# IOT Based Basement Ventilation Automation And Monitoring System

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***Abstract-*** *Industrialization increases the degree of automation then it increases pollution by releasing pollutants into the atmosphere. There should be a system to monitor and assess the industrial pollution in basement of high rise buildings. Specific attention is given to the factors, which affects the health of living organisms and Ecosystem. Industrial pollution monitoring is that the collection of information at different locations of industries and at regular intervals of your time in order to supply the info which can be wont to define current conditions. Due to the complexity of parameters large variations are found between different industries. The proposed system aims in building basements a strong system that can measure the economic pollution and help to scale back it and to decrease human interference in monitoring the economic pollution and supply a healthy environment for the workers to work in. The system evaluates the industrial Pollution continuously and indicates when there's a rise within the emissions and takes action to control it using wireless technology Internet of things.*

***Keywords*-** Basement ventilation, IoT, Microcontroller, Automation.

## I. INTRODUCTION

The terms monitoring and assessment are frequently confused and used synonymously. The method of commercial quality assessment is an evaluation of the industrial quality in reference to standard quality set by pollution control board. Thanks to the complexity of things determining industrial quality, large variations are found between different industries. Similarly, the response to industrial impacts is also highly variable. To design an Industrial machine control and monitoring system using IoT. Surveillance is the most important security systems in home, industrial, office and public places. To build a strong system which will measure the industrial pollution and help to scale back it and to decrease human interference in monitoring the economic pollution to scale back pollution and supply a healthy environment for the workers to work in. To build a strong system that evaluates the industrial pollution continuously and indicates when there is an increase in emission and controls it using IoT. Ventilation

Systems for car parks and service areas are required to realize two objectives. Firstly, when the parking lot or topographic point is generally use, it's important that the exhaust gases produced by vehicles are effectively removed which there are no pockets of stagnant air. Secondly, in the event of a fire, assistance needs to tend to the hearth service to clear smoke from the parking lot during and after the fire. Such Ventilation Systems may additionally be designed to supply clear smoke-free access for fire-fighters to tackle the seat of the hearth, or alternatively to guard means of shake the parking lot. Car Park Ventilation System uniquely positions jet fans and extract fans to move contaminated air to extract points, eliminating the necessity for expensive distribution ductwork within the car park.

## II. RELATED WORKS

Most of the proposed basement ventilation systems are automated mechanical ventilation. The already existing traditional system isn't a sensible one, it just senses gases and expels it out. It only detects the CO gas produced by the cars and better gas formation doesn't intimate to the security department. Most of the ventilation fans and ventilators are supported timer system thanks to power consumption. Mechanical fans drive mechanical ventilation. Fans are often installed directly within the windows or walls, or installed in air ducts for supplying air into, or exhausting air from, a room. the sort of mechanical ventilation used depends on climate . for instance , in warm and humidity climates, infiltration may have to be minimized or on the prevented areas to scale back interstitial condensation (which occurs when warm, moist air from inside a building penetrates a wall, roof or floor and meets a chilly surface). In these cases, a positive pressure mechanical ventilations s is usually used system. Conversely, in cold and winter climates, ex-filtration must be prevented to scale back in interstitial condensation, and negative pressure ventilation is employed . For an area with locally generated pollutants, like a toilet , toilet and kitchen, within the negative pressure system is usually used. during a positive pressure system, the space is in positive pressure and therefore the room air is leaked out through envelope leakages or other openings. during a negative pressure system, the space is in

negative pressure, and therefore the room air is compensated by "sucking" air from outside. A balanced mechanical ventilation refers to the system where air supplies and exhausts are tested and adjusted to satisfy design specifications. the space pressure could also be maintained at either slightly positive or negative pressure, which is achieved by using slightly unequal supply or exhaust ventilation rates. for instance , the slight negative room pressure is achieved by the exhausting 10% more air than the availability during a cold climate to attenuate the likelihood of interstitial condensation. In an airborne precaution room for infection control, a minimum negative pressure of two .5 Pa is usually maintained relative to the corridor (CDC, 2003) given.

