

Structural Health Monitoring (SHM) - Using IOT

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Abstract

In developing countries like India, construction is growing rapidly day by day at the same time monitoring plays a crucial role in the safety of the people but due to the irresponsibility of the monitoring team and monitoring not being done at the right time then the severity of the problem increases and leads to the damage to the structure. If the monitoring of the structure is done at the right time, then we can find the problem at the initial stage.

To overcome this problem, we came up with this project i.e., STRUCTURAL HEALTH MONITORING (SHM) using IOT. In this, we arrange multipurpose sensors to the structure which will sense the deflection, fire, and smoke in the structure. When the sensor detects any problem, an alert notification will be sent to the authenticated user. When the notification is sent then there is a chance to take immediate action so that there is a chance of reducing the risk and increase the safety.

Keywords: mq2 sensor, flame sensor, LDR sensor, GSM module, Arduino, buzzer, monitoring, deflection, structure, Internet of Things

Introduction

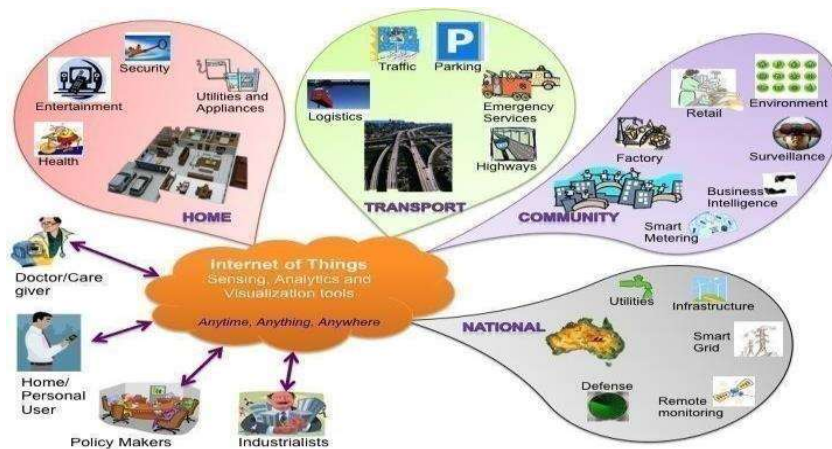
The Internet of Things (IoT) is the interconnection of physical objects such as buildings, automobiles (sometimes referred to as "connected devices/smart devices"), and other items that are embedded with electronic software and network connectivity to enable data collection and sharing. The Internet of Things (IoT) was referred to as "the infrastructure of the information society" by the Global Standards Initiative on the Internet of Things (IoT-GSI) in 2013.

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Through the current network infrastructure, the IoT enables items to be detected or operated remotely, opening up possibilities for more direct integration of the real world into computer systems. This leads to increased accuracy and financial gain in addition to a decrease in human creations. IoT becomes an example of a broader class of cyber-physical systems when it is enhanced with sensors and actuators, which include technologies like smart intelligent transportation and smart cities.

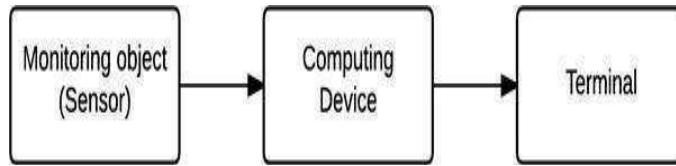
These gadgets use a variety of already available technologies to acquire important data, which they then autonomously transfer from one device to another. The control and automation of lighting, heating (using smart thermostats, for instance), ventilation, air conditioning systems, and appliances like Wi-Fi-controlled gadgets for remote monitoring are examples of current market trends.

The platforms which support IoT to store and retrieve data from things using any protocol over the Internet or via a Local Area Network are Freeboard, XOBXOB, IO, Thing Speak, Lab of Things, Konekt, KaaIoT Platform, Temboo, Things, IBM Ioud, Open Sensors, Smart Living, Google Cloud Platform, Jump Wire.



