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IOT BASED SMART INDUSTRIAL POLLUTION MONITORING SYSTEM

[1]Y.SREEVIDYA,[2]E.MANOHAR GOUD,[3]M.MOUNIKA,[4]M.SATEESHA,[5]K.SRAVANI,
[6]Mr.B.VENKATESH
[1,2,3,4,5]B.TECH STUDENTS,[6]ASSISTANT PROFESSOR
DEPARTMENT OF ECE
Bhuma Shobha Nagireddy Memorial College Of Engineering And Technology , Allagadda

Abstract

In infrastructure and industrial plants the rapid growth creating environmental issues like pollution (Air, Water, Noise), climate change, malfunctioning and has greatly consequence for the requirement of an, operationally adaptable, efficient, cheap and smart monitoring systems. In this context where combination of many challenges of computer science, wireless communication and electronics; the Smart Sensor Networks are an emerging field of research. In this project we are implementing a solution to monitor the air and noise pollution levels in industrial environment or by using wireless embedded computing system a particular area of interest is proposed. The technology like Internet of Things (IoT) is included in the form of solution which is outcome of merged field of computer science and electronics. For monitoring the fluctuation of parameters like noise and air pollution levels from their normal levels in this case the sensing devices are connected to the embedded computing system. For the requirement of continuous monitoring, controlling and behavior analysis this model is adaptable and distributive for any infrastructural environment. For those parameters like noise, CO, temperature, Humidity and Light Intensity levels the implementation is tested with respect to the normal behavior levels or given specifications which provide a monitoring over the pollution control to make the environment smart and Eco-friendly.

1. INTRODUCTION

As we probably are aware the mechanical development radically expanding, natural contamination related issues quickly appears . To satisfy the need of thriving observing framework, in our task we are setting up a system called Internet of Things, in which detecting gadgets are associated with remote implanted processing framework. Web of Things is an innovation that connects the sensors with installed framework and enables the information from these sensors to go over an Internet. We are actualizing creating model which can screens the capriciousness of parameter like Air, Noise, Temperature, Humidity and Light.

In the proposed model we are using NodeMcu . We are utilizing 5 sensors, MQ-7 as a gas sensor. We are utilizing 5 sensors, MQ-7 as a gas sensor. It identifies the convergence of carbon monoxide in air. To gauge the vacillations in commotion levels we use M213 high affectability mouthpiece sensor module. LM35 is utilized as a temperature sensor and HR201 as moistness sensor. To gauge the force of light LDR sensor is utilized. To exchange the information Over an Internet we are utilizing adaptable wi-fi ESP32. The information from these sensors is put away in the cloud. Subsequent to handling, through hotspot internet browser will get some information about IP address, by putting IP address page will make that enables us to screen the framework . We can screen the parameters on cell phones just as pc or workstation.

IOT is recently created innovation in which the availability between physical items alongside controllers, actuators and sensors synchronized over an Internet. IOT ready to give intends to screen the nature of parameters like Air, Noise, Temperature, Humidity and Light . It causes concern experts to make a move against contamination crossing past characterized level. Goal of the Project The primary goal of the task is to give a stage that screens the parameters and help to make better and contamination free future life.

2. LITERATURE REVIEW

The difficulty of the conventional monitoring instruments is their large size, heavy weight and extraordinary costlier. These lead to inadequate deployment of the monitoring stations. In order to be effective, the locations of the monitoring stations need careful placement because the air pollution situation in urban areas is highly related to human activities (e.g. construction activities) and location-dependent (e.g., the traffic choke-points have much worse air quality than average).

