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Original Article

IoT Based Air Pollution Monitoring System

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Abstract: *Internet of Things (IoT) is a worldwide system of "smart devices" that can sense and connect with their surroundings and interact with users and other systems. Global air pollution is one of the major concerns of our era. Existing monitoring systems have inferior precision, low sensitivity, and require laboratory analysis. Therefore, improved monitoring systems are needed. To overcome the problems of existing systems, we propose an air pollution monitoring system. An IoT kit was prepared using gas sensors, Arduino IDE (Integrated Development Environment), and a Wi-Fi module. This kit can be physically placed in various cities to monitoring air pollution. The gas sensors gather data from air and forward the data to the Arduino IDE. The Arduino IDE transmits the data to the cloud via the Wi-Fi module. We also developed an Android application so that users can access relevant air quality data from the cloud. If a user is traveling to a destination, the pollution level of the entire route is predicted, and a warning is displayed if the pollution level is too high.*

Keywords: *IoT (Internet of Things), Air Pollution Monitoring, Smart Sensors, Environmental Monitoring, Air Quality Index (AQI), Real-Time Data, Sensor Networks, Wireless Communication, Air Pollution Sensors, Data Analytics, Environmental Sensors, Wireless Sensor Networks (WSN), Data Logging, Particulate Matter (PM), Air Quality Management*.

I. INTRODUCTION

Over the last quarter of a century, companies developed rapidly. Such activities have created severe and complicated environmental issues. Considering the importance of environmental quality in people's lives, the World Health Organisation (WHO), by establishing limits to the amounts of different air contaminants, Ozone, nitrous oxides & sulphur oxide which include ground level, has established recommendations on minimizing public and health consequences of air pollution.

The extreme climate is first & foremost contamination that has triggered climate erosion, climatic transition, stratosphere ozone depletion, habitat destruction, shifts in ecological and hydrological processes, soil degradation and pressures on Buildings for food processing, acid rain & global warming. Occurrences of cancer, measles, asthma, respiratory problems, cardiovascular heart & chronic cardiovascular problems have been recorded for raising such pollutants. Therefore, the market for environmental emissions monitoring systems is growing through sources of emissions utilizing harmful chemicals, these devices will be able to identify and measure their origins easily. The modern air automated surveillance program uses laboratory analyzes with fairly complicated facilities, large quantities, unreliable activities and high costs.

This thesis suggests integrating IoT technologies with environmental protection to resolve deficiencies in conventional control and detection approaches and to-research costs. This work has been carried out based on many previous studies. In the past, studies performed air quality management and surveillance in the house.

II. SYSTEM IMPLEMENTATION

A. Existing System:

- In the existing system, indoor air quality monitoring and control typically rely on manual observation or rudimentary sensor systems, which often lack real-time data insights and predictive capabilities.
- Limited Monitoring Capability
- Manual Control Mechanisms
- Limited Connectivity and Accessibility

B. Proposed System:

The Intelligent Air Care (IAC) System using IoT is a modern solution designed to monitor, manage, and improve indoor air quality efficiently.

The proposed system leverages Internet of Things (IoT) technologies to provide real-time data on air quality parameters such as carbon dioxide (CO_2) levels.

Equipped with sensors and IoT-enabled devices, the system continuously collects environmental data and transmits it to a central platform for processing and analysis. Air monitoring using MQ2 gas sensor.

C. Block Diagram:

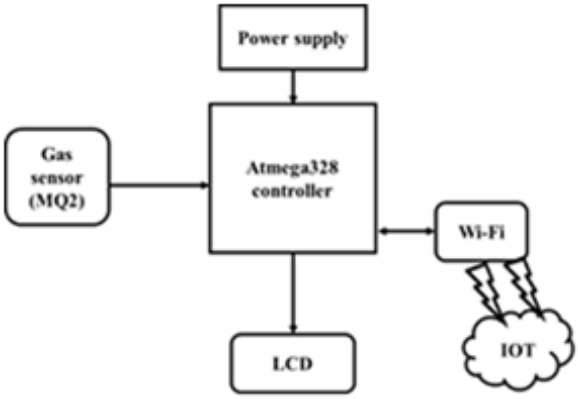

Figure 1: Proposed Block Diagram

D. Block Description:

Power supply is used to supply all units. It is used to convert AC to constant DC voltage. The Gas Sensor MQ2 module is suitable for detecting CO Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. These sensor values are given to embedded controller. Atmega328 is used as controller, it has 14 digital input/output pins 6 analog inputs. It has inbuilt ADC. Controller receive the input data and to update the webpage through IoT via Wi-Fi module.