## III. PROPOSED SYSTEM

To achieve this basement ventilation system, we gone for mechanical ventilation type system based on automation with two way monitoring section, by LCD display and for monitoring and for maintenance section the IOT platform is used. The basement ventilation system will occurs high power consumption, our system will greatly reduces the power consumption. The most of existing system will act under timer system for power consuming. But we modified the power consuming techniques ,Such as: Gases like CO, CO2, O2, methane and other flammable and toxic gases according to the location and atmosphere of high rise buildings and industries and according to these gas levels, the ventilators will generates in automation. Based on air quality the ventilation systems are generates on automation. The temperature and humidity will be maintained by DHT22 sensor by sensing their levels, according to the sensor values the ventilators and exhauster and cooling fans will act on automation. The levels of temperature, humidity, air quality, CO, CO2, O2, methane, toxic and other gases can be monitor in LCD display for public awareness, which will be displayed in entrance of building basement. The levels of temperature, humidity, air quality, CO, CO2, O2, methane, toxic and other gases can be monitor using IoT platform in website. IoT monitoring website link address: iot-dhironics.com/fabsys/bva iot/ .The vehicle count using IR reflection sensor can be monitor in website for pollution control and for maintenance sector. The fire and safety is improved in alarm, red alert and water spray system at roof mount in basement is modified in proposed system. First, when the car park or service area is in general use, it is important that the exhaust gases produced by vehicles are effectively removed and that there are no pockets of stagnant air. Second, in the event of a fire, assistance needs to be given to the fire service to clear smoke from the car park during and after the fire.. Such Ventilation Systems in addition be designed to provide clear smoke free access for fire fighters to tackle the seat of the fire, or alternatively to

protect means of escape from the car park. When fire occurs in basement, the fire will be exhausted and water spray system will be ON. When fire is detected, it will be monitored in website for fire and safety department section.
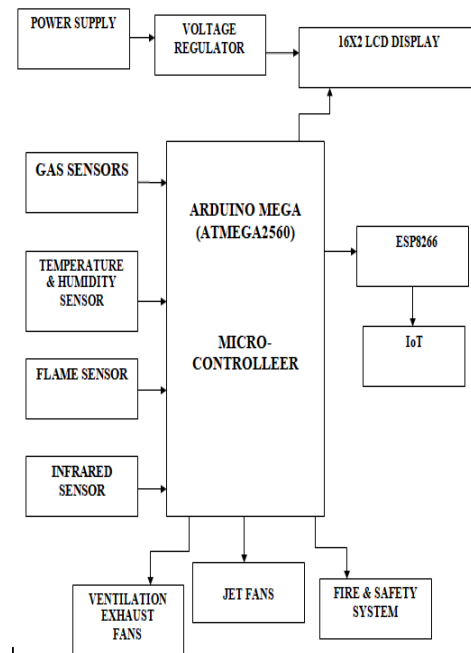
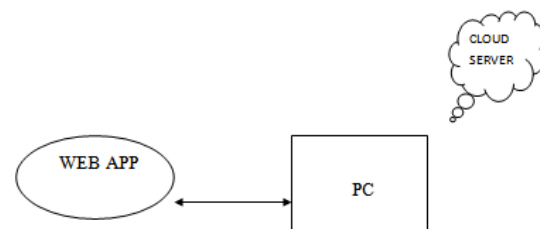## 1. Block Diagram



Fig.1   Hardware section



Fig.2   Monitoring Webpage Section

## III. HARDWARE DESCRIPTION

### 1. Arduino

The Arduino Mega 2560 R3 is an open source precise microcontroller board Successor to the Arduino Mega based on the ATmega2560 SMD chip. The Mega 2560 R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Mega 2560 R3 works with all existing shields but can adapt to new shields which use these

additional pins. This Board has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), 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. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with DC adapter or battery to get started. The Mega 2560 R3 board is compatible with most shields designed for Arduino/Genuino Uno and the former boards Duemilanove or Diecimila.



Fig.3 Arduino Microcontroller

## 2. IR Sensor

An infrared sensor is adevice that emits so as to sense some aspects of the environment. An IR sensor can measure the heat of an object also as it detects the motion. These sorts of sensors measure only infrared, instead of emitting it that's called as a passive IR sensor. Usually within the spectrum, all the objects radiate some kind of thermal radiations. These sorts of radiations are invisible to our eyes, which will be detected by an infrared sensor. The emitter is just an IR LED and therefore the detector is just an IR photodiode which is sensitive to IR light of an equivalent wavelength as that emitted by the IR LED., The resistances and the output voltages will change in proportion to the magnitude of the IR light which is received when IR light falls on the photodiode . The emitter is an IR LED and thus the detector is an IR photodiode. The IR photodiode is responsive to the IR light which is emitted by an IR LED. The photodiode's resistance and output voltage as change in proportion to the IR light received. This is the underlying working rule of the IR sensor. When the IR transmitter emits radiation, it reaches the thing and a few of the radiation reflects back to the IR receiver. The output of the sensor defines based on the intensity of the reception by the IR receiver.
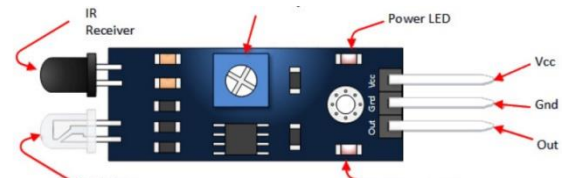


