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IOT BASED REAL TIME WEATHER MONITORING SYSTEM

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Abstract - Here we propose a savvy climate revealing framework over the web. Our proposed framework considers climate parameter detailing over the web. It permits the individuals to straightforwardly check the climate details online without the need of a climate estimating agency. System utilizes temperature, stickiness just as downpour sensor to screen climate and give live announcing of the climate statistics. The framework continually screens temperature utilizing temperature sensor, moistness utilizing dampness sensor and furthermore for downpour. The framework continually transmits this information to the microcontroller, which currently forms this information and continues transmitting it to the online web server over a Wi-Fi association. This information is live refreshed to be seen on the online server framework. Additionally, framework permits client to set alarms for specific examples, the framework gives cautions to client if the climate parameters cross those qualities. In this way the IOT based climate announcing framework gives a productive web-based climate revealing framework for users. This framework additionally proposed the dirt moistness observing framework to gauge dampness in soil and updates charts on thinkspeak.

Keywords: Internet of things (IOT), WIFI module, GSM module, Temperature sensor, humidity by using DHT11 sensor, raindrop sensor, soil moisture sensor, carbon monoxide (CO) sensor, LDR.

I. INTRODUCTION

Present-day technological advances focus mainly on controlling and tracking various devices over

the internet wirelessly, so that the internet serves as a conduit for contact between all users. Much of this technology is based on tracking and managing various items more effectively. An efficient environmental monitoring system is required for monitoring and assessing weather conditions in the event of exceeding the prescribed parameter level (e.g., noise, CO and radiation levels) and for collecting data for research purposes (amount of rainfall, wind speed, etc.).

A system is considered a smart system when the computer fitted with sensors, microcontrollers and various software applications becomes a self-protecting and self-monitoring system. The two categories to which applications are classified are Event Detection and Spatial Process Estimation. Initially, the sensor devices are installed in the atmosphere to detect the parameters (e.g., temperature, humidity, strain, LDR, noise, CO and radiation rates, etc.) when collecting, processing and monitoring data (e.g., noise and CO variance in the quantified level). Sensor sensors are placed to collect the data at different locations to predict the activity of a specific area of interest.

The main aim of this paper is to design and implement a resourceful monitoring system through which the necessary parameters are remotely monitored via the Internet and the data collected from the devices are stored in the cloud and the predictable trend is projected on the web browser. This paper proposes a solution for monitoring temperature and CO levels, i.e. any parameter value that crosses its threshold value ranges, e.g. CO levels in air in a particular area exceeding normal levels, etc. The software also offers smart remote monitoring for a specific area of interest. In this paper we also present results of collected or sensed data regarding the natural or defined ranges of specific parameters. The embedded system is an aggregation of sensor tools,

wireless communication that allows the user to access the different parameters remotely and store the data in cloud.[2&4].

II. LITERATURE

Many pollution monitoring systems in today's world are designed according to different environmental parameters. IOT-based weather monitoring and reporting system presents the existing system model where you can collect, process, analyze and present your measured data on the web server. Wireless sensor network management model consists of end device, router, gateway node and management monitoring center.[6].End device is responsible for collecting wireless sensor network data, and sending them to parent node, then data are sent to gateway node from parent node directly or by router. After receiving the data from wireless sensor network, gateway node extracts data after analyzing and packaging them into Ethernet format data, sends them to the server. Less formally, any computer running server software might also be called a server. Servers are used to manage resources within the network. The Internet-based services or information that are linked via LAN and made accessible to users via smartphones, web browsers, or other web browser devices to make the system smarter, more adaptable and more efficient. [1&3].

III. SYSTEM SETUP

(A)Components required: Hardware:

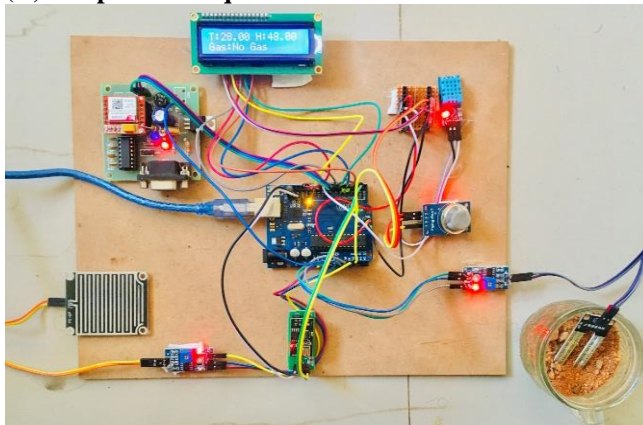


Figure1.Hardware

3.A1.ARDUINO:

It is an open-source physical platform based on a simple micro-controller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches and or sensors, controlling a variety of lights, motors, and other physical outputs.

