IOT based live temperature and humidity monitoring system

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ABSTRACT

The main objective of this paper is to design an IoT (Internet of Things) based Temperature and Humidity monitoring system for an agricultural environment. Monitoring agricultural environment for temperature, humidity and soil moisture along with other factors is important for a healthy and wealthy cause, which improves the productivity of farmers by using technology driven farming. Taking care of these things manually requires a lots of human work and time and also it is a costly affair. Hence the aim of the project is to make an IoT-based temperature and humidity monitoring system which reduces the human work and taking cares of these factors. The key feature of thiswork is to collected the field data by the sensor and send this to cloud, which can further be analyzed using any computer or mobile anywhere on the globe to take real time decision. In this project we controlled a single channel relay on real time basis which can further be used to control water flow on the field.

Keywords: Iot, Arduino, Sensors, Python.

INTRODUCTION

Almost all the activities surrounding us have impact on Temperature . An accurate calculation of temperature and humidity is a important factor in many fields and industries of science. The constant observation of temperature is crucial in lot of applications like food industry, the manufacturing factory and pharmaceutical industry. For commercial purpose of temperature sensing we have analog and digital Temperature sensors. Temperature sensors which have temperature-dependent functions can be measured using resistors, semiconductors like diodes, thermocouples and thermistors. The main objective of the project is oversee the live temperature and humidity in a less cost .The observational node is Arduino. The programming language used for Arduino is Python. The Sensor used is DHT11 temperature and Humidity sensor. This sensor consists of temperature calculating function and main advantage of using DHT11 sensor is it is inexpensive and has less weight. Sensor is connected with the Arduino using jumper wires. The temperature is perceived using the sensor DHT11 and is read, stored and displayed by the Arduino.

Field of monitoring and remote sensing has been revolutionized by wireless sensor network. Wireless sensor networks can collect data from different sensors such as temperature, humidity, voltage, current etc. from remote locations and cooperatively pass the data through the network to the control station.Online continuous monitoring of these physical quantities from remote control station helps to co-ordinate the uninterrupted operation in the process plants, industries and even in domestic utilities

All the measured data is transmitted from the site to the mobile device (control station) through SMS. The experimental setup includes temperature and humidity sensor (DHT11), LCD, Esp8266 Wifi

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Module. The codes developed in-house are run in Arduino IDE software and dumped in Arduino Uno board. This way a wireless system is designedwhich is autonomous and can monitor as well as control the physical or environmental conditions, such as temperature and humidity and could stream the respective data to the control station. This Wireless Sensor network is bidirectional which enables the control over the sensor activity. This system consists of various units as shown below which are assembled as a whole and works in rhythm for accurate analysis functioning. As this system is equipped with high sensitive sensors, networks with low delay and accuracy governed components, this system is highly reliable for any application.

- Sensing unit – Temperature & Humidity Sensor (DHT11)
- Processing unit – Arduino Uno.
- Communication unit – Esp8266 Wifimodule .
- Power unit – 12V DC Adapter.

Scope and Benefits of IOT

It's the technology of today which is touching and transforming every aspect of our real life. IoT has given a concept of Machine to-Machine (M2M) communication. Some of the companies are implementing strategy to capitalize on the Internet of Things so that you can just stop your business and start making it thrives. IoT is going to have huge impact on home automation and building automation system where every convenience will be taken care of by the interconnected devices on IoT. It is also deployed on large scale for example in Song do, South Africa, the first of it sown kind fully equipped and wired smart city is near to completion (known as Ubiquitous City). With the personal electronics good connected to Internet will enable us to "author" our lives. In medical science field, IoT has given a privilege to devices and system to sense for coming disease and to prevent it, forge. It can make a person healthier with wearable's that can predict heart attack and cardio vascular strokes. As per a report consumer will start initiating the usage of IoT in a better way during 2015 and onwards compared to past usage. It is expected that IoT products with interoperable capability will dominate the market. Awareness of