This is observed through a small device that can be placed anywhere in a Industry. First, it is studied the operation of ZigBee protocol. Second, it was chosen and tested a ZigBee module and sensors from the market. Then, it was developed a module that supervises: humidity, temperature, light, carbon monoxide, carbon dioxide and Noise. These data are measured and sent regularly to a base station connected to a computer. These data are stored and processed for presentation on the Internet in this Environment Observation and Forecasting System (EOFS) is an application for supervising and providing a forecasting about environmental circumstances. The Industrial pollution Monitoring system which involves a context model and a flexible data acquisition policy. The context model is used for understanding the status of pollution on the remote Place. It can provide an alarm and safety guideline depending on the condition of the context model. It also supports the flexible sampling interval change for effective the tradeoff between sampling rates and battery lifetimes. In this Pollution Map is a new automated system that monitors the air quality of urban cities and displays the information using a web service. The system collects pollution data using mobile hardware modules, transmits the data regularly using GPRS to a back-end server, and integrates the data to generate a pollution map of the city using its geographical information system. The pollution map is available at any time from an easy-to-view website.

IOT Based Air Pollution Monitoring System monitors the Air Quality over a web server using internet and will trigger an alarm when the air quality goes down beyond a certain level, means when there are amount of harmful gases present in the air like CO_2, smoke, alcohol, benzene, NH_3, NOx and LPG. The system will show the air quality in PPM on the LCD and as well as on webpage so that it can be monitored very easily. Temperature and Humidity is detected and monitored in the system.

The existing system makes use of gsm module, the prototype was equipped with basic functionalities, it enables the detection of pollutants and notifies the end user via message. Comparison of air quality for each timeslot cannot be done.

3. DESIGN OF HARDWARE

This chapter briefly explains about the Hardware implementation of authentication of Smart Industrial Pollution Monitoring System. It discuss the circuit diagram of each module in detail.

POWER SUPPLY

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

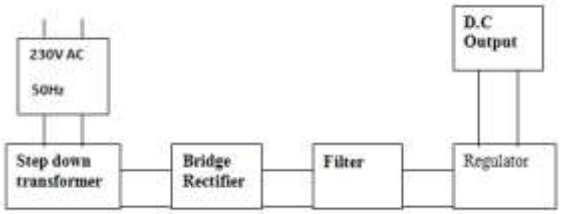


Fig1: Power supply

ARDUINO UNO

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 ceramic resonator, 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.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Arduino board has the following new features:

- 1.0 pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Fig2: ARDUINO UNO

TEMPERATURE SENSOR(LM35)

In order to monitor the temperature continuously and compare this with the set temperature preprogrammed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus a sensor has to be used and the sensor used in this project is LM35. It converts temperature value into electrical signals.

LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

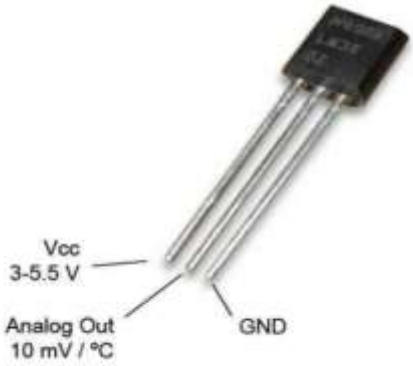


Fig3: LM35 Temperature Sensor

HUMIDITY SENSOR (HR201)

A humidity sensor (or hygrometer) senses, measures and reports the relative humidity in the air. It therefore measures both moisture and air Humidity. Relative humidity is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air Humidity.

Humidity is a term for the amount of water vapor in the air, and can refer to any one of several

measurements of humidity. Formally, humid air is not "moist air" but a mixture of water vapor and other constituents of air, and humidity is defined in terms of the water content of this mixture, called the Absolute humidity. In everyday usage, it commonly refers to relative humidity, expressed as a percent in weather forecasts and on household humidistat's; it is so called because it measures the current absolute humidity relative to the maximum. Specific humidity is a ratio of the water vapor content of the mixture to the total air content (on a mass basis). The water vapor content of the mixture can be measured either as mass per volume or as a partial pressure, depending on the usage.

In meteorology, humidity indicates the likelihood of precipitation, dew, or fog. High relative humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin. This effect is calculated in a heat index table, used during summer weather.

