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AN IOT BASED ENVIRONMENTAL MONITERING SYSTEM WITH ARDUINO BASED SENSOR

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Abstract:- *The Internet of Things (IoT) is assuming an imperative part in our day by day lives all together to accomplish assignments by in corporating the utilization of sensor networks including our current circumstance. The frameworks created to notice the actual inclination that makes information furthermore, the made information is put away in the cloud. The put away data is then used for planning applications for controlling important activities. This paper describes the application and experimentation of a framework made out of sensors for checking temperature and stickiness of the zone encompassing. This noticed data is used to perform transient activities, for example, controlling the electronic contraptions for warming or cooling that takes additional time. The recorded information is stacked to cloud for capacity and further accessed through an Android application and showcases the results to the versatile clients. The system introduced in this paper utilized Arduino UNO board, DHT11 sensor, soil moisture sensor, ESP8266 Wi-Fi module, which makes data to open IoT based API organization Thing Speak through which it is examined and kept aside. An Android application is made which gets to the cloud also, shows results for end-customers through REST API Web organization. The exploratory outcomes shown demonstrate the adequacy of the framework.*

KEYWORDS: Internet of Things, Arduino UNO, DHT11 Sensor, Soil moisture sensor, WiFi, Environmental Monitoring.

1. INTRODUCTION

The improvement of Internet of Things (IoT) has profoundly changed the world through the utilization of electronic sensors and a few such gadgets for controlling and checking climate at basic circumstances. These sensors and remote gadgets are fit for detecting, putting away and communicating information to store into consistent pools remotely namely a cloud consequently dissects and presents required information in a manner to endure the reason for the end client. This data in the cloud is accessible to various end clients gave through an interface for a few portable applications according to the necessity. Web assumes a significant part in this change for a viable, solid and quick change of information from gadgets to the cloud and to the end-clients. The idea driving this model is that an end framework comprises number of gadgets or things at the host end, in this way the title "Web of Things". The gadgets alluded to the things are fit for performing exercises like detecting and transmission of data like temperature, stickiness, contamination rates etc. The idea of IoT is successfully applied where the manual inclusion isn't much of the time conceivable like natural checking. Environmental monitoring applications require transient data as input through which necessary controlling actions are responded by the system through sensors like remote controlling. This paper provides the details of implementation and experimentation results of an environmental monitoring system. The proprietary component of the system is the Arduino UNO board that acts as an interface by accepting temperature and humidity as input readings obtained via monitoring sensor DHT11 and the output obtained by sensing the data is transmitted through ESP8266Wi-Fi module to remote cloud storage open IoT API Thing Speak. With the help of Thing Speak, MATLAB analysis is carried out about the data and generates a trigger. A mobile application is designed for an Android operating system where data is extracted from Thing Speak which would be displayed from any part in the world. The application developed is a low-cost economical system that insights the implementation of a complete IoT application involving several actions namely sensing and wireless transmission to store in cloud and information extraction from the cloud via the developed application. This paper also presents a detailed study of the deployment of Arduino board along with its interfacing of input and output modules implemented by employing sensors and Wi-Fi module, the utilization of Thing Speak open-source API and ends with the demonstration of the application. The experimental results provided at the end of this paper shows the monitoring and statistical analysis of temperature and humidity levels from any location in the world. This implementation of this application can be further extended to enable remote controlling of appliances through sensing data.

2. RELATED WORKS

Recently, Internet of Things is an emerging technology that acquired the most likely interest at both investors and innovation goliaths, bringing about an overflow research exercises which may prompt numerous business activities. There are a ton of utilizations that could be created utilizing Internet of Things which will be a section in planning metropolitan urban areas. These

applications incorporate savvy framework, brilliant city, shrewd wearable gadgets, and keen home. Every one of these applications establish sensors and transducers generally embedded in a microcontroller alongside wired or remote transmission incorporated with either a nearby data set or to a far off cloud that translates input information into helpful data which can be used in a proficient way. The research in the field of IoT App advancement through creating savvy gadgets by means of carrying out remote innovations, planning sheets, empowering network conventions, creating web applications to give some examples.