E. Circuit Diagram:

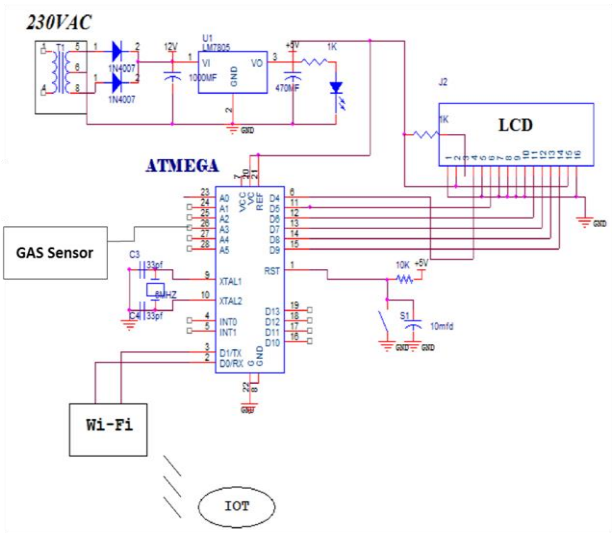

Figure 2: Proposed Circuit Diagram

F. Circuit Description:

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on ground. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component. Load will be LED and resister. LED voltage is 1.75V.if voltage is above level beyond the limit, and then it will be dropped on resister. This project has Co sensor (MQ2) for sensing the air pollutants in the surroundings and it's connected to the microcontroller atmega328 at port A0. The atmega328 is coded to monitor the sensed data and also a threshold is set to it. If the sensed data goes beyond the threshold

value a warring message is send to the user is Wi-Fi module. The WiFi module is wirelessly connected to the remote server and the data's are send from MC and Wi-Fi is connected to pin PD3/INT1 of the MC. The LCD is connected to the MC to view the live readings of the sensed data.

III. HARDWARE DETAILS

A. Atmega 328:

Figure 3(a): Atmega Controller Ic

ATMEGA 328 microcontroller, which acts as a 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. It also consists of pulse width modulation (PWM). These PWM are used to transmit the entire signal in a pulse modulation. Input power supply such as Vcc and Gnd are used. These IC mainly consists of analog and digital inputs. These analog and digital inputs are used for the process of certain applications.

B. Description Of Input:

a) Analog Input:

Arduino atmega-328 microcontroller board consist of 6 analog inputs pins. These analog inputs can be named from Ao to A5. From these 6 analog inputs pins, we can do the process by using analog inputs. Analog inputs can be used in the operating range of 0 to 5V. Analog signal is considered as the continuous time signal, from which these analog signal can be used for certain applications. These are also called as non discrete time signal. Inputs such as voltage, current etc.., are considered to be either analog signal or digital signal only by analysing the time signal properties. Various applications of arduino microcontroller can use only an analog input instead of digital inputs. For these applications, analog input ports or pins can be used.

b) Atmega-328 Ic:

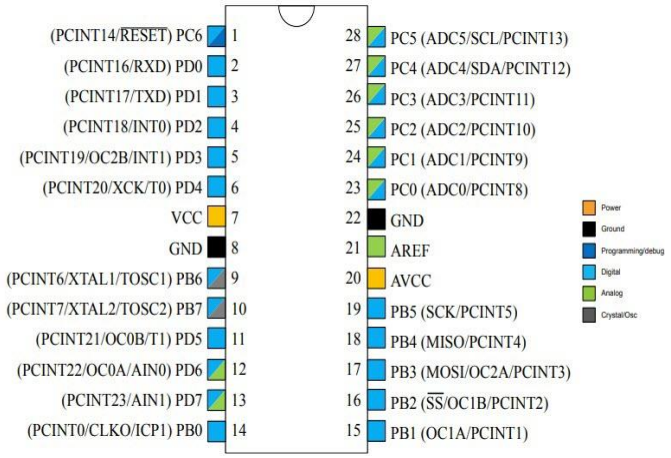

Figure 3(b): Atmega-328 Ic Pin Diagram

C. Single Power Supply:

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on ground. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component. Load will be LED and resister. LED voltage is 1.75V.if voltage is above level beyond the limit, and then it will be dropped on resister.