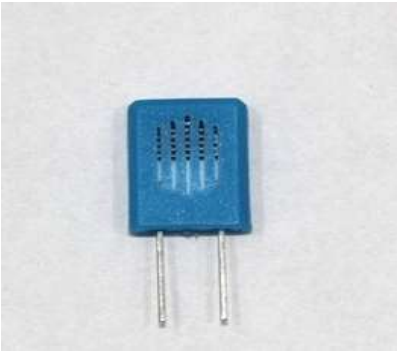


Fig4: Humidity Sensor(HR201).

GAS SENSOR:

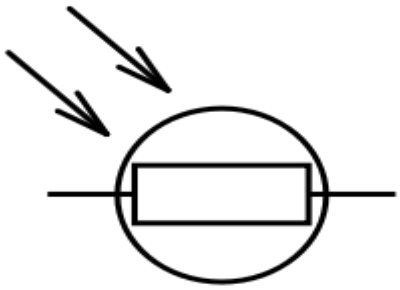
A Typical human nose has 400 types of scent receptors enabling us to smell about 1 trillion different odours. But still many of us do not have the capacity to identify the type or concentration of gas present in our atmosphere. This is where Sensors comes in, there are many types of sensors to measure different parameters and a **Gas sensor** is one which comes handy in applications where we have to detect the variation in the concentration of toxic gases in order to maintain the system safe and avoid/caution any unexpected threats. There are various gas sensors to detect gases like oxygen, Carbon Dioxide, Nitrogen, methane etc. They can also be commonly found in devices that are used to detect the leakage of the harmful gases, monitor the air quality in industries and offices etc.

A **gas sensor** is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

Fig5: Gas Sensor

LDR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. It can also be referred to as a photoconductor or CdS device, from "cadmium sulphide," which is the material from which the device is made and that actually exhibits the variation in resistance with light level. Note that CdS is not a semiconductor in the usual sense of the word (not doped silicon).



A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the

semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor. Photo resistors are basically photocells.

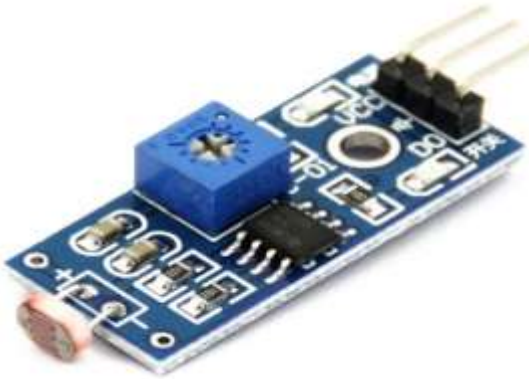


Fig6: LDR Module

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically.

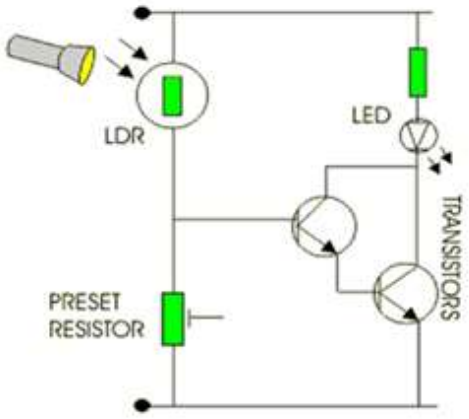


Fig7: LDR Working

This is an example of a light sensor circuit:

NOISE SENSOR (M213)

The Noise Detector or Sound Detector is a small board that combines a microphone and some processing circuitry. It provides not only an audio output, but also a binary indication of the presence of sound, and an analog representation of its amplitude. The sound sensor module provides an easy way to detect sound and is generally used for detecting sound intensity. This module can be used for security, switch, and monitoring applications. Its accuracy can be easily adjusted for the convenience of usage. It uses a microphone which supplies the input to an amplifier, peak detector and buffer. When the sensor detects a sound, it processes an output signal voltage which is sent to a microcontroller then performs necessary processing.

