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IoT BASED INDUSTRIAL POLLUTION MONITORING AND CONTROLLING SYSTEM FOR POLLUTION CONTROL BOARD

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Abstract - *Pollution levels have increased with many factors including the growth of population, automobiles, industrialization and urbanization which can have a detrimental effect on humans by affecting the health of the human beings and other living things. Industrialization increases the level of automation therefore increasing the pollution by releasing some pollutants in the atmosphere. There must be a system for monitoring the industrial pollution. This paper suggests a system to monitor industrial pollution and minimizes human intervention in monitoring the industrial pollution and maintains a healthy environment. This monitoring system continuously assesses industrial pollution with the help of Node MCU ESP8266 and sensors like MQ-2 gas sensor, turbidity sensor, conductivity sensor and sound sensor and when pollution occurs, the system cut off the main power line to control polluting industries. This can be useful for government department like the pollution control board for monitoring the industries and take necessary actions.*

Keywords: Industrialization, Industrial pollution, Node MCU, Sensors, Monitoring, Necessary actions.

I. INTRODUCTION

Pollution disrupts the balance of the environment, affects the normal lifestyle and causes some diseases. The pollution level in some areas has reached the limit and they begin to harm our health. Therefore, it is an important indicator to keep track of the pollution level in the surrounding areas to make sure people are not affected by the negative effects of environmental pollution. As the growth of industries is getting bigger, the pollution-related issues are getting faster. Particular attention should be paid to monitor the factors affecting the health of the organism and the ecosystem. Industrial pollution monitoring is a process of data collection at various positions of the industries, so that the data can be used to monitor the working conditions. The main goal of the system is to scrutinize industrial pollution and indicates the pollution is rising in the industries. The process of industrial pollution quality assessment is the comparison of industrial quality values with standard quality set by the pollution control board. This system consists of a microcontroller, power supply, IoT module, relay, gas sensor (MQ-2), turbidity sensor, conductivity sensor, and sound sensor. This system continuously monitors and transmits the values of pollutants through the IoT module. If pollution level increases, it alerts and the system cut off the main power line of the industry.

II. EXISTING METHODS

The existing system monitors air quality, water quality and sound level in separate modes and it can monitor the polluting level of industries. The commonly used microcontrollers such as ARM processors, Atmega microcontrollers, Peripheral Interference Controller (PIC) are used for processing the data from sensors and Zigbee or Bluetooth is used for wireless communication. Some of the drawbacks of the existing system are given below.

- Maintenance is high
- More space and operating time is needed
- It cannot control other than monitoring

III. PROPOSED SYSTEM

In the proposed system, the sensors are interfaced to Node MCU and monitored using a single system. The pollution levels are monitored continuously with the help of sensors and addition to this, the main power line of the industry is also controlled simultaneously. While monitoring pollution levels, two types of operations are done in the system. One is making the main power line to be ON when the pollution level is under control and another

is cutting off the main power line of the industry when the pollution level is above the critical value. With the help of this triggering cut off unit, pollution can be reduced.

IV. SYSTEM DESIGN AND DEVELOPMENT

BLOCK DIAGRAM:

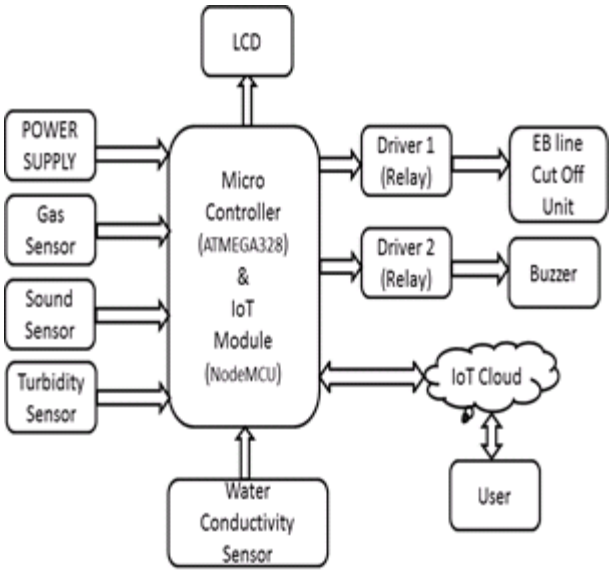

Figure 1: Block Diagram of the Proposed System

HARDWARE MODULES

1. Microcontroller (ATmega328):

ATmega328 is an Advanced Virtual RISC (AVR) microcontroller that supports data up to 8 bits. ATmega-328 has 32KB internal built-in memory. ATmega-328 contains 1KB Electrically Erasable Programmable Read -Only Memory (EEPROM) and 2KB Static Random Access Memory (SRAM). Atmega-328 has different features consisting of advanced RISC architecture, high performance, low power consumption, programmable Serial USART, programming lock for software security etc.