Fig.4   IR Sensor

## 3. Temperature Sensor

A temperature sensor may be a device, typically, a thermocouple or RTD,that gives for temperature measurement through an electrical signal. A thermocouple is formed from two various types of metals that generate electrical voltage in directly proportional to change in temperature. The LM35 series are preciseness integrated circuit temperature devices with an output voltage linearly or equally proportional to the celcius temperature. The LM35 device has a gain over linear temperature sensors calibrated in Kelvin, because the user isn't required to subtract an outsized constant voltage from the output to obtain appropriate Centigrade scaling. LM35 device doesn't require any external calibration or trimming to supply typical accuracies of $\pm\frac{1}{4}°C$ at temperature and $\pm\frac{3}{4}°C$ above a full $-55°C$ to $150°C$ temperature range. When the low output impedance, linear output, and precise inherent calibrates the LM35 device. The LM35 device makes interfacing to readout or control circuitry mostly easy. LM35 could also be a precision IC temperature sensor with its output proportional to the temperature (in $°C$). The sensor circuitry is sealed and therefore it's not exposed to oxidation and other processes. With LM35, temperature is often measured more accurately than with a thermistor. It also possesses low self-heating and doesn't cause quite 0.1 $°C$ temperature rise in still air.



Fig.5   Temperature Sensor

## 4. Humidity Sensor

A humidity or hygrometer sensor senses, calculates and describes the report of the ratio within the air. It therefore measures both moisture and air temperature. Relative humidity is that the ratio of actual moisture within the air to the very best amount of moisture which will be held at that air temperature. A humidity sensor senses and measures both the moisture and air temperature. The sensor consists of two metal plates and it has a nonconductive polymer film between the metal plates. This film collects moisture from the air, which causes the voltage between the 2 plates to vary . These voltage changes are converted into digital readings showing the extent of moisture within the air.
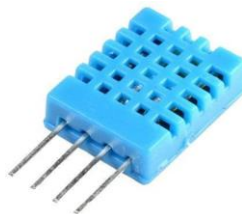


Fig.6  Humidity Sensor

## 5. WiFi

WiFi or Wireless networking may be a technology for wireless local area networking with devices supported the IEEE 802.11 standards. WiFi could also be a trademark of the WiFi Alliance, which restricts the utilization of the term WiFi Certified to products that successfully complete interoperability certification testing. WiFi most commonly uses the two .4 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands. Having no physical connections, it's more vulnerable to attack than wired connections, like Ethernet. On the technical side, WiFi usable wireless devices, including wireless routers and wireless access points are enables the communications through the IEEE 802.11 standard. Wireless access points support different types of IEEE standards in which each standard is an amendment that was ratified by given extra time. The standards operate varying frequencies, deliver different bandwidth, and support different numbers of channels.
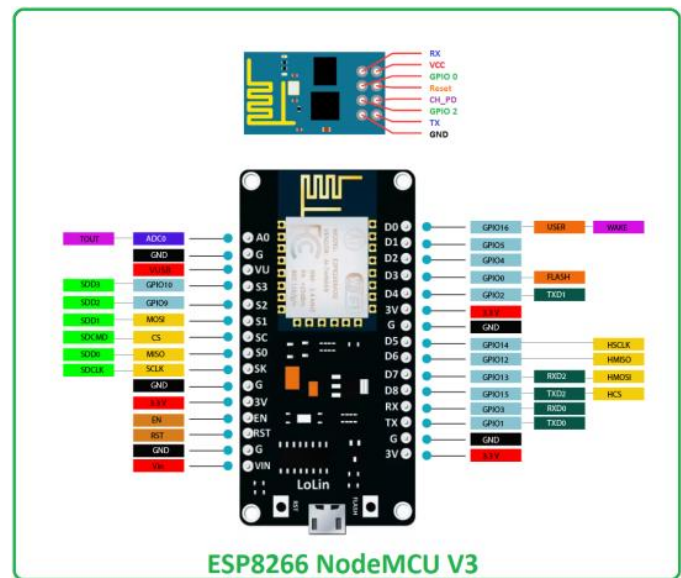


