Temperature/Humidity Monitoring Webserver

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Abstract— **This project demonstrates the programming of the ESP8266-12E with the Arduino IDE and interfacing with a DHT temperature/humidity sensor. And using Web server programming the data is uploaded to Thingspeak.com. The Thingspeak.com shows data in the form of carts of different styles eg. Bar, line This research was developed to produce a prototype product of a Web Based Temperature Monitoring system that allows the user to continuously monitor the temperature condition of a room. The enhancement from the existing system on the temperature monitoring is that this prototype system allowed the data to be monitored anytime and anywhere from the Internet. This research development project was divided into two parts that involved with the hardware and software. The hardware part involved building the temperature sensor board and for the software part involved written programming and construct coding using C language program. The programs then are uploaded into the microcontroller which then created Visual Basic 6.0 application to display the temperature and saves the data into a database. An active Server Page (ASP) scripting language is used as server side scripting to publish the current temperature at the web browser. This prototype of a Web-Based Temperature Monitoring has met all the objectives derived and planned. The research project is considered successful and ready to be launched in the real system implementations.**

Index Terms— **ESP8266-12E, 6.0 application, ASP.**

I. INTRODUCTION

Monitoring is employed in various applications, including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements [1]. Several problems usually occur during the monitoring process of the temperature in a room. For example, a server room must be kept between 15 to 20 degree Celsius to monitor a temperature in or else the server might crash and can cause a loss of hundreds thousands. Management has to choose either to place a person to monitor the temperature, or to save on human capital by developing a system that can monitor the temperature from other places at any given time.

In order to solve the problem, the web-based temperature monitoring system that can be access anywhere and anytime through the Internet is build. With this system a user can remotely monitor the ro0m temperature from anywhere which could save the human expenses. Web-Based Temperature

Monitoring is one type of temperature recorder that monitors a temperature in a room and stores the data into a database and

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display the current temperature on the website through a web server. The system will continuously monitor the temperature condition of the room and the data can be monitored at anytime and anywhere from the Internet. The temperature monitoring is widely used in various processes like in automotive industries, air conditioning, power plant and other industries that need the data to be saved and analyzed. Proposed design is to have the data acquisition system to measure and log some parameters. The main purpose of this system model is to make it easy for the user to view the current temperature.

II. PREVIOUS RESEARCH

Temperature monitoring is employed in various applications, including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements. A research has introduced a remote wireless monitoring system applied in the building construction to get the concrete temperature [1]. The system can be real–time and multi-regional access to information without the limits of distance between the monitored object and the monitor [2].

Another research has elaborate that temperature monitoring will give a big impact on logistic management and production flow management. China is the leading country to implement the temperature monitoring for logistic such as production, storage, transportation, marketing and consumption. One example called a Cold Chain which is supply the chain system in temperature management. It ensures that the core requirements of maintaining low-temperature environment for the purpose of maintaining perishable goods quality, so it has higher requirements than the general logistics system at room temperature [2]. Temperature changes will be recorded in the RFID tags with temperature sensors for the quality and meticulous, real-time management of the fresh products. In order to develop this we based proposed model, some comparison on previous project that similar with Web-Based Temperature Monitoring has been made.

There are three different research projects selected and analyzed in order to get an idea that has been included in this project.

III. TEMPERATURE SENSOR

A *temperature* is an objective comparative measure of hot or cold. It is measured in ^{0} c or ^{0}.Sensors used to measure temperature is called Thermometer. They may be Contact or Non-contact type Sensors. The sensor should have following properties.

1) Range – is the maximum and minimum value range over which a sensor works well.

2) Accuracy – how well the sensor measures the environment in an absolute sense.

3) Resolution – the ability of a sensor to see small differences in readings.

4) Repeatability – This is the ability of a sensor to repeat a measurement when put back in the same environment. Accurate sensors are always have degree of repeatability.

5) Stability – The sensor should be very stable with change in temperature.

IV. TEMPERATURE/HUMIDITY SENSOR DHT11

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost effectiveness.