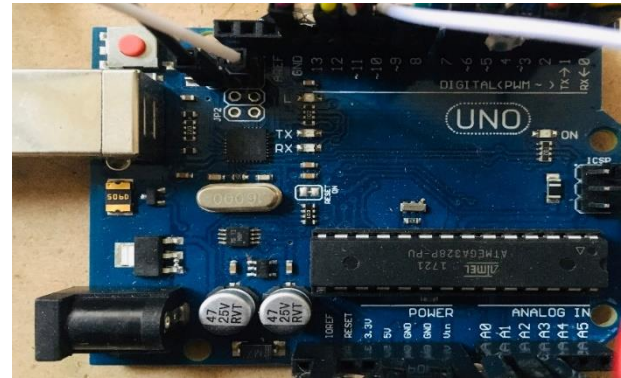


Figure2.Arduino kit.

1. Microcontroller: Microchip ATmega328Pga328P
2. Operating Voltage: 5 Volt
3. Input Voltage: 7 to 20 Volts
4. Digital I/O Pins: 14 (of which 6 provide PWM output)
5. Analog Input Pins: 6
6. DC Current per I/O Pin: 20 mA
7. DC Current for 3.3V Pin: 50 mA
8. Flash Memory: 32 KB of which 0.5 KB used by bootloader
9. SRAM: 2 KB
10. EEPROM: 1 KB
11. Clock Speed: 16 MHz
12. Length: 68.6 mm
13. Width: 53.4 mm
14. Weight: 25 g

3.A2.NodeMCU:

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP12 module.



Figure3.Node MCU

1. Type: single board microcontroller
2. Operating system: XTOS
3. CPU: ESP8266
4. Memory: 128 Kbyte
5. Storage: 4Mbytes
6. Power: USB

3.A4. Carbon monoxide(co) sensor:

Carbon Monoxide (CO) sensor, suitable for sensing CO concentrations in the air. The MQ-7 can sense CO-gas concentrations anywhere from 20 to 2000ppm. This sensor has a high sensitivity and fast reaction time. The sensor's output is an analogue resistance. [6].

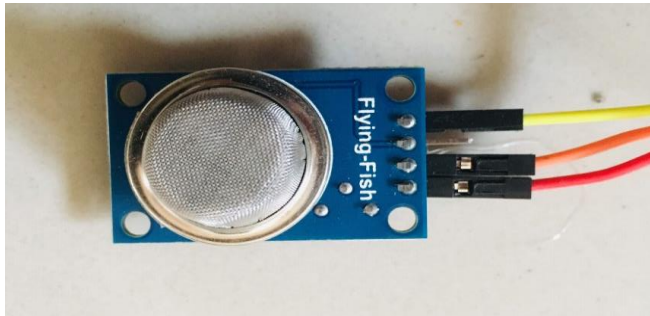


Figure4. CO sensor.

Symbol	Parameter	Technical condition
Tao	Using temperature	-20°C-50°C
Tas	Storage temperature	-20°C-50°C
RH	Relative humidity	Less than 95% RH
O2	Oxygen concentration	21% (stand condition) the oxygen concentration can affect the sensitivity characteristic

Table1. Specifications of Parameters

1. Standard working Temperature: 20°C±2°C
2. Relative humidity: 65%±5%
3. RL: 10K Ω ±5%
4. Detecting range: 20ppm-2000ppm carbon monoxide

3.A5.DHT11:

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity instrument and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). [5].