The simplest way to describe a data processing flow is the monitoring object collecting data sent to a computation device that processes and analyses the data. The device then sends the result to a terminal that executes a command based on simply presenting the data to for example a user.

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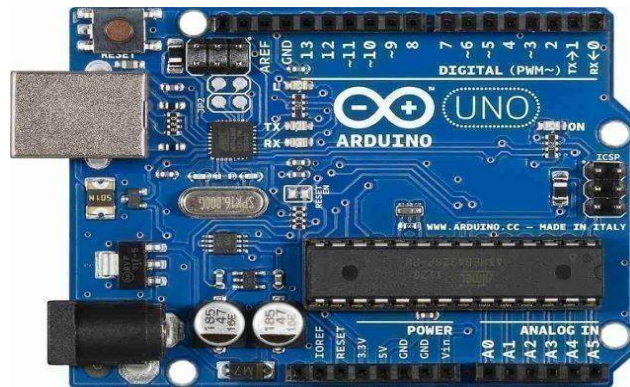


System Study

The existing system is a traditional method where the structure needs to be monitored manually and also to check the condition of the structure is regularly by using this project, we can find the structure's health by focusing on deflection, smoke, and fire, whenever the sensor detects any of this it sends alert to the mobile.

Working On The Proposed System

The MQ2 sensor senses flammable and combustible gasses like LPG, CH₄, CO, Alcohol, smoke, propane, and butane, the sensor gives a value of 0 when there are no harmful gasses then it will not give any notification when it senses harmful gasses which exceed their limit then it will immediately sense



the gases and gives alert in the form of buzzer and notification and similarly for fire detection we are using fire sensor it also gives an alert when the fire has been detected and we are using one more sensor that is for deflection and this, we are using laser when the deflection occurs then there is a disturbance for the laser path when there is deflection then it gives immediate alert to the user that deflection has detected.

Advantages:

- ❖ Through this, the officials can keep track of the health of the structures and can detect damage at the early stages

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- ❖ Reduces cost
- ❖ Saves human lives
- ❖ Less manpower.

Arduino UNO

Arduino Uno, MQ 2 Gas sensor, GSM Module, Fire sensor, Laser sensor, Adaptor, Buzzer

With the help of Arduino, you may build computers that are more capable than personal computers of sensing and managing the physical world. A straightforward microcontroller board and a programming environment for the board make up this open-source physical computing platform. The open-source Arduino platform can be used to create interactive devices that can be controlled by a wide range of motors, lights, and other physical outputs. You can use Arduino to create standalone projects or to connect them to other programmes running on your computer (like Flash or Processing).

ATMEGA 328 microcontroller, which acts as the processor for the Arduino board. Nearly it consists of 28 pins. From these 28 pins, the inputs can be controlled by transmitting and receiving the inputs to the external device.



The appropriate connection is formed during the operation of the Arduino microcontroller. examining the connection to the power supply and each input port. According to their applications, the output of the pins can be connected with external devices. The programme for the apps can be run by utilizing the Arduino software.

The ATMEGA-328 microcontroller can store programmes, and this IC can function as a processor to do tasks without making mistakes. We can perform the process in accordance with the applications after providing an analogue or digital input to the system.

The source of electricity is necessary for any modern technological invention to operate. Therefore, we consciously

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eed a suitable power source in our fast-paced society that will be suitable for a specific necessity. Only a DC supply with a voltage between 5 and 12 volts can be used to power every electronic component, from diodes to integrated circuits. We are stepping down, rectifying, filtering, and controlling the voltage while using the same, most widely used, and least expensive energy source of 230V-50Hz. Additionally, various ICs and displays run at +5v DC, including microcontrollers. Four diodes IN4007 are linked in series to rectify the step-down ac supply, which is done using a 220v ac to 12-0-12v transformer.

MQ 2

The MQ 2 sensor can sense Flammable and combustible gases like H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane, Butane, and some other gases. It gives the output in the form of voltage levels.