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request

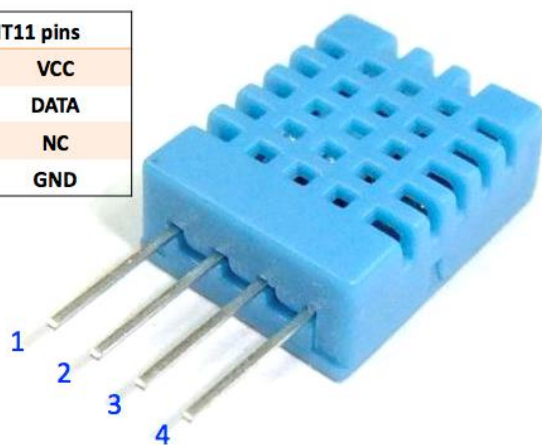| DHT11 pins	
1	VCC
2	DATA
3	NC
4	GND

Fig4.1: Pin Diagram of DHT11

Figure shows the pin diagram of DHT11 Temperature/Humidity sensor, whose output is in the form of stream of 1 &0.

DHT11's power supply is 3-5.5V DC. When power is supplied to the sensor, do not send any instruction to the sensor in within one second in order to pass the unstable status. One capacitor valued 100nF can be added between VDD and GND for power filtering. Data Single-bus free status is at high voltage level. When the communication between MCU and DHT11 begins, the programme of MCU will set Data Single-bus voltage level from high to low and this process must take at least 18ms to ensure DHT's

detection of MCU's signal, then MCU will pull up voltage and wait 20-40us for DHT's response.

A) SPECIFICATION OF DHT11

Bellow table shows the technical specification of DHT11

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
			8 Bit	
Repeatability			±1%RH	
Accuracy	25℃		±4%RH	
	0-50℃			±5%RH
Interchangeability	Fully Interchangeable			
Measurement Range	0℃	30%RH		90%RH
	25℃	20%RH		90%RH
	50℃	20%RH		80%RH
Response Time (Seconds)	1/e(63%)25℃, 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature				
Resolution		1℃	1℃	1℃
		8 Bit	8 Bit	8 Bit
Repeatability			±1℃	
Accuracy		±1℃		±2℃
Measurement Range		0℃		50℃
Response Time (Seconds)	1/e(63%)	6 S		30 S

Table4.1: Technical Specification of DHT11

B) COMMUNICATION PROCESS

Serial Interface Single-bus data format is used for communication and synchronization between MCU and DHT11 sensor. One communication process is about 4ms. Data consists of decimal and integral parts. A complete data transmission is 40bit, and the sensor sends higher data bit first.

Data format: 8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data + 8bit check sum. If the data transmission is right, the check-sum should be the last 8bit of "8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data".

When MCU sends a start signal, DHT11 changes from the low-power-consumption mode to the running-mode, waiting for MCU completing the start signal. Once it is completed, DHT11 sends a response signal of 40-bit data that include the relative humidity and temperature information to MCU. Users can choose to collect (read) some data. Without the start signal from MCU, DHT11 will not give the response signal to MCU.
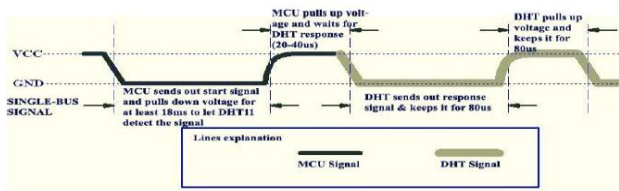
Fig4.2: Communication with DHT11

V. ESP8266

ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

ESP8266 on-board processing and storage capabilities allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. With its high degree of on-chip integration, which includes the antenna switch balun, power management converters, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

. Comparison on the three comprehensive sensor temperature systems has been done and benefits and similarities have been taken as guideline to model the web based architecture system implementations. Therefore these systems benefits the future development and designing of the web based temperature monitoring system either in contributing on the hardware, software or the systems itself.

This chip embeds an ultra low power Micro 32-bit CPU, with 16-bit thumb mode. This CPU can be interfaced using: code RAM/ROM interface (iBus) that goes to the memory controller, that can also be used to access external flash memory, data RAM interface (dBus), that also goes to the memory controller AHB interface, for register access, and JTAG interface for debugging . The memory controller contains ROM, and SRAM. It is accessed by the CPU using the iBus, dBus and AHB interface.

