IOT Equipped Smart Building Monitoring and Control

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ABSTRACT

Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real world objects through the Internet. It can be aptly incorporated to make it smarter, safer and automated. IoT focuses on building a smart wireless security system which sends alerts to the user by using Internet in case of any trespass and raises an alarm optionally. Besides, the same can also be utilized for home automation by making use of the same set of sensors. The leverage obtained by preferring system over the similar kinds of existing systems that the alerts and the status sent by the wifi connected microcontroller managed system can be received by the user on his phone from any distance irrespective of whether his mobile phone is connected to the internet. The microcontroller used in the current prototype is the Arduino UNO Launchpad board which comes with an embedded microcontroller and an on board WiFi shield making use of which all the electrical appliances inside the home can be controlled and managed. To control the appliances like dc fan and dc motor. The aim to receive the alarm from the sensors which have added to receive the proper message in order to control the devices.

Keyword: - *sensor, monitoring, control, automated, wireless system.*

1. INTRODUCTION

Wireless home security and home automation are the dual aspects of project. The currently built prototype of the system sends alerts to the user over notification using the internet. If any sort of human movement is sensed near the entrance of house and raises an alarm optionally upon the user's discretion.

The provision for sending alert to concerned security personnel in case of critical situation is also built into the system. On the other hand if the user identifies that the person entering house is not an intruder but an unexpected person of then instead of triggering the security alarm, the user can make arrangements such as fire alert, switching on exhaust fan, motor inside the house, which are also connected and controlled by the microcontroller in the system.

The alerts and the status of the Internet of Things (IoT) system can be accessed by the user from anywhere even where Internet connectivity may not be readily available since it is not necessary for the mobile phone to be connected to internet only board is required to have an access to Wi Fi.Thus in brief introduction discussed about the home automation project in general. Going to apply project for some specific applications such as motor and fan using the same concept of home automation. That have discussed briefly about the sensors and loads that used here.

2. CONTROL OF HOME SECURITY

Home automation is the process of controlling home appliances automatically using various control system techniques. The electrical and electronic appliances in the home such as fan, lights, outdoor lights, fire alarm, kitchen timer, etc., can be controlled using various control techniques.

In system it have 3 types of sensors such as fire sensor, gas sensor, PIR sensor. All these are connected to the respective loads through Arduino UNO. The message go from the sensors is processed in Arduino and then the messages are sent to IoT. There it is processed further and the function of respective loads are happen. The brief explanation of the proposed system is shown further.

2.1 Advantages

This low cost system with minimum requirements takes care of both home security as well as home automation. This home security system does not use any smartphone application or any type of user interface instead uses digits from the keypad on the phone, the system is platform independent and hence can be accessed from a wide range of phones with different operating systems. To operate home security system the user need not have data connection enabled in his phone.

The system runs fine with the launch pad connected to wifi at home. The optional smart phone application takes care of the fact that the user may also wish to control his home appliances without sensors being triggered. To operate home security system the user need not have data connection enabled in his phone. The system runs ne with the launch pad connected to wifi at home.

The use of wifi enabled launch pad in the system enables the system to be controlled from any part of the globe contrary to Blue tooth controlled or IR remote controlled existing home automation solutions that too without any net connectivity in the phone. Since the same set of motion sensors can be deployed for home automation as well as security system the system is simple and inexpensive.

This system does not require the user to manually trigger an alarm but still it provides the user with the advantage of analyzing the situation and then triggering the security alarm remotely. This idea overcomes the common fault in many existing home security systems which causes unnecessary embarrassment by triggering security alarm due to the systems inability to judge a special situation in which it should not have triggered the alarm.

3. SENSORS WITH ARDUINO

For home security system some sensors are used with Arduino uno which is microcontroller board grounded with Atmega 328 processors, they are fire sensor, gas sensor, PIR sensor.

3.1 Fire Sensor

A fire detector works by detecting heat. These devices respond to the presence of smoke or extremely high temperatures that are present with a fire. After the device has been activated, it will send a signal to the alarm system to perform the programmed response for that zone. The fire sensor is shown in fig -1.

Since a fire detector usually works by detecting heat, and not actual fire, these devices are not usually called fire detectors. Instead, these devices are more appropriately called smoke detectors and heat detectors. Some of these devices are single function devices that will only detect either smoke or high temperatures. However, other sensors are multi function, and they will detect the presence of both smoke and high temperatures.

