

Pollution Monitoring and Control Using IoT

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Abstract— One of the serious issues these days is rising pollution in air, water and sound. Increase in pollution has increased in number of diseases, where human beings are more prone to it. Therefore, to safe guard healthy livelihood and better future it has now become necessary to control the pollution. The authorities and the ordinary people belonging to that area can access the CO₂, SO₂, CO & Water, Noise Pollution Monitoring device. The live updates of the pollution level of the industries can be shown by the device which can be installed by a mobile application. These devices detects and notifies any increase in the pollution level to the pollution control board, so that necessary actions can be taken. Using IoT Technology we are monitoring the pollution parameter and also the details of the industry at the same time if the pollution level exceeds certain limit the power inside the industry will be Cut-off and stop the further production. To reconnect the power in the industry it is possible with the authentication signal generated from pollution control board.

Index Terms— IoT, Node MCU, CO₂ Sensors, Noise Sensors, Water Pollution Sensors, Regulated Power Supply

satisfied with the sensor setting then the same process of disabling power and information send to control room.

I. INTRODUCTION

To monitor and control industrial pollution the technology we are using here is IOT which is a cloud computing based communication protocol which sends and receives the signal with the help of internet. We are using an arrangement inside industry with different sensors like CO₂, water pollution and also a noise pollution sensor which goes to detect the predefined levels of the parameter. And in case of exceeding the level to a 50%, there will be an alert alarm generated inside the industry. And if there is negligence by the industry and still increasing the level to 100% there will be an automatic power cutoff using electromagnetic relays and this will disable the machineries of the industry to stop the further production.

The IOT modules picks this information and sends it to the authentication monitoring mobile unit in the pollution control board and intimate the status of the pollution increased by the particular industry followed by the industry license number and the details. The disabled power of the industry is possible to reconnect only when a fine has been paid by the industry to the pollution control board and control signal is generated from the pollution control board mobile so the signal reaches to the IOT module and it will once again enable the power of the industry to run all the machinery is to a normal condition.

The water pollution sensor design IR LED and photodiode combinations and the arrangement is connected at the exhaust of the industry through which the processed water has been flows to a nearby Reservoir are pond system the sensor used to detect the cleanliness of the water and in case of if it is not

To detect the noise pollution inside the industry we are using a miniature microphone with a proper calibration so that whenever any machinery or the process exceeds the noise level beyond the safe limit for the worker immediately send this information and sends to the pollution control board and disable the power.

Internet of Things

The Internet of Thing is the elaboration of internet connectivity into devices and objects Combined with electronics, Internet connectivity and hardwares such as sensors, these appliances can communicate with others over the internet, they can be monitored and controlled easily.

The IoT has evolved due to convergence of multiple technologies, machine learning, commodity sensors, embedded systems, and Real time analytics. IoT is most synonymous with products like smart home, covering devices and appliances such as home security system and cameras, lighting fixers, thermo stats and other home appliances. They can be controlled via devices like smart phones and smart speakers.

II. OBJECTIVES AND METHODOLOGY

NODE MCU (WI FI MODULE)

OBJECTIVES:

- To assemble and design the IOT module
- To sense the CO₂ level generate alarm
- To sense the CO₂ level and disable power and send information to control room
- To sense and generate power disable action for water pollution detection
- To sense and generate power disable action for noise pollution detection
- Getting information in the control room mobile in IOT app and to disable or enable the power of industry



Figure 2: Node MCU

METHODOLOGY:

- Collecting information from the website and understand the behavior and working of electronic and IOT components
- Designing and implementation of an IOT module
- Designing and implementation of co2 sensor circuit
- Designing and implementation of noise sensor circuit
- Designing and implementation of water pollution sensor circuit
- Design and implementation of overall interfacing with IOT module
- Testing of the operation by sending a IOT signal from the mobile
- Testing and calibration of all the operation of the sensors
- Preparation of report and presentations

Node MCU is an open source software and hardware development that is built around system on a chip (SoC) called the ESP8266. The word Node MCU means firmware rather than the development kits. The firmware employs the Lau scripting language. It is based on the Lau project, and built on the Express if Non-OS SDK for ESP8266.