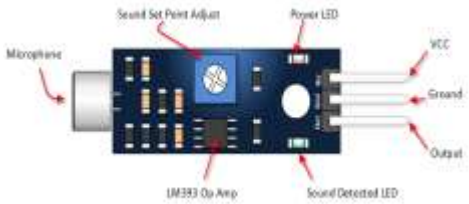


Fig9: Noise Sensor

LM213 Sound Detection Sensor Module is used With All Micro Controllers which detects

whether sound has exceeded a threshold value. The sound is detected via microphone and fed into an LM393 op-amp. The sound level setpoint is adjusted via an onboard potentiometer. When the sound level exceeds the set point, an LED on the module is illuminated and the output is sent low. The sound sensor module recognizes sound and its force. It utilizes a mouthpiece which supplies the contribution to an intensifier, top identifier and cushion. At the point when the sensor recognizes a sound, it forms a yield flag voltage to a microcontroller. Typical voice sound dimension 19 to 60 dB. Working at 3.3V-5V.

BUZZER

A Buzzer or Beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric .Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. The vibrating disk in a magnetic buzzer is attracted to the pole by the magnetic field. When an oscillating signal is moved through the coil, it produces a fluctuating magnetic field which vibrates the disk at a frequency equal to that of the drive signal.

The buzzer consists of an outside case with two pins to attach it to power and ground. Inside is a piezo element, which consists of a central ceramic disc surrounded by a metal (often bronze) vibration disc. Changing this then causes the surrounding disc to vibrate. That's the sound that you hear.

Fig10: Buzzer

LCD

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

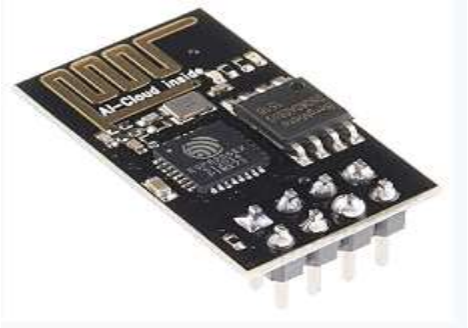
Fig11: 16*2 LCD Display

ESP8266 WIFI

- The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Expressive Systems.

- The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of

connecting to Wi-Fi. The successor to these microcontroller chips is the ESP32.



4. THINGSPEAK SERVER

ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates. ThingSpeak is an open cloud data platform where you can store and retrieve data.

Steps to Configure Thingspeak Server Account:

Step 1: Sign up ThingSpeak

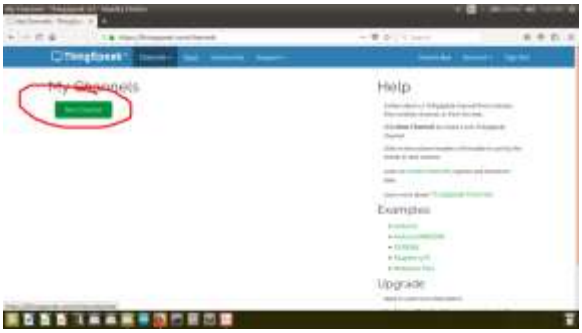
It's simple just enter your email id and verify your account.

Step 2: Configuring ThingSpeak

Configuration is just few clicks Process

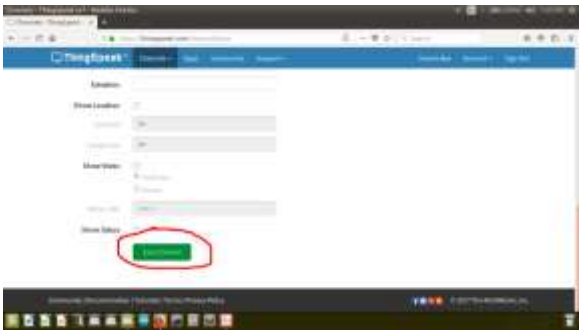
Step 2.1: Create New Channel

Click on New Channel



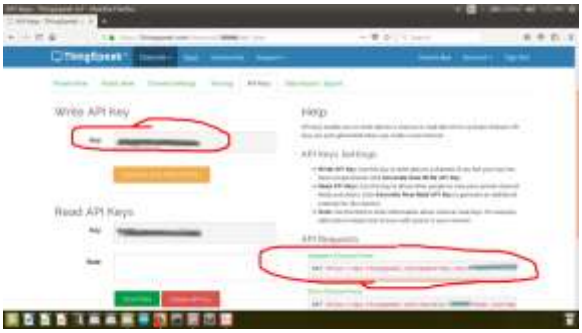
Enter Name and Field. You may have multiple Fields depending on number of sensor create multiple fields such as Light, Temperature, Humidity, etc.