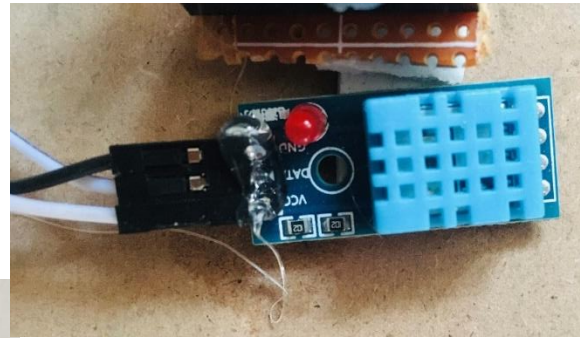


Figure5.DHT11.

1. Temperature range: 0°C-50°C / ±2°C
2. Humidity Range: 20°C-80°C / ±2°C
3. Sampling rate: 1Hz (one reading every second)
4. Body size: 15.5mm*12mm*5.5mm
5. Operating voltage: 3-5V
6. Max current during measure: 2.5mA

3.A6.RAIN DROP SENSOR:

The rain sensor module/board is shown below. Basically, this board includes nickel coated lines and it works on the resistance principle. This sensor module permits to gauge moisture through analog output pins & it gives a digital output while moisture threshold surpasses. The pin configuration of this sensor is shown below. This sensor includes four pins which follows

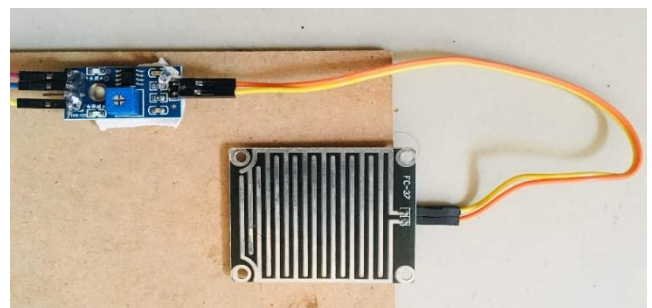


Figure6.RAIN DROP SENSOR.

- Pin1 (VCC): It is a 5V DC pin
- Pin2 (GND): it is a GND (ground) pin
- Pin3 (DO): It is a low/ high output pin
- Pin4 (AO): It is an analog output pin

Specifications

- Adopts high quality of RF-04 double sided material
- Area: 5cm x 4cm nickel plate on side
- Anti-oxidation, anti-conductivity, with long use time
- Comparator output signal clean waveform is good, driving ability, over 15mA
- Potentiometer adjust the sensitivity
- Working voltage 5V

- Output format: Digital switching output (0 and 1) and analog voltage output AO
- With bolt holes for easy installation
- Small board PCB size: 3.2cm x 1.4cm
- Uses a wide voltage LM393 comparator

3.A7.SOIL MOISTURE SENSOR:

Soil moisture is basically the content of water present in the soil. This can be measured using a soil moisture sensor which consists of two conducting probes that act as a probe. It can measure the moisture content in the soil based on the change in resistance between the two conducting plates. The resistance between the two conducting plates varies in an inverse manner with the amount of moisture present in the soil.[5].

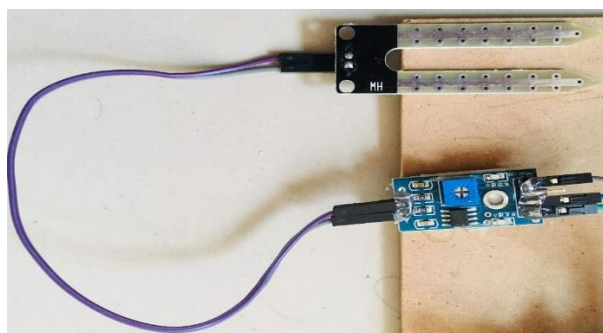


Figure7. Soil moisture sensor:

- VCC pin is used for power
- A0 pin is an analog output
 - D0 pin is a digital output
 - GND pin is a Ground

Specifications

- The required voltage for working is 5V
- The required current for working is <20mA
- Type of interface is analog
- The required working temperature of this sensor is 10°C~30°C

3.A8.GSM 800L:

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board LED displays connection state (no network coverage - fast blinking, logged in - slow blinking).

This module have two antennas included. First is made of wire (which solders directly to NET pin on

PCB) - very useful in narrow places. Second - PCB antenna - with double sided tape and attached pigtail cable with IPX connector. This one have better performance and allows to put your module inside a metal case - as long the antenna is outside.[6].