GSM Module

GSM (Global System for Mobile Communications: originally from Group Special Mobile) is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 80% of the global mobile market uses the standard.

FIRE Sensor

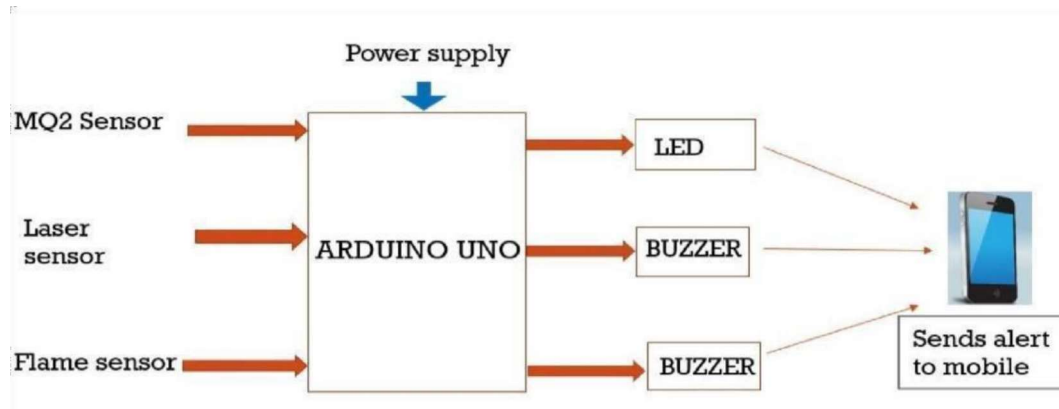
The prime function of a fire detector is to detect one or more changes in the protected environment indicative of the development of a fire condition. Usually mounted on the ceiling or in air ducts, detectors are activated in the main by smoke or radiation.

LDR Sensor

An LDR or light-dependent resistor is also known as a photoresistor, photocell, or photoconductor. It is a type of resistor whose resistance varies depending on the amount of light falling on its surface.

Buzzer

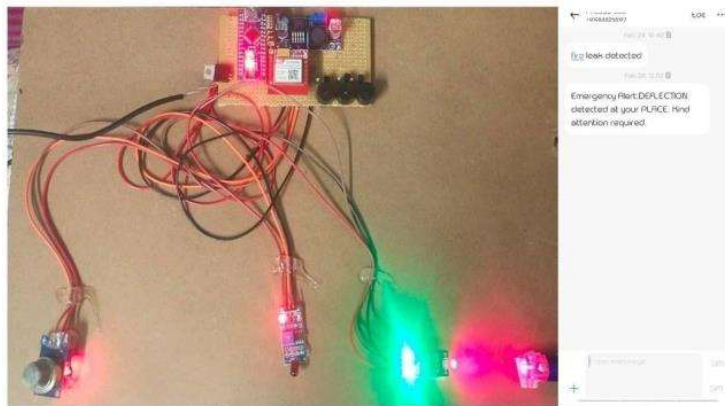
A buzzer or beeper is an audio signaling device. Whenever the air pollution goes above the threshold level the buzzer starts beeping indicating danger.



System Architecture

In the above architecture diagram, the sensors are MQ 2, MQ 6, and LM 35, pH sensors are connected to the Arduino board and values are displayed in LCD. If the values exceed than the threshold value the buzzer will give an alert sound.

Results



Conclusion

The system to monitor the structure using Arduino microcontroller and other sensors, IOT Technology is proposed to check the condition of the structure, If there is any problem in the structure the sensors alert the user via buzzer and sms. By using IOT the system enhances the process of monitoring various

aspects of structures like buildings and bridges. MQ2 and MQ6 gas sensor senses the different type of dangerous gas, fire sensor detects if any fire accidents caught near the structure, and LDR and laser were used to find the internal deflection in the structure, GSM is the main reason to alert the user through SMS and Arduino is the heart of this project which control the entire process. Our main aim is to reduce human effort and for continuous monitoring of the existing structure.

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