Pin configuration of Node MCU

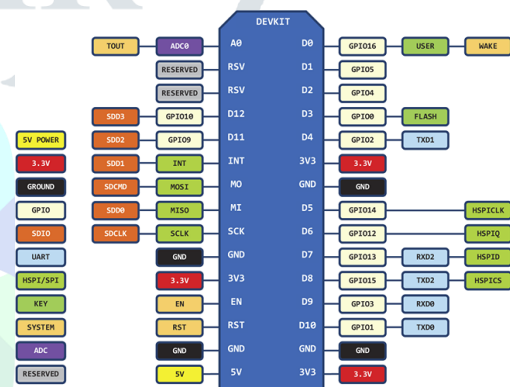


Figure 3: Pin configuration of Node MCU

III. BLOCK DIAGRAM

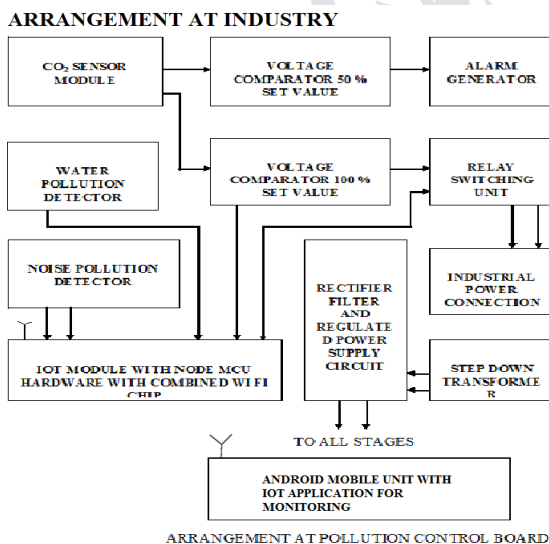


Figure1:Block Diagram Representation

What is ESP8266

The ESP8266 is a micro chip with TCP/IP stack and microcontroller capability produced by manufacturers. The ESP8285 is an ESP8266 which consists of 1MiB of built in flash which allows the single chip devices to connect to the Wi-Fi.

WATER POLLUTION SENSING CIRCUIT

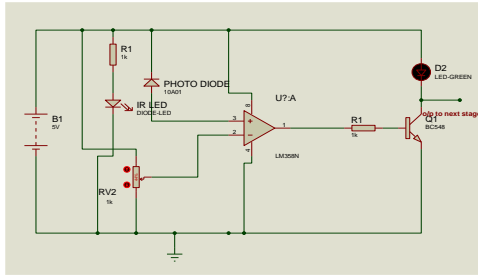


Figure 4: Water pollution sensor circuit

A water pollution Sensing circuit is designed with IR LED and Photo diode, OP-AMP (IC LM358) and Transistor. The IR LED and Photo diode converts the pollution contents in the water if the water exhausted from the industry is not polluted (clear water) then the light fall on the photodiode is at maximum if the water is polluted (dirty water) the light fall on the photodiode fall in less quantity . The diode conduction variation is inversely proportional to IR light fall on it.

Here the OP-AMP is used as a voltage comparator. The sensor combination is connected to the non-inverting terminal Pin No 3 of the OP-AMP to provide the potential difference.

The inverting terminal Pin No 2 of the OP-AMP get the potential difference & variable resistor (10 KΩ), to adjust the Reference Voltage or a set value of the parameter.

The LED connected at the collector gives an indication of sensing parameter when it exceeding the threshold value.

When the pollution level in industry exceeds the predefined safe value Because of this condition the voltage at Pin No 3 i.e. non-inverting terminal of the OP-AMP changes and its output goes high which in turn activate (Saturate) the transistor. This signal is given connected to buzzer, transmitter, relay, microcontroller or NODE MCU unit to take further actions like alert indication.