The execution some portion of this paper achieves the new improvement with regards to IoT through planning a versatile based application in a lesser expense by utilizing sheets like Raspberry Pi and Arduino. These sheets have effectively taken its shape in the improvement of uses like home robotization, patient observing frameworks, and climate and ecological checking frameworks. In the paper[1], estimations of temperature, dampness, light power, gas spillage, ocean level, and downpour force are thought of and the info is transmitted remotely through Thing Speak utilizing Arduino UNO kept up utilizing MATLAB. Creators in paper[2] additionally have observed ecological conditions specifically temperature, relative moistness, light force and CO2 level utilizing sensors and LPC2148 microcontroller where the information was again shipped off the Thing Speak cloud. Interestingly, this paper is executed with Arduino UNO building up the framework which is easy to understand, ease and less unpredictable to process maller applications. Creators in [3] portrayed an IoT based application to screen ongoing climate utilizing Raspberry Pi which is troublesome contrasted with Arduino because of Python language and Raspbian working framework. In paper[4], creators planned climate observing framework fusing Arduino to import information from different sensors. The equivalent is introduced in[5], that incorporates planning and advancement a remote sensor network framework utilizing Raspberry Pi and Arduino by utilizing a Xbee module to carry out the IEEE 802.15.4 norm for information assortment from different sensor hubs at a base station (Raspberry Pi). The creators in [5] referenced that their venture can likewise be applied for bigger applications, regardless of in the current situation, the framework needs cloud network.

3. EXPERIMENTAL SETUP

3.1 HARDWARE DESIGN

Arduino UNO is the central unit which acts as the main processing unit for the whole system. This is interfaced with the sensor chip to receive temperature and humidity as input readings. There by, integrated with the Wi-Fi module to produce output over receiving data from cloud. The microcontroller then initiates the sensor to recieve data and transmit over the Internet via ThingSpeak cloud for further analysis.

3.2 MICROCONTROLLER

The main part of the framework is the microcontroller, a focal equipment part that interfaces with different segments of the framework. As the creating application requires a solitary sensor for checking temperature and stickiness where no information is privately put away, Arduino UNO is chosen as microcontroller which fills our need well because of its effortlessness, heartiness and ease. This microcontroller board is created on ATmega328P involving 14 advanced info/yield pins, 6 simple information sticks, a USB association, 16 MHz quartz precious stone, a force jack, and a reset button. The microcontroller gets power through a battery, and carried out utilizing Arduino IDE (Integrated Development Environment) by means of a kind B USB link.

Figure1: Arduino UNO

3.3 SENSOR (DHT11)

The execution in this paper is performed utilizing s single sensor to screen temperature and humidity for natural observing. This intention is presented with the DHT11 composite sensor chip, thus is remembered for the framework for understanding temperature and stickiness simultaneously. The out rating trademark highlight of this sensor is its high unwavering quality and long haul steadiness. This is additionally famously utilized on the grounds that this is exceptionally prudent with more modest measurements, fast reaction, solid enemy of obstruction capacity, advanced sign yield, and exact alignment. Likewise this is effectively interfaced with the Arduino UNO board. The figure shows an image of the DHT composite sensor which we utilized in our system. It can peruse temperature going from 0 to 50°C and dampness goes from 20 to 90%RH. It has a sign transmission scope of 20m. To interface it with Arduino UNO, we associated the Ground and VCC of the DHT11 sensor with the Ground and 5V of the Arduino. At that point we associate the Data pin of the DHT11 to stick 2 of the Arduino. At that point we introduced the DHT library and run the code for kicking it off.

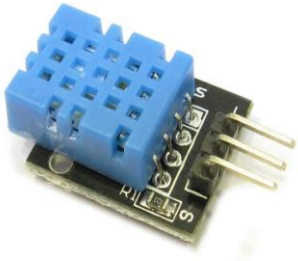

Figure2: SENSOR (DHT11)

3.4 SOIL MOISTURE SENSOR

In this article, we are going to interface a Soil moisture sensor FC-28 with Arduino. This sensor measures the volumetric content of water inside the soil and gives us the moisture level as output. The sensor is equipped with both analog and digital output, so it can be used in both analog and digital mode.