A) Features of ESP8266

1) 802.11 b/g/n protocol
2) Wi-Fi Direct (P2P), soft-AP
3) Integrated TCP/IP protocol stack
4) Integrated TR switch, balun, LNA, power amplifier and matching network
5) Integrated PLL, regulators, and power management units
6) +19.5dBm output power in 802.11b mode
7) Integrated temperature sensor
8) Supports antenna diversity
9) Power down leakage current of < 10uA
10) Integrated low power 32-bit CPU could be used as application processor
11) SDIO 2.0, SPI, UART
12) STBC, 1×1 MIMO, 2×1 MIMO
13) A-MPDU & A-MSDU aggregation & 0.4□s guard interval
14) Wake up and transmit packets in < 2ms
15) Standby power consumption of < 1.0mW (DTIM3)
16) Ultra low power technology.
17) SPI interface.

18) The ESP8266 radio consists of the following main blocks:
2.4GHz receiver,
2.4GHz transmitter,
 High speed clock generators and
Crystal oscillator,
Real time Clock

B) SPECIFICATION:

Fig Shows the Specification of ESP8266

Module	Model	ESP8266-12
	IC	ESP8266
Wireless Parameter	Wireless standard	IEEE 802.11b/g/n
	frequency range	2.412GHz-2.484GHz
	Transmitted power	802.11b: +16 +/-2dBm (@11Mbps)
		802.11g: +14 +/-2dBm (@54Mbps)
		802.11n: +13 +/-2dBm (@HT20, MCS7)
	Receive sensitivity	802.11b: -93 dBm (@11Mbps ,CCK)
		802.11g: -85dBm (@54Mbps, OFDM)
		802.11n: -82dBm (@HT20, MCS7)
	Wireless form	Stamp hole
		I-PEX connector、SMA connector
		Onboard PCB antenna
Hardware Parameter	Hardware connector	UART，IIC，PWM，GPIO，ADC
	Working voltage	3.3V
	GPIO driver capability	Max: 15ma
	Working current	Continue to send=> AVRG: ~70mA,MAX: 200mA Normal mode=> AVRG: ~12mA,MAX: 200mA standby: <200uA,
	Working temperature	-40℃~125℃
	Ambient temperature	temperature: <40℃, RH: <90%R.H.
	Size	24.0mm*16.0mm*1mm
Serial transmission	Transmission rate	110-921600bps
	TCP Client	5
Soft parameter	Wireless network type	STA/AP/STA+AP
	Security mechanism	WEP/WPA-PSK/WPA2-PSK
	Encryption Type	WEP64/WEP128/TKIP/AES
	Firmware Upgrade	Local serial port，OTA Remote upgrade
	Network protocol	IPv4, TCP/UDP/FTP/HTTP
	User Configuration	AT+order set, Web Android/iOS , Smart Link APP

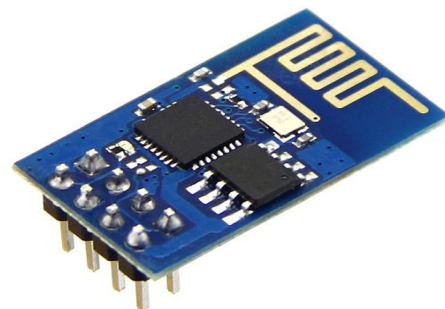Table 5.1: Specification of ESP8266

Fig5.1: ESP8266.

VI. PROGRAMMING OF ESP8266

The ESP8266 is a 3.3 volt device only. It can draw over 300 milliamps at some peak operations. To give it a safe margin, the LD1117-3.3 regulator is safe, able to supply 800 milliamps when it needs to, cool at 500 milliamps. So you can connect a3.7 V battery,5V battery. If you have noisy power, like a poor quality cell charger, etc. place a capacitor between power and ground on the input and output. 0.1 microfarad would be typical, 10 microfarad electrolytic capacitor (which have + and - leads) for a more noisy supply.ESP8266 being connected via generic FTDI USB to Serial device . 5 volt signal levels can harm the ESP8266. This may be mitigated via level shifting or a voltage divider on the ESP8266 receive (RXI) pin for such devices. The FTDI Friend is safe as the default transmit and receive signal level is 3.3 volts if left on the default on the back. Download and install FTDI drivers from http://www.ftdichip.com/Drivers.htm
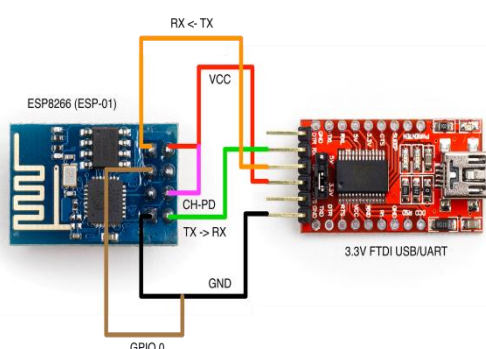

Fig6.1: Connection of ESP8266 with FTDI cable.