Fig.7 WiFi module

## 6. Power supply unit

A power supply unit converts mains AC to the low voltage regulated DC power for the internal parts of a computer. Modern personal computers globally use switched mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage. A power supply is used to reduce the mains electricity at 240 volts AC down to something more usable , say 12 volts DC. There are two sorts of power supply, linear and switch mode. A linear power supply uses a transformer to scale back the voltage. The AC signal is rectified and regulated to produce a high DC voltage. An AC adapter, AC/DC adapter, or AC/DC converter is a type of external power supply, often enclosed in a case similar to an AC plug. Adapters for battery powered equipment could also be described as chargers or rechargers (see also battery charger). AC adapters can be used with electrical devices that need power but don't contain internal components to derive the specified voltage and power from main power. The internal circuitry of an external power supply is extremely almost like the planning that might be used for a built in or internal supply.

Fig.8 Adapter



Fig.9 Gas sensors

## 7. GAS SENSORS

Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration. Gas sensors are employed in factories and manufacturing facilities to identify gas leaks, and to detect smoke and carbon monoxide in homes. Gas sensors vary widely in size (portable and fixed), range, and sensing ability. They are often part of a larger embedded system, such as hazmat and security systems, and they are normally connected to an audible alarm or interface. Because gas sensors are constantly interacting with air and other gasses, they have to be calibrated more often than many other types of sensors. Depending on their intended environments and functions, the physical makeup and sensing process can vary notably between sensors. One of the most commonly used gas sensors for toxic identification and smoke detection is the metal oxide based gas sensor. This type of sensor employs a chemiresistor which comes in contact and reacts with target gasses. Metal oxide gas sensors increase their electrical resistance as they come into contact with gasses such as carbon monoxide, hydrogen, methane, and butane. Most home based smoke detection systems are oxide based sensors.
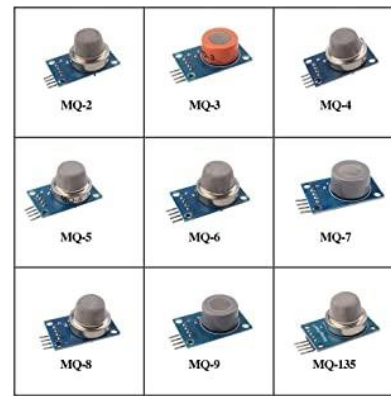
## 8. LCD DISPLAY

LCD DISPLAY LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. Flat-Screen LCD and plasma screens work in a completely different way. In a plasma screen, each pixel is a tiny fluorescent lamp switched on or off electronically. In an LCD television, the pixels are switched on or off electronically using liquid crystals to rotate polarized light Fig .5.8 16X2 LCD Display 32 LCD stands for liquid crystal display. They come in many sizes 8x1 , 8x2 , 10x2 , 16x1 , 16x2 , 16x4 , 20x2 , 20x4 ,24x2 , 30x2 , 32x2 , 40x2 etc . Many multinational companies like Philips Hitachi Panasonic make their own special kind of LCD'S to be used in their products. All the LCD'S performs the same functions (display characters numbers special characters ASCII characters etc).Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15). Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc.
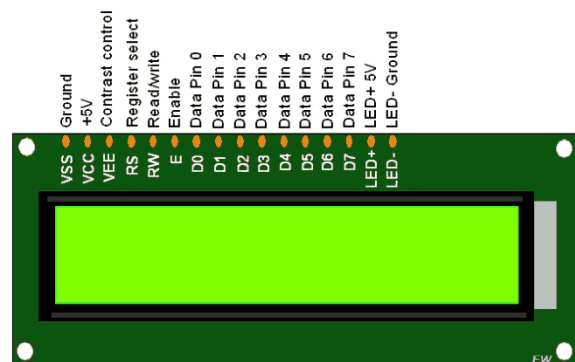