Figure3: Soil Moisture Sensor

3.5 WIFI MODULE

To transfer sensor readings from DHT11 to the open source cloud ThingSpeak, Arduino UNO interfaces at the yield with Wi-Fi module ESP8266. It is a minimal effort Wi-Fi microprocessor with a full TCP/IP stack. It chips away at the 3.3V that is given by Arduino UNO in our framework. The module is arranged through AT orders and needs the necessary grouping to be utilized as a customer. The module can fill in as both customer and worker. It gets an IP on being associated with Wi-Fi through which the module and afterward imparts over the Internet. Subsequent to testing our ESP8266 module, we associated it with Arduino UNO and afterward modified Arduino UNO to design the ESP8266 Wi-Fi module as TCP customer and send information to ThingSpeak worker which is an open IoT stage to imagine and investigate live information from sensors.

Figure4: WiFi Module

3.6 HARDWARE BLOCK DIAGRAM

The below figure picturizes the essential equipment block graph for our framework. The figure portrays about the progression of the framework usefulness where DHT11 gives live record estimations of temperature and humidity parallelly to the microcontroller which moves these qualities to ThingSpeak through the Wi-Fi module.

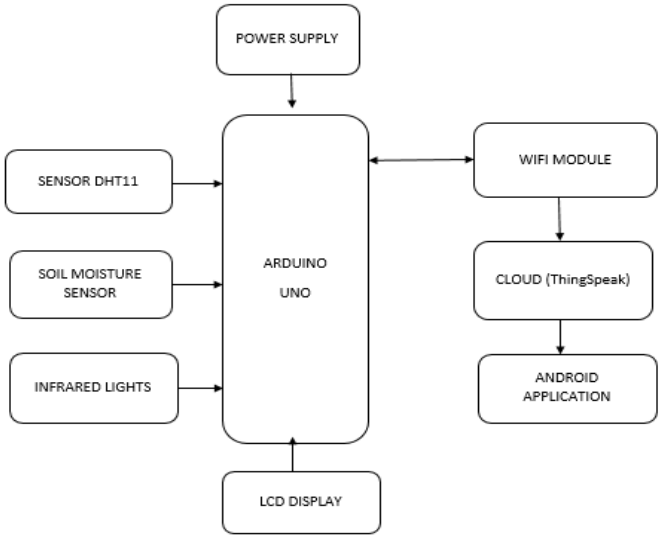

Figure5: Hardware Block Diagram

4. SOFTWARE IMPLEMENTATION

5. Software plays as a key role in functioning of hardware

5.1 Software for Initialization and Configuration of Hardware

Arduino works to gather data from sensors and transfer data to cloud. Assimilation can be done in later stages after examination of hardware elements. Initially AT commands were used in desired pattern to initialize to functionalize it as user. Thus Wi-Fi Module ESP8266 is characterized to TCP/IP client. A software is written for retrieving the sensor data from DHT11 which generates temperature and humidity values. After this data had got updated in the cloud we use IoT analytics (like ThingSpeak to aggregate, visualize and analysis of live streams).

ThingSpeak generates instantaneous visualisation of present data in the cloud which had got updated. IP is used to transfer data to cloud through WIFI module. After API connection to ThingSpeak has been done, a key called API key is used to view the results over a channel. Thus before storing the data and displaying it in channel we first write the API key.

5.2 ANDROID APPLICATION

Thus the process of developing Android application through Aurdino studio is done through JAVA. This developed application interact with the microcontroller through cloud (ThingSpeak). Manipulation on channels (Update, Create, Clear, Delete) can be done through REST API methods like GET, POST, PUT, DELETE. A request to ThingSpeak is sent through JavaScript Object Notation with help of REST API Web Services and Channel ID and Field Number in its limits. The response will be reached in JSON format and produce tables in Application through JSON parser. The users execute the application and thus will be able to monitor the temperature and humidity readings of particular area. Application designed is portable, efficient and uses GUI. The end users observes results in graphical forms from cloud as shown in previous section.