IoT products is also vital for market penetration along with security features. Even very few Americans are aware of the usage of these products. As per a study of Consumer Electronics Association and Parks Associates found only 10% of the household in USA fully understood the usage of these products. Many interesting IoT products like automatic door locks, Wi-Fi connected ceiling fans, light switches, LED bulbs, smart watches,3-D printers and smart clothes will be popular among consumers. My Brain Technology in France has developed "Melomind". This EEG Headset can measure a human's brain waves and adjust music in a Smartphone app as they change. This product can be used as a digital meditation aid. A smart baby pacifier can measure the temperature of a baby and transmit the same to the Smartphone of parents. Many scopes will be created for technology companies to release offerings as per the behavior of consumers. It may so happen that Netflix can know when a person is sad and alone by monitoring the smart watch, smart thermostat and inhome camera. Subsequently, Netflix may offer a movie to change the mood. In a consumer electronics show in Los Vegas, a branded company informed that the company would invest 100 million dollars for progress of IoT. ii. Issues and Challenges IoT is not free from challenges Issues of Goverance, security, Interoperability, privacy, regulations, providing power to billions of sensors and standardization issues can slow down the progress of Internet of Things. Due to the absence of generic governance, there is much confusion and inconsistencies. Absence of a universal numbering system is a bane for providing a true IoT environment. In the current context, systems like EPC Global and ubiquitous ID systems are used to address the issue of global ID systems. There is a challenge of implementing common security protocols. So, interoperability is an issue while interactingamongIoT objects developed by different manufacturers. Lack of Support of the regulatory bodies, Government agencies and ubiquitous connectivity are barriers to device integration. Even quality and cost of receiving data from multiple sources are still with issues. Though, Applications like home monitoring systems, wearable devices along with consumer oriented

products are the centre of attention of Internet of Things domain, Enterprise IT professionals are still with issues to apply these concepts from the context of generating business values. IoT Consortium conducted a research on the adoption of IoT during 2015.As per the study, there is a concern for Security and privacy. Though IoT is moving towards mass adoption, the manufacturers should provide cost effective, Intuitive and simple solutions for connected Home. ETSI has formed an internal M2M taskforce for M2Msystems and sensor networks. Objective of this taskforce is to develop and maintain end-to-end architecture, integration of sensor network, enhancement of security, quality of service and to strengthen interface of hardware devices. Similarly, IPv6, 6LoWPANs and ROLL networks are evolved for Standardization. CASAGARAS model is evolved for standards, regulations, and global coding systems of Radio Frequency Identification. The group is also putting effort in development of ubiquitous computing, Networks and usage of RFID network in socio economic components. This model is quite open and facilitates RFID to interface with physical world with ease. W3C model is facilitating coordination among machines, solves security and privacy issues and resolves different addressing schemes in Peer to Peer Networks. The network technologies like Wi-Fi, WI-MAX, Bluetooth, ZigBee, and Cellular Packet Radios are evolving rapidly. W3C is trying to mix these technologies for adding network effect. ANEC and BUEC models are concerned for openness, Interoperability, Trust, Security, safety, reliability, protection of fundamental rights and respect for European values.

PROBLEM DEFINITION & WORK PLAN

This work includes the development of a system, which gathers the temperature and humidity parameters in various premises through wireless sensor networks which ranges from 0°C to 50°C and 20%-90% RH respectively. This system is modeled to a working platform with the help of the Arduino IDE software which is an open-source platform. The Arduino IDE allows you to implement the system coding in C/C++ and some other languages too, enables you to dump the code into the microcontroller and make your project come alive.