Keep everything else as it is. Blank or default values. and click on Save
Channel.



Step 2.2: Getting API Key

Click on API Key Tab and look for these two fields Write Api Key and Update channel feed line.



Step 4: Check Data on ThingSpeak Server

Open Your ThingSpeak Account and Click on Private View of Your Channel

5. PROJECT DESCRIPTION

The project utilizes "Thingspeak" Server on the Cloud to receive data from the sensors. The messages are transferred from the Arduino using ESP8266 in the form of Graphs.

. BLOCK DIAGRAM:

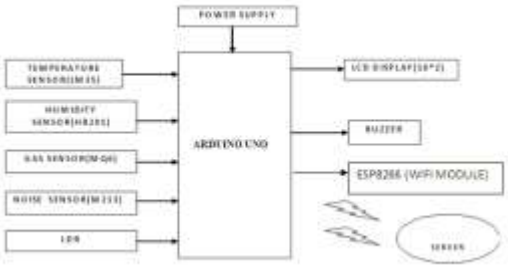


Fig 6.1 Block diagram

SOFTWARE REQUIREMENTS:

- ARDUINO IDE
- THINGSPEAK SERVER

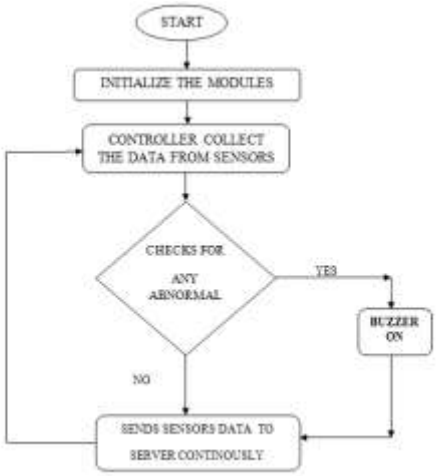
HARDWARE REQUIREMENTS:

1. NODEMCU 32S
2. LDR
3. TEMPERATURE SENSOR (LM35)
4. HUMIDITY SENSOR (HR 201)
5. GAS SENSOR (MQ 6)
6. NOISE SENSOR (M213)
7. POWER SUPPLY
8. 16*2 LCD DISPLAY
9. BUZZER
10. RESISTORS
11. CAPACITORS
12. VOLTAGE REGULATOR (7805)

WORKING:

In this Project, we are using 5 sensors for the Industrial Pollution Monitoring. We are utilizing 5 sensors, MQ-6 as a gas sensor. It identifies the convergence of carbon monoxide in air. To gauge the vacillations in commotion levels we use M213 high affectability mouthpiece sensor module. LM35 is utilized as a temperature sensor and H203 as moistness sensor. To gauge the force of light LDR sensor is utilized. The Micro controller Used in this Project is NodeMcu 32S .To exchange the information Over an Internet we are utilizing Arduino which has easy Access to ESP8266. The information from these sensors is put away in the cloud. Subsequent to handling, through hotspot internet browser will get some information about IP address, by putting IP address page will make that enables us to screen the framework . We can screen the parameters on cell phones just as pc or workstation.

FLOW CHART:



6. CONCLUSION

The IoT concept can be applied to a wide range of application and this project is an attempt to diminish the problem of cost and regular inspections by the utility of IoT in Industrial pollution monitoring and control. For alleviating these problems, Arduino with Wi-Fi is used. The attainment and robustious of the industrial pollution monitoring and control system is Implemented by sensors for controlling dust, noise, smoke, moisture and other parameters, thereby improving the industrial and natural environment. This system contributes quick response rate and the diffusion of the critical situation can be made faster than the manual methods.

7. REFERENCES

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