SMART SENSORS ARCHITECTURE FORINDUSTRIAL IOT

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***Abstract* -Nowadays, the concept of intelligent manufacturing is being introduced, based on the integration of new advanced technologies such as the Internet of Things (IOT), distributed control, data analysis, and cyber-security in the manufacturing area, with the aim of improving manufacturing processes and the articles produced. In this sense, new intelligent devices (Smart Sensors) should be developed that integrate several detection methods (sensors), real-time data analysis and wired and/or wireless connectivity. The main contribution of this project is the design, implementation and experimental verification of an architecture of a Smart Sensor that satisfies the operational requirements needed by the Industrial Internet of Things (IIoT).**

***Keywords* – DHT11 Sensor, MQ2 Gas Sensor, Fire Sensor, PIR Motion Sensor, LDR Sensor, Arduino Uno, ESP8266 Wi-Fi module, DC Boost Converter.**

I. INTRODUCTION

In this project, we will provide the automation for an industry or a home by monitoring fire sensor, MQ2 gas sensor, PIR sensor, LDR sensor and DHT11 temperature sensor. Here the wireless communication between the remote areas can be achieved by using IOT module. The project is designed in such a way that we will interface all these sensors to an 8 bit microcontroller Arduino Uno.

The status of these sensors will be transmitted through the IOT module which is interfaced to the controller. If any of the sensor values exceeds the predefined values then we get alert through buzzer. And we will see the sensors values in smart phone. And we will receive an alert to the particular mobile number that is owner of the Industry. So peoples will safe by any fire accidents, and gas leakages in the Industry.

A. Literature Survey

- The Industrial Internet of Things (IIOT) is a rapidly growing field that involves connecting industrial devices and sensors to the internet for the purpose of data collection and analysis. Smart sensors play a critical role in this field by providing real-time data on the performance of industrial equipment and processes. Smart sensor architecture for IIOT systems can vary depending on the specific application and the desired performance characteristics. In this literature survey, we will review some of the recent research on smart sensor architecture for industrial IOT applications.

- "Smart Sensors for Industrial Internet of Things" by Anand Paul et al. (IEEE Sensors Journal, 2017).This paper provides an overview of the design and architecture of smart sensors for IIoT. It covers the different types of smart sensors, such as MEMS sensors, wireless sensors, and wearable sensors, and their integration with IIoT systems. The paper also discusses the challenges and opportunities in the development of smart sensor networks for IIoT applications.

- "Design of Smart Sensors for Industrial IOT Applications" by Vinod Kumar et al. (International Journal of Advanced Research in Computer Science and Software Engineering, 2018).This paper focuses on the design and implementation of smart sensors for IIoT applications. It presents a framework for the development of smart sensors, including the selection of sensors, communication protocols, and power management techniques. The paper also discusses thechallenges and future directions in the development of smart sensors for IIoT.

- "Smart Sensors for Industrial Internet of Things (IIOT) Applications: A Review of Design and Fabrication Techniques" by M. Rizwan Jameel Qureshi, et al. (2021). This paper provides an overview of the design and fabrication techniques for smart sensors used in IIOT applications. The authors discuss various aspects of smart sensor design, including the choice of sensors, signal conditioning, and power management. They also review different fabrication techniques, such as microelectromechanical systems (MEMS) and printed circuit board (PCB) technologies.

B. Methodology

We have ESP8266 , an DHT11 sensor, Fire sensor MQ2 Gas sensor, PIR Motion sensor, LDR Sensor and DC-DC Boost Converter, mobile phone connected to MIT App Inverter (Smart industry app) through an IOT application. Using a mobile phone consisting of the IOT application smart industry app which is connected to the cloud and to the Esp8266 microcontroller. And we we'll program the microcontroller to automatically sense the fire or gas using the sensors attached with it.

As soon as the micro controller board sense that accident has happened it will automatically turn on the buzzer to indicate the people working and alert them. In addition to this, the sensor data is uploaded to the cloud using the Wi-Fi for monitoring the conditions in the factory remotely and take necessary precautions accordingly.

We will receive the Sensors values to the mobile phone. And we install IFTTT - automation & workflow app in mobile phone, after installation we create the account in app (owner of the industry) and we receive notification from accident place. In this way, the particular accidents can be prevented as soon as the sensors are turned on.