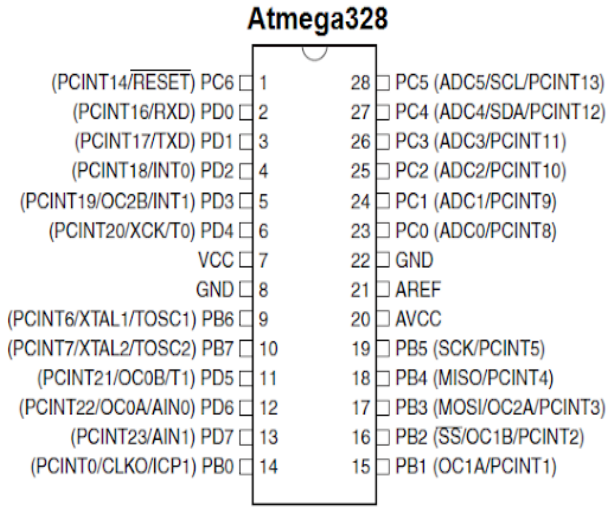

Figure 2: Pin Configuration of ATmega328

2. Node MCU:

ESP8266 delivers highly integrated Wi-Fi System-On-Chip solution to meet the continuous demands on efficient power consumption, compact designing and reliable performance in the industry. With the complete and self-contained Wi-Fi networking capabilities, it can perform as either a stand-alone application or the slave to a host MCU. The integrated high-speed increases the system performance and optimize the system memory. Also, ESP8266 can be applied to any micro-controller design as a Wi-Fi adaptor through SPI / I2C / UART interfaces.

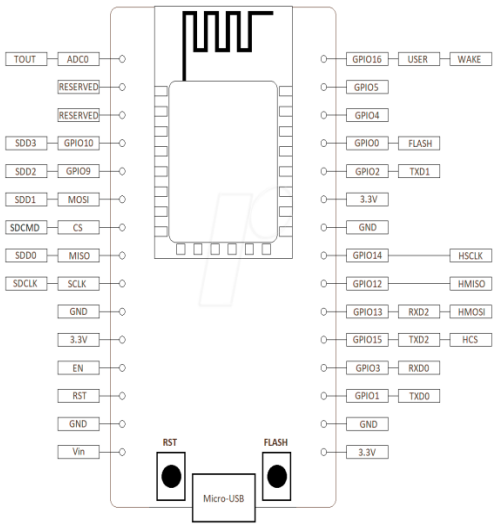

Figure 3: Pin Configuration of ESP8266

3. Power Supply:

The proposed system contains battery of 6V. A steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and regulating to obtain a desired fixed dc voltage.

4. Voltage Regulator:

IC7805 is a voltage regulator that regulates 5V supply as output to all other components consuming power.

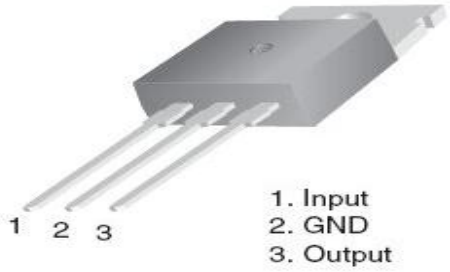

Figure 4: Voltage regulator IC 7805

5. MQ-2 Gas sensor:

MQ2 gas sensor is an electronic sensor used for measuring the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide. MQ-2 gas sensor is also known as chemi-resistor. It contains a sensing material and its resistance changes when it comes in contact with the gas. MQ-2 gas sensor is a metal oxide semiconductor type gas sensor. Concentration of gas is measured using a voltage divider network present in the sensor. This gas sensor can detect gas in the concentration of range 200 to 10000 ppm.

Figure 5: MQ-2 Gas sensor

6. Turbidity sensor:

Turbidity sensor senses the amount of light that is scattered by the suspended solids in water. As the amount of total suspended solids (TSS) in the water increases, then the water's turbidity level (and cloudiness or haziness) increases. Turbidity sensors are used in rivers and streams, wastewater and effluent measurements, sediment research, and laboratory measurements.

Figure 6: Turbidity sensor

7. Conductivity sensor:

Conductivity is the measure of a solution's ability to carry electric current. Conductivity sensors are used in water quality applications to measure how well a solution conducts electric current. This measurement assesses the concentration of ions in the solution. The more ions that are present in the solution, the higher is the conductivity.