CO₂ SENSING

The exhaust level of CO₂ for all kinds of Industries is monitored through a pollution control board or routinely but this method cannot provide a 100% efficient control over CO₂ level. The method shown above can be used for controlling such a problem. This system can be useful to detect the CO₂ level and also control this level whenever it reaches abnormal values. But for such an arrangement government has to make mandatory rules that such a device has to be fitted in every Industry so that a proper monitoring of CO₂ level and its controlling is possible.

Different Level sensing for (50% and 100 %) CO₂

A CO₂ sensor (transducer) which is actually placed inside the Industry exhaust pipe. The CO₂ contents are converted back in terms of voltage. In voltage conditioning unit a suitable potential divider is provided which converts the voltage in such a way that the % of CO₂ level is in linear characteristics.

The output of voltage conditioner unit is fed to voltage Comparators where these are predetermined reference voltages are adjusted for each level of voltage the corresponding comparator activates its output and corresponding LEDs (Indicators) turn ON and indicates the level of CO₂. The 2 level of comparison can be possible to monitor. For initial levels of CO₂ (low level) the first comparator which goes ON indicates output. As the level of CO₂ increases which further triggers comparator second. The electromagnetic relay control circuit is designed to disable power unit goes to activate which cuts off the Industry AC power supply and thereby indicate the message as the pollution level increase to 100%.

NOISE SENSING CIRCUIT

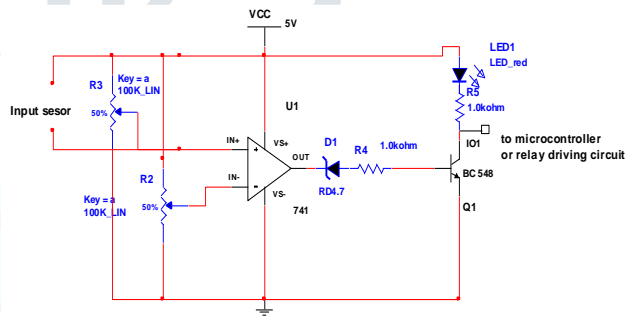


Figure 5: Noise sensing circuit

A noise sensing circuit is designed using a microphone, OP-AMP, Transistor. Here the OP-AMP is used as a voltage comparator. The non inverting terminal pin No 3 of the OP-AMP is connected to microphone and variable resistor VR1 to provide the potential difference. The inverting terminal Pin No.2 of the OP-AMP get the potential difference from resistor R1 and variable resistor VR2, to adjust the Reference Voltage.

When noise is detected by using the microphone the sound signals are converted into electrical signals, because of this condition the potential difference between two inputs at comparator also changes and the output of the comparator goes from its low to high state to activate (Saturate) the transistor. The collector of the transistor further drives microcontroller or relay.

AC power supply cutoff unit

The switching unit consists of relay, Relay is an electromechanical switch & it works on the principle of energizing an electromagnet.

It consists of primary coil, 2 contacts one is normally open contact “NO” & the other is normally closed contact “NC”& pole normally identified a common. The input for the relay coil can be connected to the required DC coil energizing voltage from its COM, N/O and N/C terminal any device of any voltage can be connect for switching actions.

IV. 7805 REGULATED POWER SUPPLY

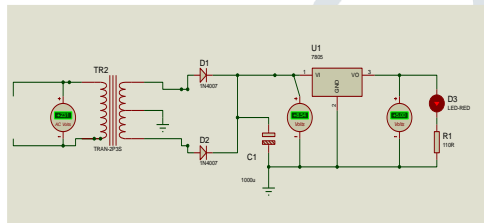
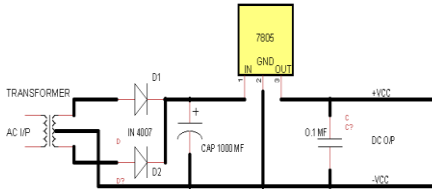


Figure 6: Regulated Power Supply

The load current in the Full wave that has two or more Diodes arranged Flows in the same direction during each half cycle of the ac.