Multi function devices are usually the most effective when it comes to detecting a fire. However, single function devices are typically less expensive. Additionally, multi function devices might not be appropriate for every area. For example, there may be a room inside the home where smoke is commonly present. This could include a kitchen or a designated room for smoking herbs. For these areas, a single function heat sensor may be more appropriate than a dual function smoke and heat detector.

3.2 Working

Once a heat detector has activated, it will send a signal to the alarm system to perform a predetermined response. Many users will set up their system to immediately send out a distress signal to a central monitoring

station as soon as the device activates. This will ensure that the fire department is sent out to the premises as soon as possible. However, it is also common practice to require that the sensor receives verification of a fire before it sends an alert to the central station. This usually involves having the sensor activate twice within a short period of time. By programming the sensor this way, the user can prevent false alarms.

A flame sensor detects the presence of fire or flames. In extremely hazardous environments, flame sensors work to minimize the risks associated with fire. There are several different types of flame sensor some will raise an alarm while others may activate a fire suppression system or deactivate a combustible fuel line.

Among the many different types of flame sensor, ultraviolet flame sensors, near IR array flame sensors, infrared flame sensors and IR3 flame detection sensors are the most prominent.

In a hazardous environment, such as a petrochemical processing plant, failing to detect gas leaks, fires or explosions could prove disastrous. However, more needs to be done to help distinguish dangerous gas leaks or flames from annoying false alarm.

In this paper, Artificial Neural Network Technology Improves Gas and Flame Detection in Hazardous Areas, we take a closer look at the different ways we can reduce false alarms. Ultraviolet flame sensors work within wavelengths of no more than 300 nm. Within 3 to 4 milliseconds, ultraviolet flame sensors can detect explosions and fires by measuring the levels of radiation in the atmosphere additional radiation is emitted at the moment of ignition. Unfortunately, false alarms are fairly commonplace. Other UV sources, such as lighting, arc welding and even sunlight can all trigger the sensor. In order to counter this, many ultra violet flame sensors feature a built in time delay.

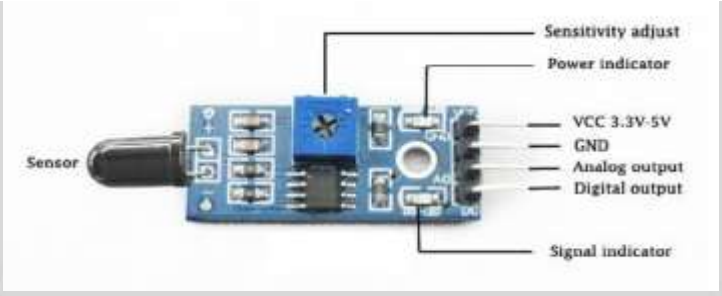

Fig -1: Fire sensor

Near IR array flame sensors, which are also known as visual flame detectors, boast flame recognition technologies. These sensors confirm the presence of flames by reading" near IR radiation via the pixel array of a CCD.

Infrared flame sensors, Infrared flame sensors are designed to work within the infrared spectral band. When an explosion occurs, certain hot gasses will emit patterns in the infrared region, which can then be analyzed using a specialized thermal imaging camera. Infrared flame sensors are somewhat prone to false alarms, so generally feature an inbuilt time delay.

IR3 flame detection sensors, Most IR3 flame detection sensors have been designed to disregard background radiation. These devices measure the modulated elements of radiation only. IR3 sensors are, therefore, less susceptible to false alarms than their ultraviolet and infrared counterparts.

Other notable types of flame sensor include ionization current flame detection and thermocouple flame detection. Ionization current flame detection systems are generally used in conjunction with large industrial processes gas heaters and are connected to the flame control system. Thermocouple fame detection systems are found in gas powered ovens and heating systems.

Flame sensors are utilized in a number of hazardous environments, such as hydrogen stations, industrial heating and drying systems, industrial gas turbines, domestic heating systems and gas powered cooking devices. Their primary purpose is to minimize the risks associated with combustion. Often, a flame sensor responds more swiftly than a heat or smoke detector.