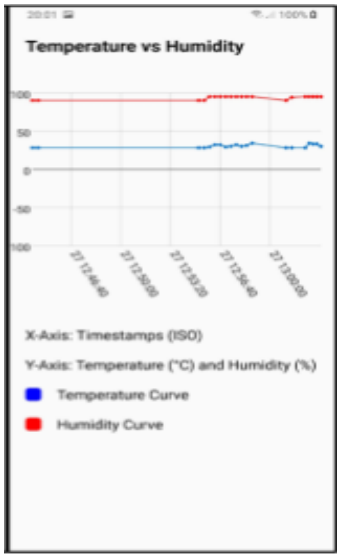

Figure6: Android Application

6. PROJECT METHODOLOGIES

Step 1: ThingSpeak Setup for Temperature and Humidity Monitoring

Sign on ThingSpeak (If there is an account which is already signed up just login with id and password. View www.thingspeak.com to create an account. Now move to sign up option in case if you don't have account and thus sign in with your details. After this verify your E-mail id.

Step 2: Create a Channel for Your Data

After Creation Of account produce a replacement channel through button named New Channel. After this enter Name and title to the information to be uploaded therein specific channel. currently we've to feature the attributes temperature and humidity in Field one and Field a pair of severally.The box next to the sphere choice may be used if we would like to feature another attribute as field and enter the outline of information. To save your details click on save channel button.

Step 3: API Key

ThingSpeak uses associate special API Key to seek out the situation to store the information and navigate the activity once it's referred to as. To transfer DHT11 knowledge by having distinctive API key, press the API key Button in ThingSpeak website.

7. IMPLEMENTATION METHOD

The Arduino Uno is Associate in Nursing ASCII text file microcontroller board supported the semiconductor device ATmega328P microcontroller and developed by Arduino.cc. The board consists digital and analogue input/output pin sets that will be connected with various shields and circuits. The board consists of 14 Digital, 6 Analog pins, that are flexible with type B USB cable connected with ArduinoIDE. The Aurdino board will accept the voltages between 7-20 volts however it's powered only by an external 9-volt that is similar to Arduino Nano and Leonardo.

7.1 Circuit and working

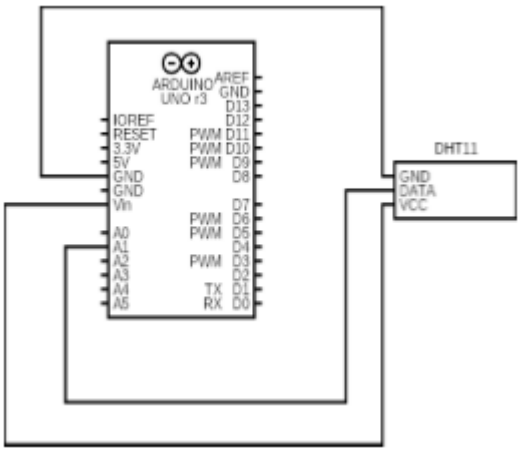

Figure7: Interfacing Arduino UNO and DHT11

Figure7: The diagram defines the humidity and temperature circuit is designed is intended with DHT11 sensor and Arduino. As shown on top of the data concerning humidity and temperature is distributed to digital pin 1 of NodeMCU through sensor. .At uniform intervals of your time, with

facilitate of ESP8266 Wi-Fi module the temperature and humidity values ar recorded within the cloud from node. Thus the temperature and humidity are often viewed graphically on ThingSpeak from the cloud. The serial port establishes the interaction between Arduino board and computer. The interception of knowledge bits takes place through server and so it's keep in short buffer that is then restored with wild cards and it. The communication between the Arduino board and also the computer is established through a port. Cloud is employed to intercept the info bits returning from Arduino through the port and keep within the temporary buffer that is then reformatted with pre-defined patterns (wild-cards) and is non parallelly placed in cloud by exploitation HTTPS protocol. Therefore the temperature and humidity are often viewed graphically on ThingSpeak from the cloud.