A full wave rectifier i.e., centre tap is used to rectify Ac power so that Both positive and negative half cycle of the sine wave is used.

A full wave rectifier uses transformer with a centre –tap is as shown in the figure below.

Circuit diagram of Full-wave rectifier.

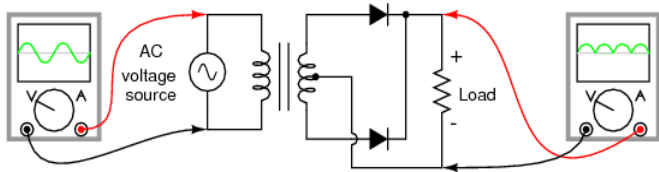


Figure 7: Circuit diagram of Full-wave rectifier

The above circuit is explained as follows. During positive half cycle, the top diode is forward biased and hence it conducts whereas the bottom diode is reversed biased and hence it will not conduct.

During positive half cycle the load carries current which is as shown in the figure below.

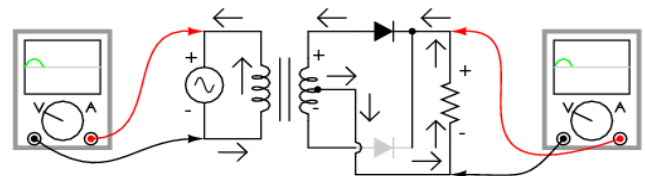


Figure 8: Full-wave center-tap rectifier: load carrying current during positive half cycle

During negative half cycle the bottom diode is forward biased whereas the top diode is reversed biased hence the bottom diode conducts during negative half cycle. Hence the load carries current during negative half cycle is as shown in the fig below.

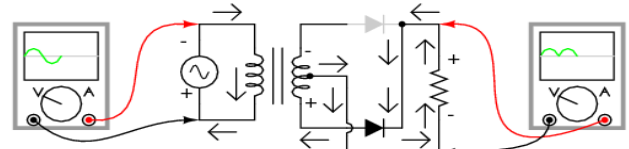


Figure 9: Full-wave center-tap rectifier: load carrying current during negative half cycle

The pulsating DC is connected across a filter capacitor which removes the ripples and smoothness the DC output.

V. ELECTROMAGNETIC RELAY AND INTERFACING CIRUIT.

Relay acts as electromagnetic switch, and can be used to control the external devices with isolation and the internal structure and working is shown below.

RELAY INTERNAL CONTACTS

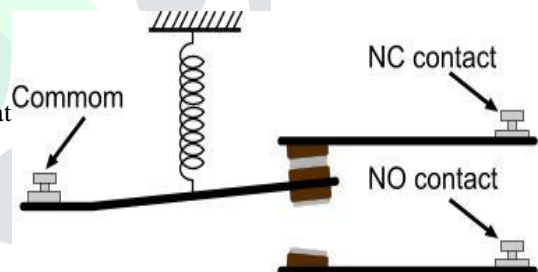


Figure 10: Relay internal contacts

The figure indicates the internal contacts of the relay. The relay shown in the figure is in off state. When the relay is off common is in contact NC contact (normally closed) and common is open with respect to NO contact (normally open).

Relay internal circuit along with the electromagnetic coil

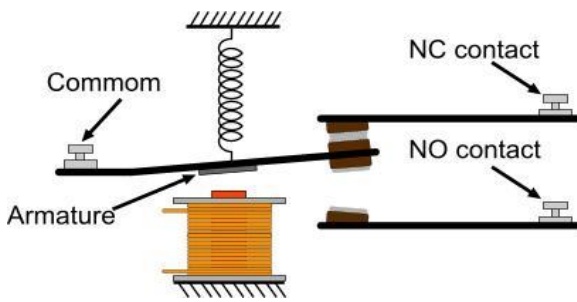


Figure 11: Relay internal circuit along with the Electromagnetic coil

The relay consists of the electromagnetic coil as shown in the figure.