3.3 GAS SENSOR

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals gas sensor is shown in fig -2.

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting.

Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Exposure to toxic gases can also occur in operations such as painting, fumigation, fuel filling, construction, excavation of contaminated soils, landfill operations, entering confined spaces, etc. Common sensors include combustible gas sensors, photoionization detectors, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors. More recently, infrared imaging sensors have come into use.

All of these sensors are used for a wide range of applications and can be found in industrial plants, refineries, pharmaceutical manufacturing, fumigation facilities, paper pulp mills, aircraft and shipbuilding facilities, hazmat operations, waste water treatment facilities, vehicles, indoor air quality testing and homes.

Fig -2: Gas sensor

Fixed type gas detectors may be used for detection of one or more gas types. Fixed type detectors are generally mounted near the process area of a plant or control room, or an area to be protected, such as a residential bedroom.

3.4 Working of gas sensor

Electrochemical gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized or reduced. The amount of current produced is determined by how much of the gas is oxidized at the electrode, indicating the concentration of the gas. Manufactures can customize electrochemical gas detectors by changing the porous barrier to allow for the detection of a certain gas concentration range. Also, since the diffusion barrier is a physical or mechanical barrier, the detector tended to be more stable and reliable over the sensors duration and thus required less maintenance than other early detector technologies.

However, the sensors are subject to corrosive elements or chemical contamination and may last only 1 to 2 years before a replacement is required. Electrochemical gas detectors are used in a wide variety of environments such as refineries, gas turbines, chemical plants, underground gas storage facilities, and more.

Catalytic bead sensors are commonly used to measure combustible gases that present an explosion hazard when concentrations are between the lower explosion limit (LEL) and upper explosion limit (UEL). Active and reference beads containing platinum wire coils are situated on opposite arms of a Wheatstone bridge circuit and electrically heated, up to a few hundred degrees C. The active bead contains a catalyst that allows combustible compounds to oxidize, thereby heating the bead even further and changing its electrical resistance. The resulting voltage difference between the active and passive beads is proportional to the concentration of all combustible gases and vapors present. The sampled gas enters the sensor through a sintered metal frit, which provides a barrier to prevent an explosion when the instrument is carried into an atmosphere containing combustible gases. Pellistors measure essentially all combustible gases, but they are more sensitive to smaller molecules that diffuse through the sinter more quickly.

Fig -3: Gas senor with Arduino board

Ultrasonic gas detectors are mainly used for remote sensing in outdoor environments where weather conditions can easily dissipate escaping gas before allowing it to reach leak detectors that require contact with the gas to detect it and sound an alarm, gas sensor with Arduino board is shown in fig -3.These detectors are commonly found on offshore and onshore oil or gas platforms, gas compressor and metering stations, gas turbine power plants, and other facilities that house a lot of outdoor pipeline.

3.5 PIR SENSOR

A passive infrared sensor PIR sensor is an electronic sensor that measures infrared IR light radiating from objects in its field of view. They are most often used in PIR based motion detectors, it is shown in fig -4.

PIR sensor works on principle, all objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is not visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

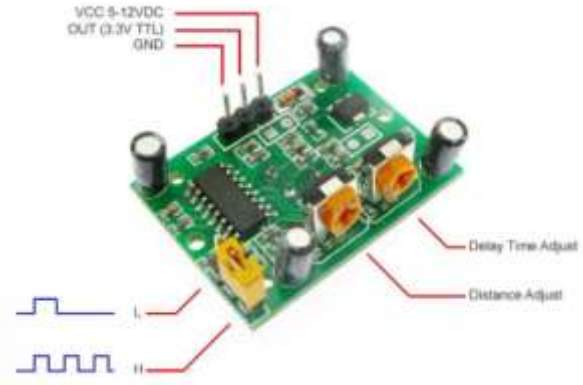

Figure -4: PIR sensor

The term passive in this instance refers to the fact that PIR devices do not generate or radiate energy for detection purposes. They work entirely by detecting infrared radiation radiant heat emitted by or reflected from objects.

4. CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, motion sensors but also actuates a process according to the requirement, for example switching on the buzzer when it sense the motion. It also stores the sensor parameters in the cloud in a timely manner. This will help the user to analyse the condition of various parameters in the home anytime anywhere.

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