Fig.10 LCD DISPLAY

## 9. FIRE & SAFETY SYSTEM

This system includes flame detection sensor, buzzer for alarm, red alert LED and water spraying pump. An automatic fire alarm system comprises a receiver, automatic sensors, manual transmitters, sound devices, fire doors, fire shutters, smoke shutters, and network devices to which they are connected. The receiver is installed in a fire protection center or management office within the building. It receives signals from the sensors if a fire breaks out, and controls such things as the display of indications of where the outbreak occurred and the sounding of audible alarms such as bells or voice messages. The receiver also supplies power to the system as a whole. It normally operates on the AC 100V power supply, but it is equipped with a backup power supply in case of a power failure. Receivers are classified into two types: P and R. Figure below shows an example type-R receiver and peripheral system.
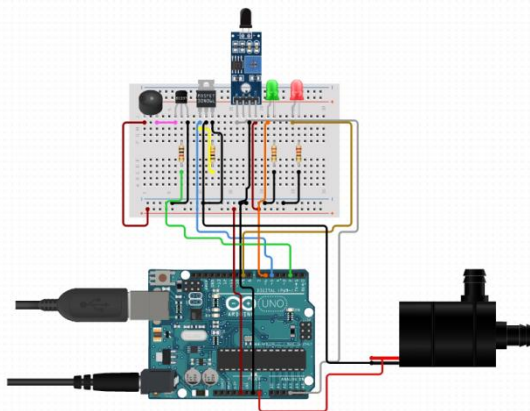


Fig.11 Fire & Safety system

## 10. VENTILATION AND EXHAUSTING FANS

DC FAN DC Brushless cooling fans have a long history of being an effective method of cooling electronic circuits. Today, DC brushless cooling fans are found in new applications and are being evaluated by engineers that may not have previously used fans in their products. These engineers may not be familiar with all of the "undocumented features" that are inherent to these types of fans. 50 If the engineer is not familiar with all the characteristics of air moving devices, they could be in for a nasty surprise. Fan manufacturers typically specify the nominal speed of the fan, as well as an operating voltage range. Fig .5.17 DC Fan A DC fan is a device used for cooling purpose in many systems. When a supply is given to a device it starts rotating. The direction of the fan can be changed by reversing the supply. DC or direct current fan works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. The fan has a DC brushless motor, with an operating voltage of 5V, and is rated at 360mA. Keeping the temperature down in your project can often be a necessity, and this fan can definitely help. When

designing the electronics that interface to a DC brushless cooling fan, it is critically important to be aware of this behavior. The fan has a DC brushless motor, with an operating voltage of 5V, and is rated at 360mA. Keeping the temperature down in your project can often be a necessity, and this fan can definitely help. When designing the electronics that interface to a DC brushless cooling fan, it is critically important to be aware of this behaviour.
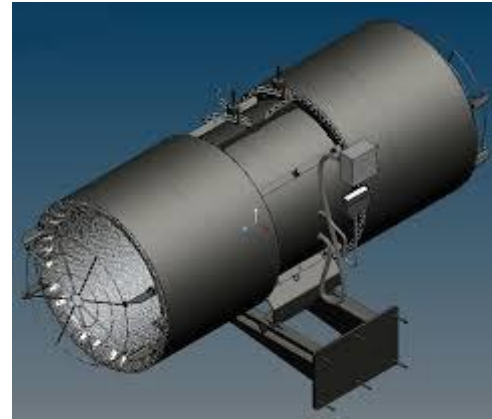


Fig.12 ventilation and exhausting fans

## IV. SOFTWARE DESCRIPTION

### 1. Embedded C Programming

Embedded C is an attractive programing language in software field for developing electronic gadgets. Each processor utilized in electronic system is related to embedded software. Embedded C programming plays a essential role in performing certain function by the processor. In day today life we used many electronic devices like mobile , washer , camera , etc. These all device working is predicated on microcontroller that are programmed by embedded C. It is also preferred over other languages due to the following reasons such as easy to understand, high reliability, portability and scalability. The C language programming is meant for function with variables, list , data types, keywords, expression then on are used for writing a C program . The extension in C language is understood as embedded C programing language . As compared to above the embedded programming in C is additionally have some additional features like data types, keywords and header file etc. It is extended to deal with the commonality issues that exist between C extensions for various embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language so as to support exotic features like fixed point arithmetic, multiple distinct memory banks, and basic I/O operations. Modern embedded systems are often supported microcontrollers (i.e. CPU's with integrated memory), but ordinary microprocessors (using external chips for memory)

also are common, especially in more complicated systems. In either case, the processor(s) used could also be types starting from general purpose to those specialized in certain class of computations, or maybe bespoke for the appliance at hand. A common standard class of dedicated processors is that the digital signal processor (DSP). Since the embedded system is assigned to a specific tasks, design engineers can improvise it to scale back the dimensions and cost of the merchandise and increase the reliability and performance. Some embedded systems are produced in large scale, therefore taking advantage of economies of scale.