Figure8.GSM 800L.

Specifications:

- Supply voltage: 3.8V - 4.2V
- Recommended supply voltage: 4V
- Power consumption:
 - sleep mode < 2.0mA
 - idle mode < 7.0mA
 - GSM transmission (avg): 350 mA
 - GSM transmission (peek): 2000mA
- Module size: 25 x 23 mm
- Interface: UART (max. 2.8V) and AT commands
- SIM card socket: microSIM (bottom side)
- Supported frequencies: Quad Band (850 / 950 / 1800 / 1900 MHz)
- Antenna connector: IPX
- Status signalling: LED
- Working temperature range: -40 do + 85 ° C

(B). Components required: Software:

3.B1. ARDUINO INTEGRATED DEVELOPMENT ENVIRONMENT (IDE):

Arduino is an open-source prototyping platform in electronics based on easy-to-use hardware and software. Subtly speaking, Arduino is a microcontroller based prototyping board which can be used in developing digital devices that can read inputs like finger on a button, touch on a screen, light on a sensor etc. and turning it in to output like switching on an LED, rotating a motor, playing songs through a speaker etc. Arduino is based on open source electronics project i.e. all the design

specifications, schematics, software are available openly to all the users. Hence, Arduino boards can be bought from vendors as they are commercially available or else you can make your own board by if you wish i.e. you can download the schematic from Arduino's official website, buy all the components as per the design specification, assemble all the components, and make your own board.[4].

IV. METHODOLOGY

(A). MEASURED PARAMETERS:

4.A1.RAIN DROP SENSOR:

Rain drop sensor is basically a board on which nickel is coated in the form of lines. It works on the principle of resistance. When there is no rain drop on board. Resistance is high so we get high voltage according to $V=IR$. When rain drop present it reduces the resistance because water is conductor of electricity and presence of water connects nickel lines in parallel so reduced resistance and reduced voltage drop across it.

4.A2.SOIL MOISTURE SENSOR:

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This sensor can be connected in two modes; Analog mode and digital mode. First, we will connect it in Analog mode and then we will use it in Digital mode.[5].

4.A3.CARBON MONOXIDE (CO-7) SENSOR:

Sensitive material of MQ-7 gas sensor is SnO₂, which with lower conductivity in clean air. It makes detection by method of cycle high and low temperature, and detects CO when low temperature (heated by 1.5V). The sensor's conductivity is more higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases

contains CO, it is with low cost and suitable for different application.[6].

4.A4.DHT 11 SENSOR:

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form. For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers. The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.[4].

(B). DISPLAY HARDWARE:

It has 16 pins and the first one from left to right is the Ground pin. The second pin is the VCC which we connect the 5 volts pin on the Arduino Board. Next is the Vo pin on which we can attach a potentiometer for controlling the contrast of the display. Next, The RS pin or register select pin is used for selecting whether we will send commands or data to the LCD. For example if the RS pin is set on low state or zero volts, then we are sending commands to the LCD. We use this register to insert a command into the LCD. These commands can be things like telling the LCD to clear the screen, set the cursor, move to line 1, move to character 1, etc. Here's the table of all the commands that you can send to the LCD.[6].



Figure9.LCD.

(C). ARDUINO PROGRAM:

The proposed Embedded device is for monitoring Temperature, Humidity, rain fall, soil moisture levels and CO levels in the atmosphere to make the environment intelligent or interactive with the objects through wireless communication. The proposed model consists of 4-tiers.

- 1 Tier 1 provides information about the parameters under the region which is to be monitored for noise and air pollution control.
- 2 Tier 2 deals with the sensor devices with suitable characteristics, features and each of these sensor devices are operated and controlled based on their sensitivity as well as the range of sensing.
- 3 Tier 3 describes about the data acquisition from sensor devices and also includes the decision making. Which specify the condition the data is representing which parameter
- 4 Tier 4 deals with the intelligent environment. Which means it will identify the variations in the sensor data and fix the threshold value depending on the identified level of CO or noise levels. In this tier sensed data will be processed, stored in the cloud i.e.in to the Google spread sheets and also it will show a trend of the sensed parameters with respect to the specified values. The end users can browse the data using mobile phones, PCs etc.