Figure 7: Conductivity sensor

8. Sound sensor:

The sound sensor is one type of module used to detect the intensity of sound. The applications of this module include switch, security, and monitoring. The accuracy of this sensor can be changed to make it easy to use.

Figure 8: Sound sensor

9. Buzzer:

Buzzer is an audio signalling device, which may be mechanical, electromechanical or piezoelectric.

Figure 9: Buzzer

10. Relay:

Relays are simple switches used for switching. The switching mechanism is carried out with the help of an electromagnet.

Figure 10: Relay board

11. LCD:

Liquid Crystal Display is an electronic display module which is used to display the status of the Node MCU.

Figure 11: LCD

SOFTWARE

Arduino IDE – Source code IDE

V. IMPLEMENTATION RESULTS AND DISCUSSION

The hardware modules are connected and the program is dumped into the hardware using Arduino IDE.

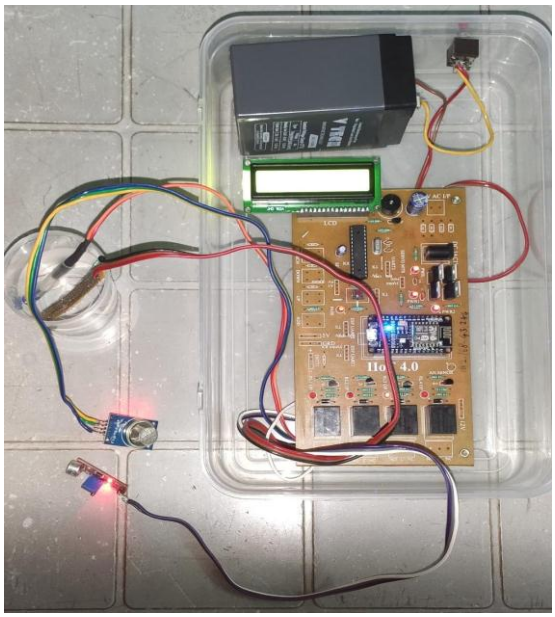

Figure 12: Hardware module of the proposed system

Implementation result of the proposed system is made to display in a smart phone application.

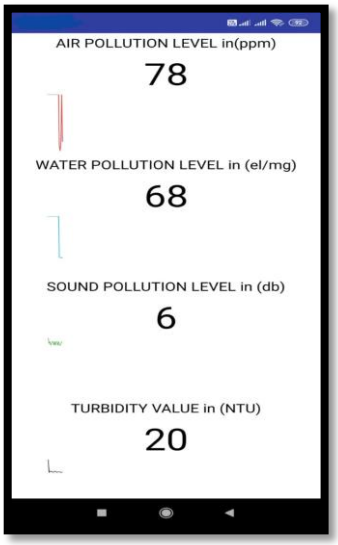

Figure 13(a): Under Pollution Level Result

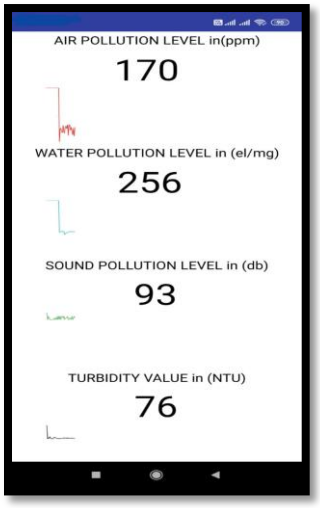

Figure 13(b): Above Pollution Level Result

VI. ADVANTAGES AND APPLICATIONS

ADVANTAGES:

- Online inspection can be done and instant action can be taken in polluting industries
- Water, air and sound pollution can be monitored and controlled 24 x 7 over IoT

APPLICATIONS:

- Industries and public places like parks, roads, etc.
- Private sectors like school, office, hospital, etc.

VII. CONCLUSION AND FUTURE SCOPE

The IoT facility can be applied to a wide range of applications. Real-time pollution monitoring system is based on IoT. An IoT module is connected to get the real-time data so that the users can log in and get data. Real-time monitoring of pollution ensures that industrial emission levels are maintained throughout and helps to track all the data in a single place with the help of IoT and reduce the pollution based on the collected data. The implementation cost is economical as the sensors and microcontrollers are easily available. The camera can be upgraded with image processing algorithms to enable a fully automated system for safety, such as fire alarm, gas leakage in future. This enables to generate automated control in the absence of the authorized user.

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