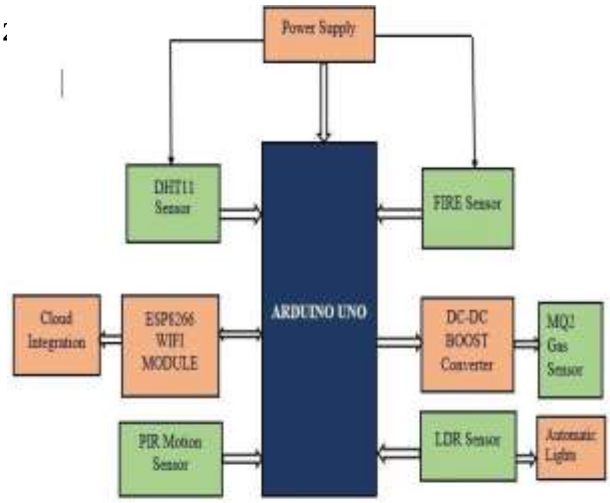

Fig: Block Diagram

C. System Design

IMPLEMENTATION

The proposed system for the “Smart Sensor architecture for industrial IOT” using Arduino Uno and ESP8266 Wi-Fi module works as follows:

- Our project is used to detect any Fire leakage or Gas leakage in the Industries
- When the Gas or Fire got detected by the connected sensors with Arduino then we have programmed the Arduino to turn on the buzzer.
- The buzzer alerts the workers or working peoples in the area.
- An SMS alert will also be sent to the desired mobile number, it may be the owner of the factory or higher officials that an accident has taken place in order to take necessary action.

The main components used in this project

- Arduino Uno
- DHT11 Sensor
- MQ2 Gas Sensor
- PIR Motion Sensor
- Fire Sensor
- LDR Sensor
- DC – DC Boost Converter
- Buzzer
- Wi-Fi Module

2.1 Arduino Uno Microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2.2 Sensors

Sensors are devices that detect and measure physical and environmental phenomena, such as light, temperature, pressure, motion, and sound. They are used to gather data about the world around us and convert it into electrical signals that can be read and analyzed by electronic circuits and computer systems.

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- **Arduino Uno:** The Arduino Uno is the main component of the system. It acts as the brain of the system and controls all the other components. The Arduino Uno receives the commands from the Wi-Fi module and controls the other sensors sensing values.
- **ESP8266:** The ESP8266 Wi-Fi module is a SOC microchip mainly used for the development of end-point IOT(Internet of things) applications. It is referred to as a standalone wireless transceiver. It is used to enable the internet connection to various applications of embedded systems.
- **Smart sensors:** The smart sensors are transforming workhorse machines into automated devices that perform on their own, by providing conditional and quality monitoring.

2.2.1 DHT11 Sensor

The DHT11 sensor is a digital temperature and humidity sensor that is widely used in hobbyist and DIY electronics projects. It consists of a capacitive humidity sensor and a thermistor for temperature measurement, and communicates with a microcontroller using a single-wire digital interface.

2.2.2 MQ2 Gas Sensor

2.2.3 The MQ-2 sensor is used to detect the levels of gas around the area, so you can utilize this sensor as a gas leak monitoring system for homes, businesses, or factories, and is suitable for monitoring devices such as gas, butane, propane, methane,alcohol, hydrogen, and smoke

2.2.4 PIR Motion Sensor

A PIR (Passive Infrared) motion sensor is a type of electronic device that is designed to detect movement by sensing changes in the infrared radiation emitted by objects within its field of view. PIR sensors typically consist of a yroelectric sensor, which is capable of detecting heat radiation, and a lens that focuses the radiation onto the sensor.

2.2.5 Fire Sensor:

A fire sensor is a device designed to detect the presence of fire or smoke in a particular area. The sensor can trigger an alarm or other safety systems in response to the detection of a fire or smoke, alerting occupants of the building and allowing them to take appropriate action to evacuate and prevent the spread of the fire.

2.2.6 LDR Sensor: (Light Dependent Resistor)

Photoresistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity.

2.2.7 DC-DC Boost converter

The boost converter is a DC-to-DC converter designed to perform the step-up conversion of applied DC input. In the Boost converter, the supplied fixed DC input is boosted (or increased) to adjustable DC output voltage i.e. output voltage of the boost converter is always greater than the input voltage. So, a Boost converter is also called a step-up converter or step-up chopper. It is given the name “boost” because the obtained output voltage is higher than the supplied input voltage. It performs the reverse operation of
the buck converter which converts higher DC input into lower DC output.