## 2. Arduino IDE

The Arduino Integrated Development Environment or Arduino Software (IDE) , has contains a text editor for code writing, a message area, a control and switches of a text, a toolbar with buttons for common functions and a sequence of menus. It connects to the Arduino hardware to sync programs and communicate with them. The sketches are which uses Arduino software to write programs. These sketches are written within the text editor and it is saved with the file called extension.ino. The editor has features like cutting or pasting and also for searching or replacing text. The message area sends feedback while saving and sending and also shows errors. The console displays text output like overall error messages and other information by the Arduino Software (IDE). The configured board and interface are shown at the bottom right hand corner of the window display. The toolbar buttons permit you to verify and upload programs, create, open, and save sketches, and open the serial monitor. On Mac, the link is perhaps something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Key span USB board to Serial adapter). On Windows, it's probably COM1 or COM2 for a serial board or COM4, COM5, COM7, or higher for a USB board  to seek out and to search for USB serial device within the ports section of the Windows Device Manager. On Linux OS, it should be /dev/ttyACMx , /dev/ttyUSBx or similar. Once you've selected the right interface and board, press the upload button 50 within the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and start the upload. With older boards (preDiecimila) that lack auto reset, you will need to press the push button on the board just before starting the upload. On most boards, you will see the RX and TX LEDs blink because the sketch is uploaded. The Arduino Software (IDE) will displays a message like when the upload is complete, or shows a error and mistake.

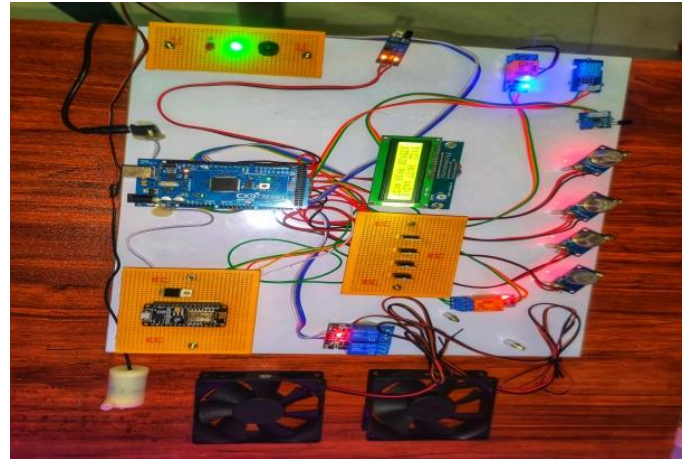## V. RESULT AND DISCUSSION



Fig. 13 Hardware setup view

This hardware contains microcontroller unit such as Arduino 2560 and node MCU Wi-Fi controller. Mq-135, Mq-9, Mq4, Co2 Sensor, ventilator and jet Exhaust Fans, Dht12d, Relay, Water Pump, Ir Sensor, LCD Display, Power supply Unit, Buzzer, Connecting Wires, Red Led and the whole system works as basement ventilation automation and IoT monitoring system. Automated basement ventilation systems would reduce the power consumption largely .power consumption would also help to cost reduction in power management .It will make more smarter than compared to existing one. These mechanical ventilators will reduce the man power by 50%, because of IoT monitoring system with improved fire and safety. Our proposed system will makes a pollution awareness for people by displaying the air quality, temperature and humidity and co, methane etc., .These technology should be implemented in the PLC because the real – time application of basement ventilation automation is high voltage device set-up .The maintenance department of this system man power completely reduced, however the development is increased the technology of the high rise buildings.

Fig.14 IoT monitoring in website

If the basement ventilation is power ON, then the data of the hardware contains gas sensors, temperature sensor, flame detection date and car entries can be monitored by monitoring management.

## VI. CONCLUSION

The IOT based pollution monitoring and controlling using Arduino system is designed to sense the smoke, temperature, and gases present in basements. If any pollution is detected then the facility supply of that industry will stop. This will prevent further emissions of pollution. This is a strong system which is extremely useful in industries due to the increasing pollution due to increase in industries. The results of this project are accurate and hence are often implemented in any industries for the security of workers and the environment. Each and each industry whether small scale or large scale should and must have this technique to watch the emissions. This system contains sensors that detect the parameters causing pollution. Whenever there's a rise within the level of those parameters the sensors sense the situation then, it sends as a message to authorized person through GSM. The authorities of monitoring management can cut off the power supply of the polluting industry through IOT. This system is operate through the wireless system using the concept of IoT technology.

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