7.2 Construction and Testing

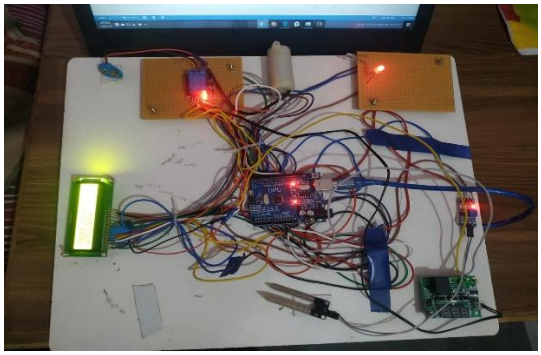

Figure8: Hardware Implementation method

System Component	Details
Sensors	DHT11 sensor, soil moisture sensor
Connectivity	Wi-Fi ESP8266
Microcontroller	Arduino UNO
Cloud	ThingSpeak
User Interface	Android Application

Table1: System Component Details

After storing the DHT library is utilized by the Arduino program, in the event that it isn't at first there in Arduino IDE, follow Sketch→ Include library→ Manage libraries→ Install DHT Sensor library. At that point order program and update in an Arduino by IDE .Note: Wifi modem and web association ought to be working appropriately code, the Temperature and Humidity information are set on ThingSpeak .subsequently we can see it graphically in window of your channel secretly.

8. EXPERIMENTAL RESULTS

The entire design of environmental monitoring system is shown in Figures. The design that's utilized is shown in image that describes the mixing of all hardware components throughout operational conditions. DHT11 and ThingSpeak are interfaced victimization the Arduino IDE. The detected data is viewed once android Application gets connected with ThingSpeak. The results of the experiment unit shown here i.e., the data required for the user is shown through mobile application and graphical depiction of humidity and temperatures records.

8.1 Tabular representation of Temperature and Humidity

The below tabular knowledge represents the sample of temperature and humidity readings observed at totally different time intervals recorded victimization DHT11 detector. The info is transmitted to the ThingSpeak cloud wherever the it's automatically converted into a graph as shown in later result. This tabular knowledge is extracted from JSON object file generated by the ThingSpeak cloud service. The scope of this paper is to slowly get this knowledge over web remotely. In practice this setup is integrated with different home sensing application to remotely trigger an action supported patterns observed within the readings.

Time	Temperature	Humidity
14-04-2021 18.12	90	28
14-04-2021 18.13	90	28
14-04-2021 18.13	90	28
14-04-2021 18.13	90	28
14-04-2021 18.14	90	28
14-04-2021 18.14	90	32
14-04-2021 18.15	90	32
14-04-2021 18.16	95	37
14-04-2021 18.16	95	37
14-04-2021 18.17	95	37

14-04-2021 18.17	95	29

Table2: Temperature and Humidity readings

8.2 Graphical Record of Temperature Monitoring

The Figure 10. Displays the data of temperature observed over a period of time. The graph here makes changes in temperature for an interval of 15 seconds. Here the graph is drawn among temperature and Date. In the process of testing accuracy, we have changed the temperature through lightening systems therefore we observed a raise in graph followed with average temperature reading.

Figure9: Record of Temperature Monitoring

The Figure 11. Displays the data of humidity observed over a period of time. The graph here makes changes in temperature for an interval of 15 seconds .Here the graph is drawn among humidity and Date. In the process of testing accuracy, we have changed the temperature through lightening systems, therefore we observed a fall in graph followed with average humidity reading.

Figure10: Record of Humidity Monitoring

9. CONCLUSION

This paper defines an environmental monitoring system for real-time monitoring of temperature and humidity of the surrounding environment. The data which is collected or sensed is passed to cloud by wifi where we can see data and graphical analysis. An Android application is developed for the client who can monitor the environment of the area where the hardware is placed an executed using a smartphone. The designed application is used as basic home automation system where the observed values of temperature and humidity can be used to operate some action and control the devices through the mobile application. Thus designing of this system is an important step in understanding the IoT application development and implementation and works as a foundation for many useful innovations in this direction.

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