V. IMPLEMENTATION

(A). Thingspeak:

5.A1. Initial Setup with ThingSpeak with Arduino:

Before start sending data to ThingSpeak from the Arduino board sensors, users are needed Arduino board with network connection either built-in Wi-Fi module or manual Wi-Fi connection set-up. For achieving this ThingSpeak provides library files for Arduino versions 1.6.x or above running on any versions Linux or Windows or Mac series. These library files are needs to be installed in Arduino devices before start communication between ThingSpeak and Arduino board.

5.A2. Setup ThingSpeak

In order to perform operations in ThingSpeak tool, every user must have an user account and a channel. In ThingSpeak, channel is treated most important because through this only sensor data is sending and storing. Through each channel user can

utilize maximum 8 fields,3 location fields and 1 status field. For every 15 seconds user can send data to ThingSpeak and this delay time is customizable.

- For first time users open <https://thingspeak.com> website for registration and signup
- After successful registration create your own channel by selecting Channels, next click My Channels, and then New channel.
- Write down separately Write API Key and Channel ID for coding purposes.

5.A3.Install ThingSpeak Communication Library for Arduino

Open the Arduino IDE from the menu choose Sketch option then select Include Library from the list select Manage Libraries. It opens library manager window in that select ThingSpeak Library from the list and press Install button.

5.A4.Setup Arduino Sketch

Open the Arduino IDE software basically it is having few Arduino sketch examples with the ThingSpeak library. They are primarily help to work right away with no changes. If you want to work with built-in examples of ThingSpeak channel, you will need to configure the myChannelNumber and myWriteAPIKey variables.

For example:

```
unsigned long myChannelNumber = 31461;  
const char * myWriteAPIKey  
="LD79EOAAWRVY04Y"
```

(B). IOT:

The final result of each module status will be shown in the window named as serial monitor.

5.B 1.Rain fall sensor status:

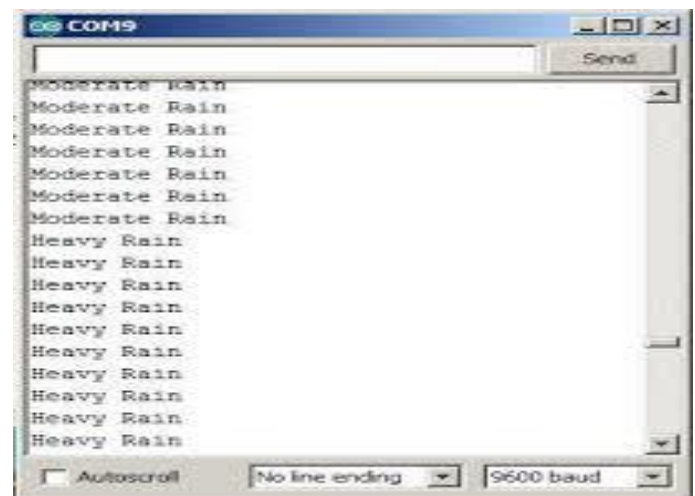


Figure10.Rain fall serial monitor.

5.B2. Temperature and humidity status :

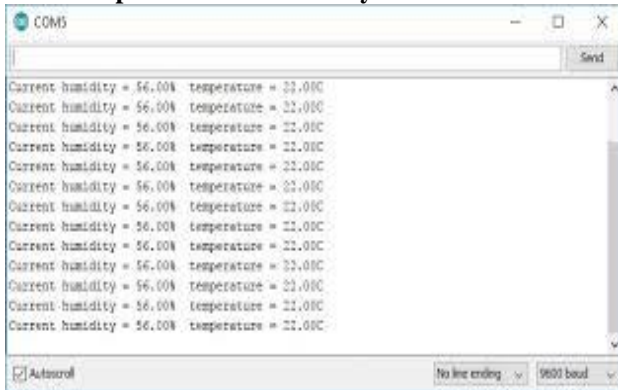


Figure11. Temperature and Humidity serial monitor.

