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# Design and Development of Online Environment Monitoring System

Subhadeep Sen\*, Swarnil Roy, Kamalendu Langal, Dr. Sudip Dogra

Assistant Professor, 700084, India

\**subhadeep0977@gmail.com, roy.swarnil@gmail.com, kamalendulangal@gmail.com, dogra.sudip@gmail.com*

**Abstract:** Environment is a very important factor in almost every field starting from human survival to any working field. In this work, we are introducing a system which can be used to monitor environmental details. This system is based on Internet of Things (IoT) which makes it a location independent system and can be accessed from any part of the world via internet. This proposed system can give the details of temperature, humidity, pressure, altitude and presence of flammable gas in a particular location. Not only that, it can be further modified according to the needs of environmental details. As this system can be controlled from internet, one can remotely monitor the sensor details and if the values cross a threshold limit, necessary actions can be taken immediately.

**Keywords:** Arduino UNO R3; ethernet shield; DHT11; MQ-6; BMP180.

## 1 INTRODUCTION

Sometimes it becomes very difficult for one to sit in front of a system and monitor the output details if the environment is not suitable for human, especially in the field of research work where human cannot go or in the manufacturing industry where it is tough for a human to be present there and get the details. In those cases our developed system is very useful to get the details of environmental factors. Even if, one wants to get the readings of sensors in his home, that is also possible. This system works on the principle of internet communication. Hence multiple users can get the readings/details at the same time in different locations of the world through internet.

This paper is organized as follows: In section II, Internet of Things (IoT) is described in brief. Section III describes the design and operation of the system. In section IV, we have described the technical details of the developed prototype system.

In section V, the applications of the system are mentioned. We concluded with section VI.

## 2 INTERNLET OF THINGS (IoT)

By the name one can easily define IoT as ‘Things’ which are connected to internet. Here ‘Things refer to the devices and everyday objects, from small ones (like wrist watch) to really big ones (like robots, cars). No matter what definition one may find about Internet of Things, the main concept behind every IoT technology and implementation is the same: devices are integrated with the virtual world of internet and interact with it by sensing and monitoring objects and their environment (Fig. 1).

The features of a device that can act as an IoT are as following:

- Collect information by sensing the environment and transmit those data to a different device.

- It can be programmed to control other devices.
- It must be able to receive information from the network it belongs to.
- It must assist in communication between other nodes of the same network.

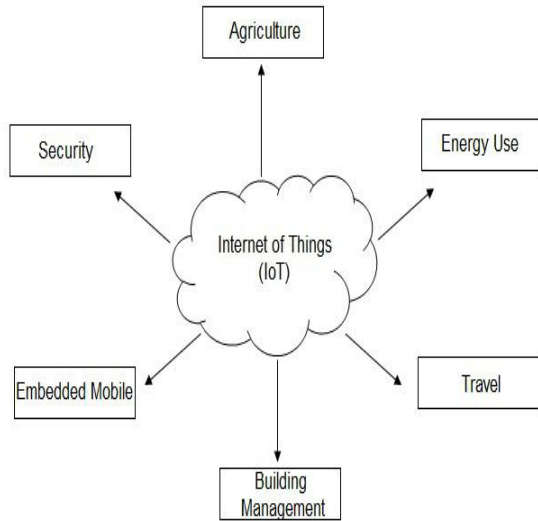


Fig. 1. Internet of Things.

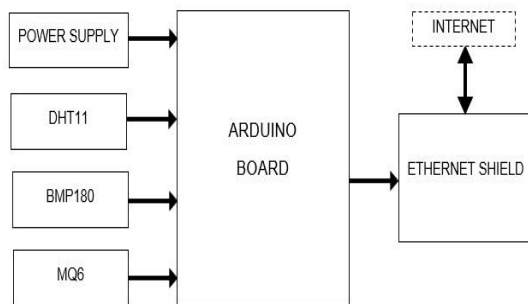


Fig. 2. Block diagram of the system.

### 3 DESCRIPTION OF THE SYSTEM

In our designed prototype, there are three sensors, DHT11 (Temperature and Humidity sensor), MQ-6 (Flammable gas sensor) and BMP180 (Barometric pressure sensor). The block diagram of our developed system is shown in Fig. 2. And flowchart in Fig. 3. The DHT11 sensor senses the temperature and humidity of the external environment and gives the data input to the CPU of the system. The MQ-6 sensor senses the presence of flammable gas in the environment and BMP180 senses the barometric pressure & altitude and they all provide the necessary data input to controller. These data are then processed by the CPU and converted into percentage. With the processes data, HTML code for the web browser is sent to the internet using Ethernet shield. Now if one opens the link for the system in web browser, it will display the readings of the sensor according to

formatted output defined by the HTML code. Thus one can monitor the results from any part of the using internet connection and the link for the system.

