking in restricted areas. Smoke detector are usually operated by a system of central fire alarm, which is powered by building energy with a spare battery. Local smoke detectors ranges from individual battery-powered units to many main-powered units connected with a spare battery; with these interconnected units, if any smoke unit is detected, they all will be triggered even if the home power is off.
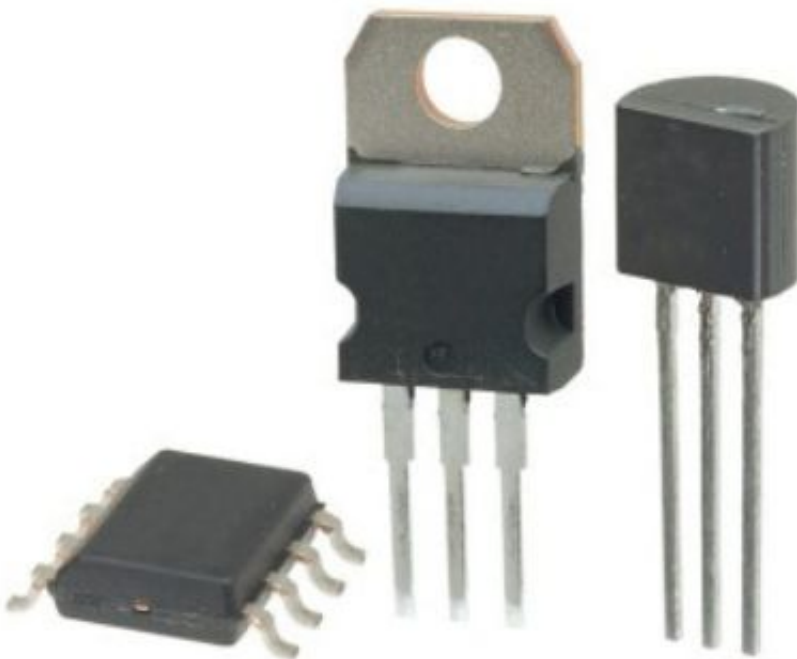
Figure 5. *Temperature sensor*

Temperature sensor

The temperature detector is an electrical device, usually a thermal unit or RTD, which through an electrical signal can measure for us the temperature. Dual (T/C) is composed of dissimilar metals that generates voltage through direct ratio with temperature changes. Resistance Temperature Detector (RTD) is known as a variable resistance that has the ability to change the current electrical resistance in an exactly direct proportional to temperature variations in a precise, repetitive and semi-linear manner (Ibrahim, Hassan, Abdulkarim, Akorede, & Amuda, 2019).

Result

Our goal was to implement a smart fire alarm using smoke and temperature sensors through Intel Galileo Gen 2 board and we have achieved the block diagram and the process of operation for this system. In this paper we aimed to show the management of electronic devices remotely which is also has been achieved successfully.

Discussion

Technology has been developed that affects people's lifestyle. It relies on technology even for everyday activities, the presents of technology switch the lifestyle to a relaxed and sophisticated life. We can see that it is hard to live without technology. Traditional lifestyle has been changed to advance technology in the last few years.

This paper included general idea that explains a fire alarm and control system. The proposed method of detecting the movements and the temperature is done through installing sensors in several points. The temperature of the building on which the installation of any sensor is known at any time before the critical limit is reached.

Conclusion

This research includes the way we use and develop devices around us by relying on the Internet of Things. Technology has become dominant in the world and the lives of people, and we use it in all matters of our daily life and are increasing in development rapidly and positively benefit society. Intelligent fire detection system can be used in any part of your house, buildings or forests. This research focuses on the Middle East college in particular or we can say in government buildings and other places. This system provides us with many advantages in that it saves the time required to evacuate the building and the ability to communicate quickly with the people involved in the evacuation process and help to maintain the safety of students and staff. On the other hand, it works to direct those at risk to the nearest accessible exit, which makes us aware of the importance of having a smart fire detection system in every building in Oman.

Acknowledgement

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