5.B3. Soil moisture status :

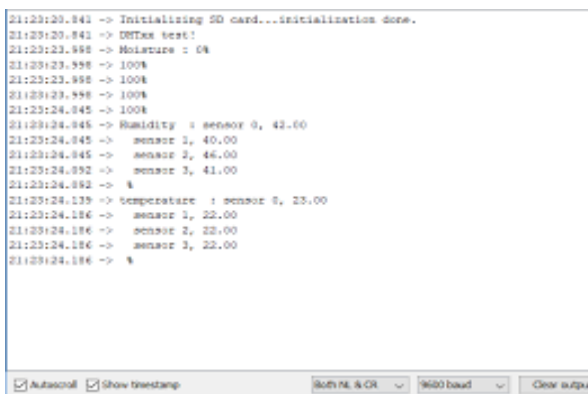


Figure12. Soil moisture serial monitor.

VI. RESULTS

In this portion, the Result of the Proposed work is depicted with the help of snapshots. The main data analysis tool ThingSpeak consists of various type of charts, we can easily find out different types analysis values like maximum or minimum temperature and humidity, high or low rainfall, high or low moisture in soil, gas levels.

(A). Graphical Results.

6.A1. Humidity

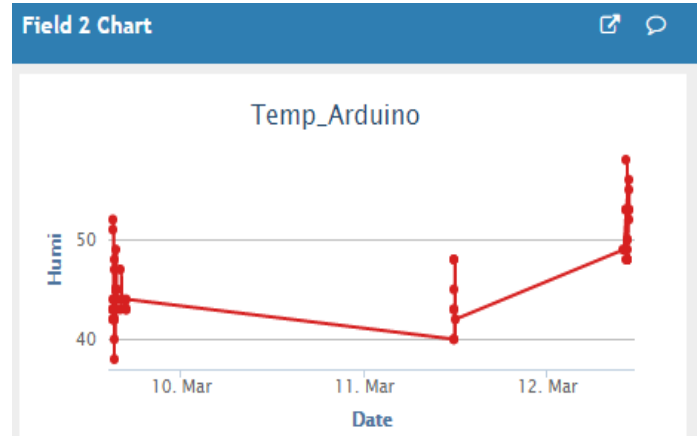


Figure 13: Humidity analysis of using built-in ThingSpeak MATLAB.

6.A2. Temperature

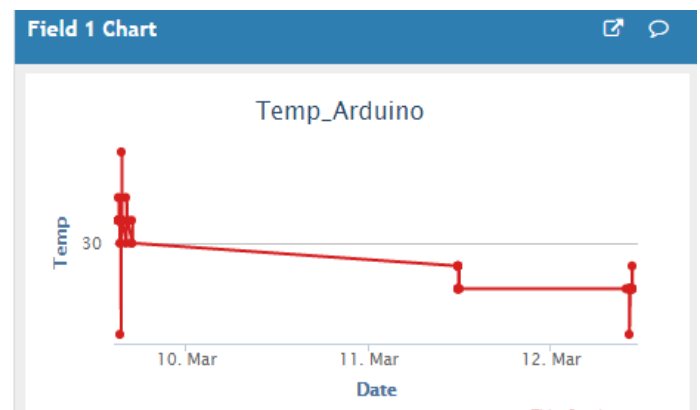


Figure 14: Temperature analysis of using Built in ThingSpeak MATLAB.

6.A3. Rain fall

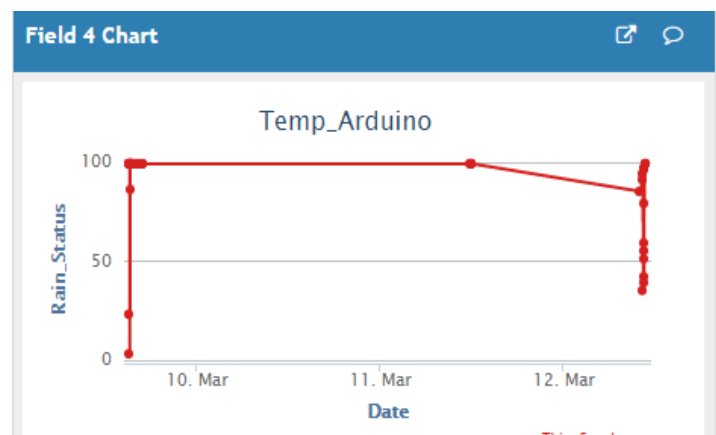


Figure 15: Rain status analysis of using Built in ThingSpeak MATLAB.