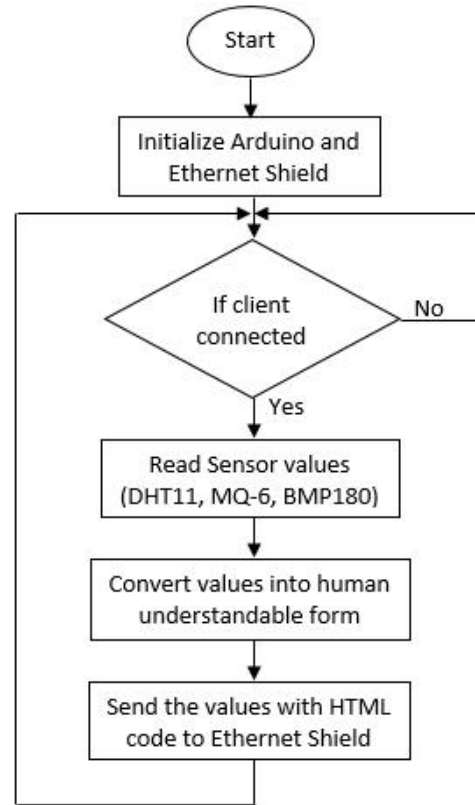


Fig. 3. Flowchart.

#### 3.1 Working Principle

- When the power is on, the system initialize itself by setting the configurations of ethernet shield, serial communication interfaces.
- Then the system waits for connection originating from a client.
- If it finds any client connected with the system, then it starts to read data from the sensors from analog channels of the Arduino.
- Now it converts that values coming from the sensors into human understandable form (percentages).
- When the data are ready, it sends these data with the HTML code for displaying data on web browser, to ethernet shield.
- The ethernet shield now sends the HTML code along with the data to the web browser of the connected client.
- Until when the client is available, it reads the sensors and repeat the aforesaid process.

- The page will automatically refresh itself after 3 seconds to display the current read data.

#### 4 IMPLEMENTATION OF THE SYSTEM

To implement the basic prototype of this system, we have used Arduino UNO R3 development board, Ethernet shield, and DHT11, MQ-6 & BMP180 sensors. The basic building block diagram of the system is already shown in Fig. 2. The coding of this system has been done in Arduino IDE (C Language) and for the coding of HTML, notepad++ has been used.

##### 4.1 Arduino UNO R3

Arduino [1] is an open source platform for developing project prototypes. It has ATmega328p microcontroller as CPU. This board is capable of handling both analog and digital devices and it features serial communication interfaces, including Universal Serial Bus (USB) for loading programs from personal computers. The arduino development that we have used in our prototype is shown below (Fig.4).

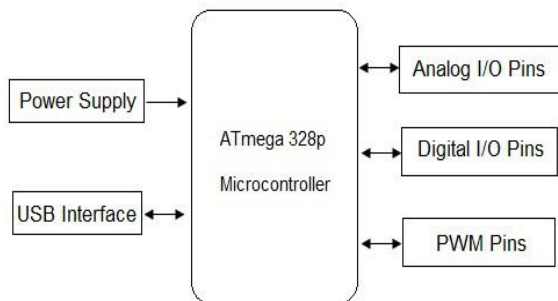


Fig. 4 .Arduino UNO R3 board.

##### Specifications:

- On board voltage regulator
- Operating voltage is 5V
- Operating frequency 16 MHz
- 14 digital I/O pins, of which 6 are PWM pins
- 6 ADC channel (10 bits)
- 32KB flash memory (0.5KB for boot loader)
- 2 KB SRAM memory
- 1KB internal EEPROM
- Programmable Serial USART
- Master/Slave SPI Serial interface
- I2C interface
- Programmable watchdog timer with separate on-chip oscillator.