METHODOLOGY

The following methodology has been implemented in my proposed work: First, we have placed the temperature and humidity sensor (DHT11) in the premises, where the monitoring is to be done. The sensor is interfaced with the Arduino UNO development board. The programming in the Arduino board will convert the analog output of sensor into digital form. The digital values of temperature and humidity would be displayed on LCD. After that, the digital information is given to the Esp8266 Wifi Module which is interfaced as a Serial Communication Peripheral with Arduino. The WifiModule will transmit the data to the cloud from the Arduino. Additionally, the output can also be viewed through the android application.and same is displayed on the LCD too. The Arduino and GSM shield are powered by DC Adapters/USB chords.Rests of all the components in setup are powered by the Arduino (+5V).
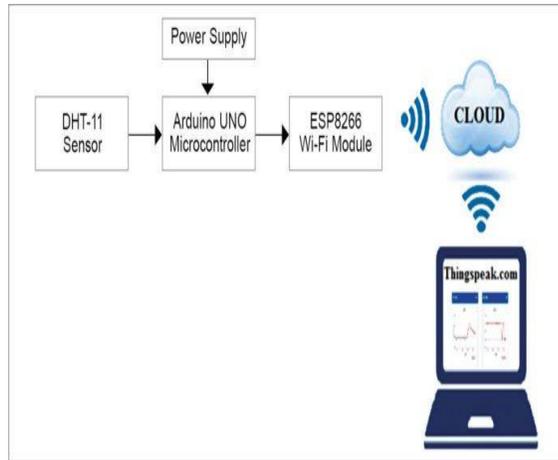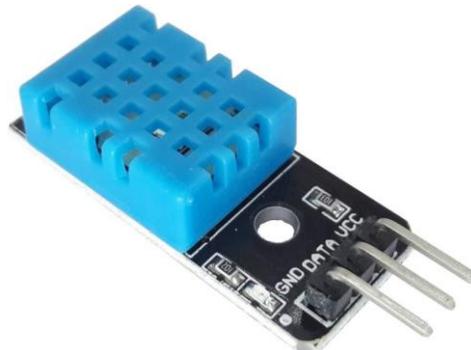
Figure 1: Block diagram of the system

EXPERIMENTAL SETUP

Figure 2 Block diagram of the system we have developed an experimental setup using various hardware modules to measure and monitor temperature and humidity parameters in various environments. Let's discuss in brief about the Hardware Modules interfaced in the setup.

Hardware Modules

Temperature & Humidity Sensor (DHT11)

Figure 2 : DHT11 Sensor

DHT11 (Digital Humidity and Temperature) sensor senses the temperature and humidity of the surrounding and gives a calibrated digital signal output. The sensor includes a resistive type humidity measurement component along with an NTC temperature measurement component. It is connected to an 8-bit microcontroller for high performance which offers excellent quality, fast response and ant interference ability. It has a low power operating range (3V-5V). The component is 3-pin single row package and the major feature of this sensor is that the data for both temperature and humidity is available on a single data pin of the sensor

Arduino UNO Development Board

Arduino is an open-source prototyping platform. Arduino boards are able to receive inputs and can convert into relevant output. It contains onboard power supply, USB port to communicate with PC, and an ATMEL microcontroller chip. It simplifies the process of creating any control system by providing the standard board that can be programmed and connected to the system without the need to any sophisticated PCB design and implementation. It is inexpensive, open-source and extensible, cross-platform and has a clear IDE.

Figure 3 Arduino UNO

Esp8266 Wi-Fi Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. 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. 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.

Pin out of ESP- 8266

The pin out is as follows for the common ESP- 8266 module:

* VCC, Voltage (+3.3 V; can handle up to 3.6 V)
* GND, Ground (0 V)
* RX, Receive data bit X
* TX, Transmit data bit X
* CH_PD, Chip power-down
* RST, Reset
* GPIO 0, General-purpose input/output No. 0
* GPIO 2, General-purpose input/output No. 2

Figure 4 : ESP-8266 Wi-Fi Module

16x2 Liquid Crystal Display(LCD)

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCD

modules are vey commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have aLready been visualized above now let us get a bit technical.16×2 LCD is named so because; it has 16

Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots.The features of 16×2 LCD module are

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight

- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

Figure 5: 16x2 LCD

AMS1117 Voltage regulator

The The AMS1117 series of adjustable and fixed voltage regulators are designed to provide up to1A output current and to operate down to 1V input-to-output differential. The dropout voltage of the device is guaranteed maximum 1.3V, decreasing at lower load currents. On-chip trimming adjusts the reference voltage to 1.5%.

Current limit is set to minimize the stress under overload conditions on both the regulator and power source circuitry. The AMS1117 devices are pin compatible with other three-terminal SCSI regulators and are offered in the low profile surface mount SOT-223 package, in the 8L SOIC package and in the TO-252 (DPAK) plastic package.

Figure 6:AMS1117 Voltage

Thing Speak

Thing Speak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network.

Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates. Thing Speak has integrated support from the numerical computing software MATLAB from Math Works, allowing Thing Speak users to analyze and

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visualize uploaded data using Mat lab without requiring the purchase of a Mat lab license from Math works. Thing Speak has a close relationship with Math works, Inc. In fact, all of the Thing Speak documentation is incorporated into the Math works Matlab documentation site and even enabling registered Math works user accounts as valid login credentials on the ThingSpeak website. The terms of service and privacy policy of ThingSpeak.com are between the agreeing user and Math works, Inc.