6.A4. Water level

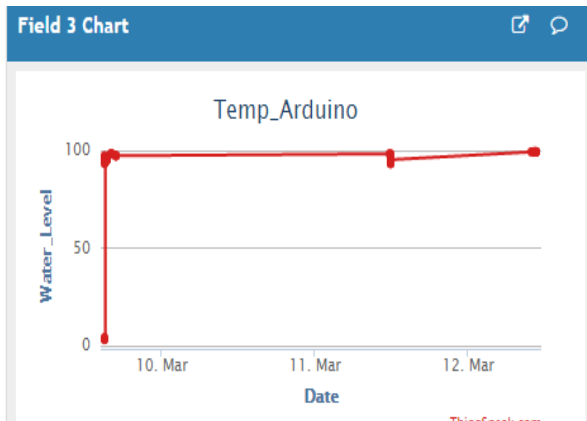


Figure16: Water level analysis of using Built in ThingSpeak MATLAB.

6.A5.Gas level

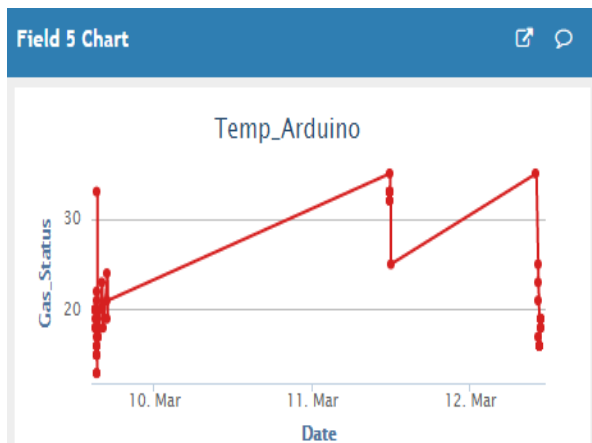


Figure17: Gas status analysis of using Built in ThingSpeak MATLAB.

(B).LCD RESULTS:

6.B1.Rainfall status indication:



Figure18.Rain fall display.

6.B2.Temperature and humidity status indication:

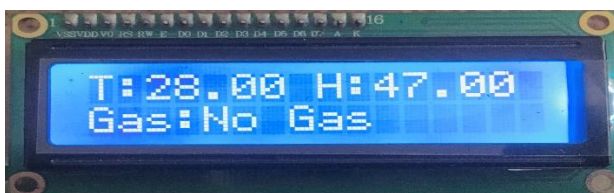


Figure19.Temperature and Humidity display.

6.B3.Soil moisture level indication:



Figure20.Soil moisture display.

VII. CONCLUSION

Through having the sensors embedded for monitoring in the system, the system can be self-protected (i.e., smart environment). To incorporate this need to deploy the sensor systems to collect the data and analyze in the environment. We can put the world into real life by installing sensor devices in the world, i.e. it can communicate with other artifacts over the network. Then the data collected and the results of the analysis will be available via Wi-Fi to the end user. This system presents the smart way to track the environment and an effective, low-cost embedded device with various models. There was discussion of roles of different modules in the proposed architecture. The temperature, soil moisture, rain fall intensity, humidity levels, CO levels with the definition of Internet of Things (IoT) experimentally tested two criteria for control. It also sent parameters for the sensor into the cloud (thingSpeak). This data can aid in future research and can easily be shared with other end-users.

VIII. FUTURE SCOPE

One can implement a few more sensors and connect it to the satellite as a global feature of this system.

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- One can implement a few more sensors and connect it to the satellite as a global feature of this system.
- Wireless transmission of the output data directly to the user using Bluetooth.
- Agriculture monitoring system can also be interfaced with solar energy production module. This can eradicate the problems of lack of electricity in remote areas.
- The future work may also include some other protocol that can send messages even in offline mode or airplane mode.
- In aircraft, navigation and military there is a great scope of this real-time system.
- It can also be implemented in hospitals or medical institutes for the research & study in “Effect of Weather on Health and Diseases”, hence to provide better precaution alerts.

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