##### 4.2 Ethernet Shield

The Arduino Ethernet Shield [2] allows an Arduino Board to connect to the internet. It is based on the Wiznet W500 ethernet chip with 16K buffer. The

Wiznet provides a network (IP) stack capable of both TCP and UDP. The shield (Fig. 5) has a standard RJ45 connector. It communicates with Arduino using the SPI bus. The latest version of the shield has on board micro-SD card slot. The on board reset button resets both Arduino and ethernet shield. The shield contains a number of informational LEDs:

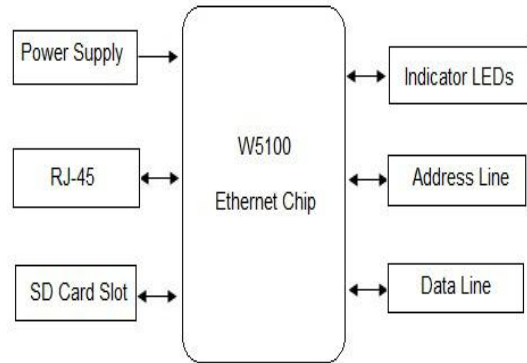


Fig. 5. Ethernet shield.

- PWR: indicates that the board and shield are powered.
- LINK: indicates the presence of network link and flashes when the shield transmits or receives data.
- FULLD: indicates that the network is full duplex.
- 100M: indicates the presence of a 100 Mbps network connection (as opposed to 10 Mbps)
- RX: flashes when the shield receives data
- TX: flashes when the shield sends data
- COLL: flashes when network collisions are detected.

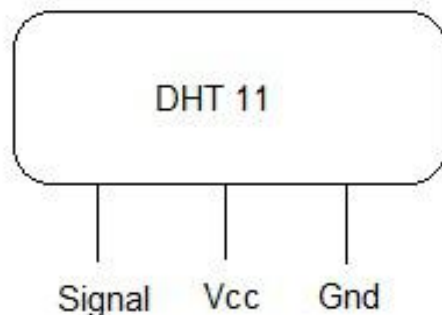


Fig. 6. DHT11 sensor.

##### 4.3 DHT11

The DHT11 [3] sensor (Fig. 6) is a Temperature and Humidity sensor in a single package. It includes a resistive-type humidity measurement component and an NTC temperature measurement component. By using the digital-signal-acquisition technique and temperature & humidity sensing

technology, it ensures high reliability and long term stability. It provides single-bus data communication interface. One communication process is about 4ms.

**4.4 MQ-6**

Sensitive material of MQ-6 [4] gas sensor (Fig. 7) is SnO<sub>2</sub>, which has lower conductivity in clean air. When there combustible gas exists, the sensor's conductivity is become higher along with the gas concentration rising. Change in conductivity corresponds to the output signal of gas concentration.

MQ-6 gas sensor has higher sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane. It is low cost device and suitable for different application.

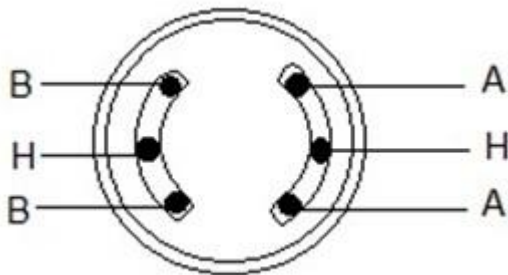


Fig. 7. MQ-6 gas sensor.

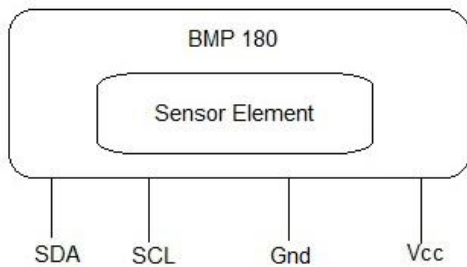


Fig. 8. Barometric pressure sensor (BMP180)

**4.5 BMP180**

The BMP180 [5] is a high precision digital pressure sensor and based on piezo-resistive technology. It has high accuracy and linearity as well as long term stability. It provides a standard I2C bus interface for connection with other system. The pressure and temperature data has to be compensated by the calibration data of the EEPROM of the BMP180 (Fig. 8). It consists of a piezo-resistive sensor, an analog to digital converter and a control unit with EEPROM and a serial I2C interface.

**4.6 Notepad++**

It is a very flexible platform to write HTML code for designing webpages. The web page of our prototype system has been designed using notepad++. Having the basic knowledge of web development, one can easily design the basic web page for displaying data on it. For the update of data, read by the sensors, the refresh rate of the page has been kept 1 sec.