HARDWARE SETUP

The 2nd pin is of DHT11 is a data pin, it can send a temperature and humidity value to the 5thpin of Arduino Uno.1st and 4th pin of DHT11 is a Vcc and Gnd and 3rd pin is no connection. The Arduino Uno process a temperature and humidity value and send it to a ESP8266 Wi-Fi module. The Tx and Rx pin of ESP8266 is connected to the 2nd (Rx) and 3rd (Tx) of Arduino Uno. Make sure that input voltage of ESP8266 must be 3.3V, not a 5V (otherwise it would damage a device).For that, we are using AMS1117 Voltage regulator circuit. It can regulate a voltage from 9V to 3.3V and will give it to Vcc pin of ESP8266.The Ch_Pd is a chip enable pin of ESP8266 and should be pullup to 3.3V through 3.3KΩ resistor. For reset the module pull down the RST pin of ESP8266 to Gnd.ESP8266 have 2 GPIO pins GPIO 0 and GPIO 2.
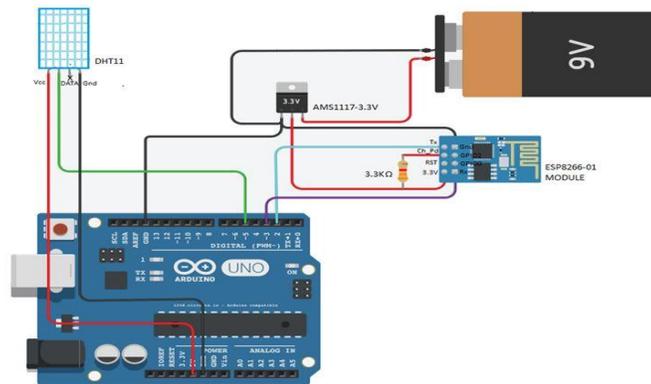

Figure 6:Circuit diagram

Construction and Testing

ThingSpeak is an open source platform to store and retrieve a data for Internet of Things application. To use this, you need to register in ThingSpeak cloud and then login to your account. After create a new channel with temperature in one field and humidity in another field.Once you created a new channel, it will generate a two API keys, they are READ API keys and WRITE API keys. First, copy the WRITE API keys from ThingsSpeak and paste it into the line (String apiKey = "**************";) of the program. Next, replace the Hostname and Password with your Wi-Fi name and Wi-Fi password in the two lines given below in the program. (String Hostname = "******" and String Password = "********"). The Arduino program Uses DHT

library, if it is not presented in your arduino IDE, select Sketch Include library Manager and Install DHT Sensor library. Then compile the program and upload to aArduino Uno through Arduino IDE. Ensure that Wi-Fi modem and internet connection in your Smartphone or PC are working properly. After uploaded a program, the Temperature and Humidity data is uploaded on ThingSpeak platform. You can see it graphically in the private view window of your channel And you can able to see the uploaded data from serial port of Arduino IDE and also through the android application and LCD display.

CONCLUSION

This concludes that the present proposed work was a success and it will provide a convenient

method for effective monitoring of temperature and humidity in real time. This system is compact to an extent and cost effective when compared to prices of instruments used to measure the environmental factors. From the above all analysis, it is ensured that the nested wired systems can be replaced by the wireless sensor networks to get an accurate data as well as to avoid many hazardous issues.

DISCUSSION AND FUTURE SCOPE

From my present proposed work, it is clear that the system developed by me is working absolutely fine at Temperature & Humidity Monitoring System Based on Arduino, DHT 11Sensor, and ESP-8266 Wi-Fi module in domestic premises. This system is slightly improved with respect to some previous projects like this taken by another people and a development of some new features is also included under my proposed work. In future, this system would be upgraded to web based monitoring system by using the GPRS technique which would easy to the user to have access over the system remotely over the Internet. Also, an upgrade for the monitoring of larger area would be done. Additionally, sensors like barometric pressure sensor, gas detector for air quality check, a web interface would be all integrated into a single system which could just not only measure the temperature and humidity parameters but also the other parameters would be analyzed.

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