2.2.8 Buzzer

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to

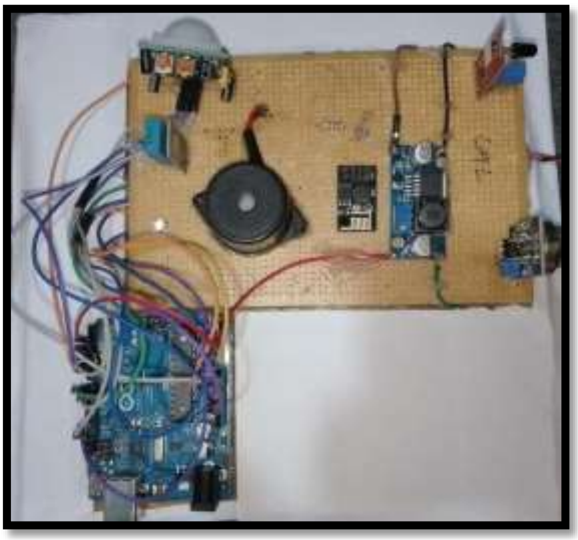

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Fig : Implementation

3. Software Implementation

- Introduction to Arduino IDE
- ThingSpeak Cloud
- Mit App Inverter

3.1 Introduction to Arduino IDE

Arduino IDE stands for “Integrated Development Environment”, the Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino- based projects. The top menu bar has the standard options, including “File” (new, load save, etc.), “Edit” (font, copy, paste, etc.), “Sketch” (for compiling and programming), “Tools” (useful options for testing projects), and “Help”. The middle section of the IDE is a simple text editor where you canenter the program code.

3.2 ThingSpeak Cloud

ThingSpeak is an Internet of Things (IOT) platform that allows users to collect, store, analyze, and visualize data from connected devices. It was developed by Math Works, a software company that provides tools for technical computing
sound.

2.2.9 Wi-Fi Module

An ESP8266 Wi-Fi module is a SOC microchip mainly used for the development of end-point IOT (Internet of things) applications. It is referred to as a standalone wireless transceiver, available at a very low price. It is used to enable the internet connection to various applications of embedded systems.

Espressif systems designed the ESP8266 Wi-Fi module to support both the TCP/IP capability and the microcontroller access to any Wi-Fi network. It provides the solutions to meet the requirements of industries of IOT such as cost, power, performance, and design.

and data analysis. ThingSpeak provides a cloud-based
infrastructure that allows users to easily create IOT applications and dashboards without needing to set up and maintain their own servers. It supports a variety of communication protocols, such as HTTP, MQTT, and UDP, toenable data transfer between devices and the cloud.

3.3 Mit App Invertor

MIT App Inventor is a cloud-based platform for creating Android mobile applications without requiring any programming experience. It was developed by a team at the Massachusetts Institute of Technology (MIT) led by Professor Hal Abelson.

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4. Applications

- Prevent industrial accidents.
- Reduce the risk of thefts.
- Save lives by Predicting the accidents that occur.
- 24*7 monitoring via cloud integration.
- Mobile interface to monitor the data remotely.
- Provides industrial automation.

5. Advantages

- **Reduced data transmission:** Smart sensors can process and filter data at the source, sending only relevant data to the cloud or edge devices. This reduces the amount of data transmission and storage required, leading to cost savings and improved network efficiency.
- **Increased accuracy:** Smart sensors can collect more accurate data by eliminating measurement errors caused by environmental factors such as temperature, humidity, and electromagnetic interference. This results in more reliable and precise measurements, leading to improved decision-making.
- **Flexibility:** Smart sensors can be easily reconfigured and updated to adapt to changing industrial processes, making them more versatile and adaptable to new use cases.
- **Improved security:** Smart sensors can incorporate security features such as encryption and authentication, providing a higher level of security and privacy for industrial processes.

6. Conclusion

- Adding a module for high-speed wireless communications with mechanisms to guarantee high availability and security.
- The latest generation of programmable devices have allowed the development of electronic devices that are interconnected and are responsible for more complex activities.
- The new architecture offers advantages regarding response time system integration, as well as flexibility and adaptability to the different applications and communication protocols to be implemented in the future.
- In future implementation Fan can be added to reduce the temperature and brings the temperature to normal level or room temperature.

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