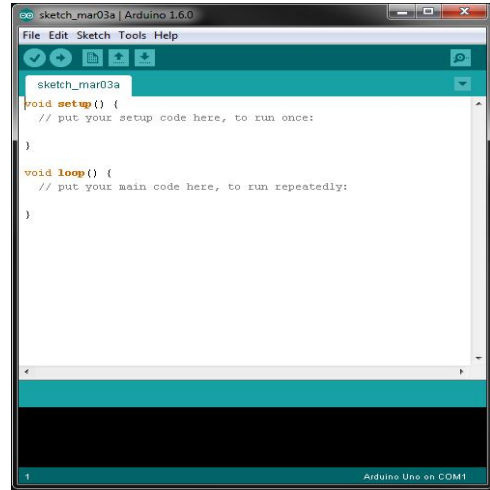


Fig. 9. Arduino IDE.

**4.7 Arduino IDE**

Arduino IDE (Fig. 9) provides an integrated development environment for writing C language especially for embedded system developed with Arduino boards. Since it supports C language, one can easily develop the code with having the basic knowledge of C Programming Language. One can also use the header files for the ease of development. The syntax and programming procedure is almost similar to C. Our developed system reads the analog values (using the library function analogRead (channel)) of the sensors from the ADC channel of Arduino which provides digital data. Then these digital data are translated into voltages using mathematical calculation. Finally these values voltages are converted into a form of information (percentages) that human can easily understand. With all these information, the HTML code for the webpage is sent to Ethernet shield which then transmit all to internet. Photograph of developed system is given in figure 10. Snap of one sample web page output is given in figure 11.

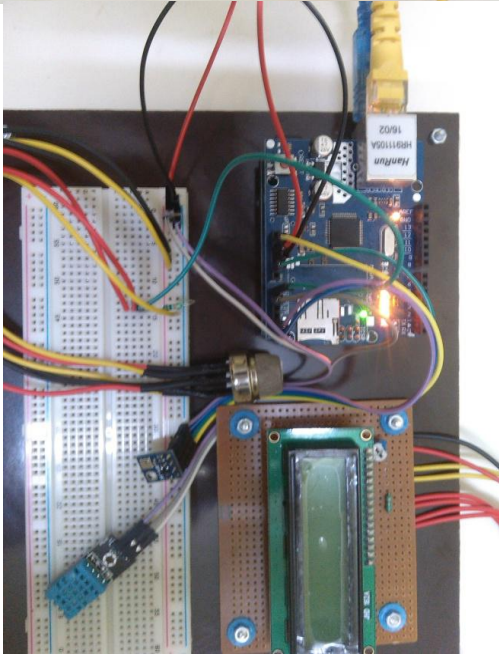


Fig. 10. Photograph of the developed system.

## 5 APPLICATIONS OF THE SYSTEM

This system has a tremendous potential to be used in places where environment monitoring is necessary. It can be used in small applications such as home environment monitoring as well as in large

[6]

application such as industrial environment observation or in places where environment is hostile and human being cannot reach by sending the system using bot. Not only that, as the keeps the scope of further development, one can easily changes the configuration according to the needs.



Fig. 11. Web Page

## 6 CONCLUSION

The system developed by us can be modified /upgraded by using other sensors as per need. This system can be used to monitor the weather parameters of a particular location which can be very useful for the farmers of that location to decide their action during growth of their crops. These location specific data can also help farmers and national level government agencies to make planning of cultivation. If this system is deployed nationwide along with GPS system, the farmers can get realtime weather/environment information of particular location through internet.

## REFERENCES

- [1] Arduino:<https://en.wikipedia.org/wiki/ArduinoSIM900>
- [2] EthernetShield:<https://www.arduino.cc/en/Main/ArduinoEthernetShield>
- [3] DHT11:[www.micropik.com/PDF/dht11.pdf](http://www.micropik.com/PDF/dht11.pdf)
- [4] MQ-6:[https://www.sparkfun.com/data\\_sheets/Sensors/Biometric/MQ-6.pdf](https://www.sparkfun.com/data_sheets/Sensors/Biometric/MQ-6.pdf)
- [5] BMP180:[https://www.adafruit.com/datasheets/BST-BMP180\\_DS000-09.pdf](https://www.adafruit.com/datasheets/BST-BMP180_DS000-09.pdf)