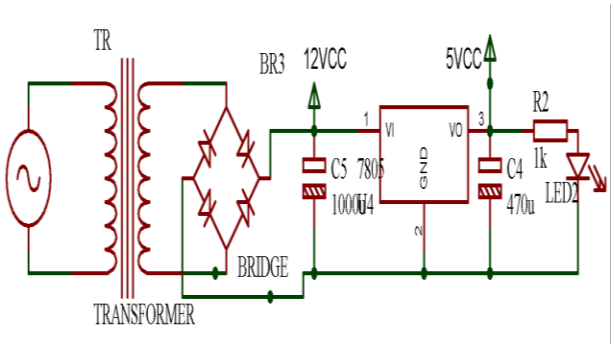

Figure 4: Single Power Supply

D. Smoke Sensor (MQ-2):

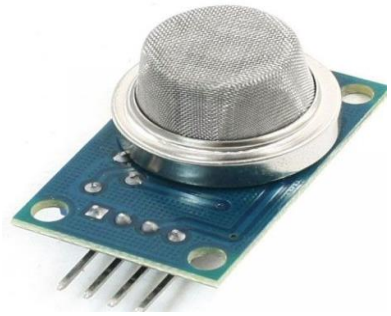

Figure 5: Smoke Sensor (Mq-2)

E. Description:

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration.

MQ-2 gas sensor has high sensitity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

F. WI-FI MODULE (ESP8266):

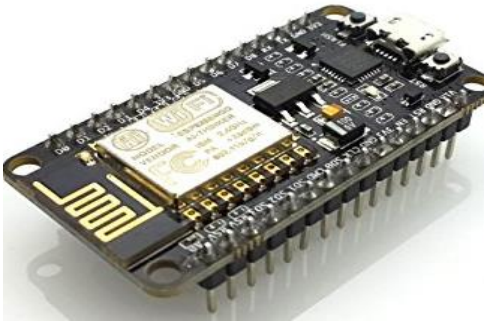

Figure 6: Wi-Fi Module

The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community.

This module has a powerful enough onboard processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

G. LCD – Liquid Crystal Display:

Figure 7: Liquid Crystal Display

Liquid Crystal Displays (LCDs) have materials, which combine the properties of both liquid and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer are pasted outside the two glass panels.

H. Internet of Things (IoT):

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

I. IoT as a Network of Networks:

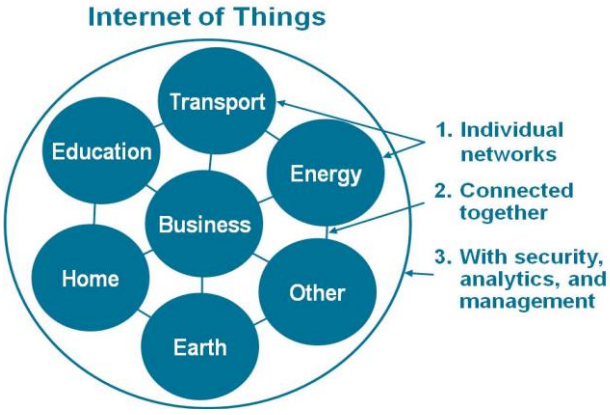

Figure 8: IoT as a Network of Networks

IV. ADVANTAGES

- Continuously monitor with sensors
- High alert system
- High transmission rates.
- Low power consumption.

- Logging data.
- Reliability and security

V. APPLICATIONS

- Environmental and ambient monitoring applications.
- Real time applications.
- Indoor air quality monitoring.
- Site selection for reference monitoring stations.
- Making data available to users.

VI. RESULTS & DISCUSSION

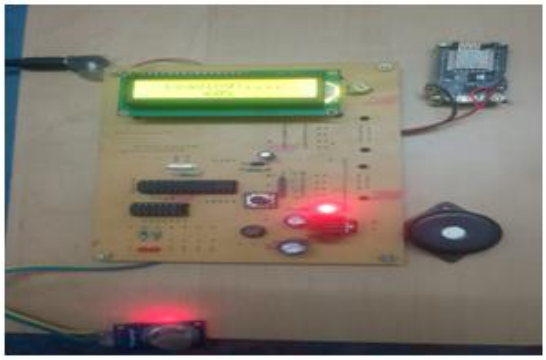

Figure 9(a): Hardware Setup

Figure 9(b): Hardware On Display

Figure 9(c): Hardware side input normal

Figure 9(d): IoT side input normal

Figure 9(e): Hardware Side High Pollution Level

Figure 9(f): Iot Side High Pollution Level And Pollution Detected Indication

Figure 9(g): Haredware Side Pollution Detected Indication

VII. CONCLUSION

We also created a low-cost surveillance program. The semiconductor gas sensors may be used to track the gas concentrations of the target gas. A device has numerous advantages such as low-cost, rapid response, low maintenances, continuous measurement capacity, etc., using semiconductor sensors. One of the system's key benefits is a compact scale. The WLAN, the network server and the site server Gateway Node are all bundled into one lightweight edition. That is really compact for the device. This device also helps one to incorporate certain hardware components into the controller as a microcomputer of credit scale. Through incorporating further sensing nodes, the network can be updated.

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