Whenever the electromagnetic coil gets the supply the coil energizes because of the electromagnetic induction. As the coil energizes it attracts the common contact, common contact will be closed with respect to NO contact.

RELAY INTERFACE



Figure 12: Relay Interface circuit

The circuit diagram shows the connection of Relay Driver Circuit. When the logic signal from controller or any other circuits like timers or amp is applied to base of the transistor through resistor 1K ohm. When Base signal is high, the transistor saturates and it energizes the relay. Three transistor act as a small signal amplifier resistor of 1K ohm is used to provide proper emitter base voltage to turn the transistor to ON state from OFF state.

An electromechanical switch called relay which works on the principle of electromagnetic attraction. A relay consists of primary coil, 2 contacts, one is normally closed contact "NC" & the other is normally open contact "NO" & pole usually identified a common. When relay is in off state the pole (common) is connected to normally closed (NC contact).

The load may be a fan or dc motor or heater coil, when transistor starts conducting current starts flowing through the coil. Which develops its own magnetic flux when the strength of current is suitable; whenever a sufficient flux is produced it attracts the pole to make contact with normally

open position 'NO'. Hence the load connected to it performs its operation until the contact is broken.

A diode connected in parallel across the primary coil is to eliminate the effect of back EMF on the transistor. Relays have great application in industry. Using the principle of energizing an Electromagnet we can handle large voltages & current application without the risk of shocks.

VI. PROJECT OUTCOME

The outcome of the project is monitoring of air pollution to required set value and also monitoring of water and noise pollution to the required set values which is monitored by the pollution control board. And also getting the complete information of the industry including a license number and address then an enabling and disabling action of the industry power using IOT app and by this we can avoid manpower and effective management of increasing pollution in the atmosphere.

By this project we can minimize the pollution to some extent. By decreasing the pollution we can improve the health conditions of human beings.

The proposed system which is designed shows the simulation output of sensing the carbon dioxide gas in air, noise pollution and water pollution in Environment. The sensor output is pushed to cloud and can be viewed through internet. This is a flourishing system which is very useful in industries because of the increasing pollution due to increase in industries. This system is user friendly and cost of the product is affordable. The results of the project are accurate and hence can be implemented in any industries for the safety of workers and the environment.

VII. APPLICATIONS

- ✓ Industrial perimeter monitoring
- ✓ Vehicles Emission Test.
- ✓ Municipal works
- ✓ Site selection for reference monitoring
- ✓ To make data available to the common man
- ✓ Air, Water and Noise pollution detector and messaging

ADVANTAGES:

- ✓ No man power is required
- ✓ Effective management and monitoring of air, sound and water pollution
- ✓ Because of using IOT the data transmission is quick and fast
- ✓ Reduces diseases which is caused by air, noise and water pollution

- ✓ Simple, compact and easy to handle
- ✓ Quality of air can be checked indoor as well as outdoor
- ✓ Consumes less power
- ✓ Detecting the wide range of gases including CO₂, CO etc.

DISADVANTAGES

- ✓ Always need of internet connection

VIII. CONCLUSION

Pollution is the presence of impurities in the environment either due to naturally occurring contaminants or due to human activities which is adversely affecting the living beings. Our ecosystem is severely affected by pollution and hence it is very necessary to safeguard it. The release of CO₂ due to combustion of fuels are resulting in the earth to be warmer day-by-day.

Now-a-days pollution is increasing very rapidly. Because of Pollution there is lot of diseases and hence Human life is distracted. To stop the pollution we need take some severe actions.

In our project we are employing the techniques of controlling the air, water and noise pollution. Here we are using IoT technology to control the pollution. We are using sensors like CO₂, water and noise which will be installed in the industries. If the pollution level is increased from the set value, then the sensors will sense the pollution level and sends the signal to the pollution control board through mobile applications. The pollution control board will take action against the particular industry and the power supply of the industry will be cut-off.

The IoT Technology based pollution monitor and control is greater step to healthy life. We can control and monitor air, water and noise pollution. By this we can protect our environment.

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