A) Arduino IDE setup

Arduino allows installation of third-party platform packages using Boards Manager.
➢ Install Arduino 1.6.8 from the Arduino website.
➢ Start Arduino and open Preferences window.
➢ Enter http://arduino.esp8266.com/stable/package_esp8266com_in dex.json into *Additional Board Manager URLs* field. You can add multiple URLs, separating them with commas.
➢ Open Boards Manager from Tools > Board menu and install *esp8266* platform (and don't forget to select your ESP8266 board from Tools > Board menu after installation).
➢ Select the board (Tools->Board->Generic ESP8266 board).
➢ Select the COM port to which ESP8266 is connected via FTDI cable.
➢ Install libraries for esp8266 and DHT11.
➢ Now we can load program to ESP8266 using Arduino IDE 1.6.5.
➢ We can also View the Status on serial window of Arduino.

B) UPLOADING DATA TO THINGSPEAK.COM

ThingSpeak is an open source "Internet of Things" application and API to store and retrieve data from things using HTTP over the Internet or via a Local Area Network. With ThingSpeak, you can create sensor logging applications,

location tracking applications, and a social network of things with status updates.

In addition to storing and retrieving numeric and alphanumeric data, the ThingSpeak API allows for numeric data processing such as time scaling, averaging, median, summing, and rounding. Each ThingSpeak Channel supports data entries of up to 8 data fields, latitude, longitude, elevation, and status. The channel feeds support JSON, XML, and CSV formats for integration into applications. The primary element of ThingSpeak activity is the *channel*, which contains data fields, location fields, and a status field.

We have to follow following steps:
1) Sign In to ThingSpeak™ using either your MathWorks® Account or ThingSpeak account, or create a new ThingSpeak account.
2) Click Channels > MyChannels.
3) On the Channels page, click New Channel.
4) Check the boxes next to Fields 1–3. Enter these channel setting values:
Name: Temperature/Humidity Measurement
Field 1: Temperature (F)
Field 2: Humidity
5) Click Save Channel at the bottom of the settings.

You now see these tabs:
• Private View: This tab displays information about your channel that only you can see.
• Public View: If you choose to make your channel publicly available, use this tab to display selected fields and channel visualizations.
• Channel Settings: This tab shows all the channel options you set at creation. You can edit, clear, or delete the channel from this tab.
• API Keys: This tab displays your channel API keys. Use the keys to read from and write to your channel.
• Data Import/Export: This tab enables you to import and export channel data.
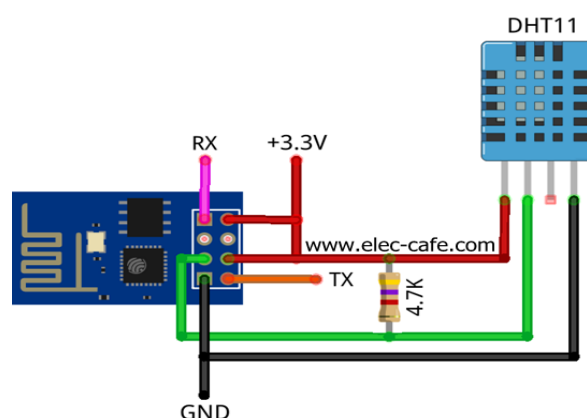
VII. WORKING OF SYSTEM:

Fig. 6.2: Connection of ESP8266 with DHT11

Connect the DHT11 as shown in fig. Connect FTDI RX to ESP8266 TX,FTDI TX to ESP8266 RX, FTDI GND to GND,FTDI CP_PD to 10K ohm resistor and then to vcc 3.3v ESP8266 GND to GND,ESP8266 Vcc to +3.3V. Plug the FTDI adaptor in to a usb port on your computer and power up

the ESP8266. The power LED on the ESP8266 should come on.

Upload the code that takes reading from DHT11and upload to Thingspeak channel whose apikey is provided in code.

VIII.   RESULT:
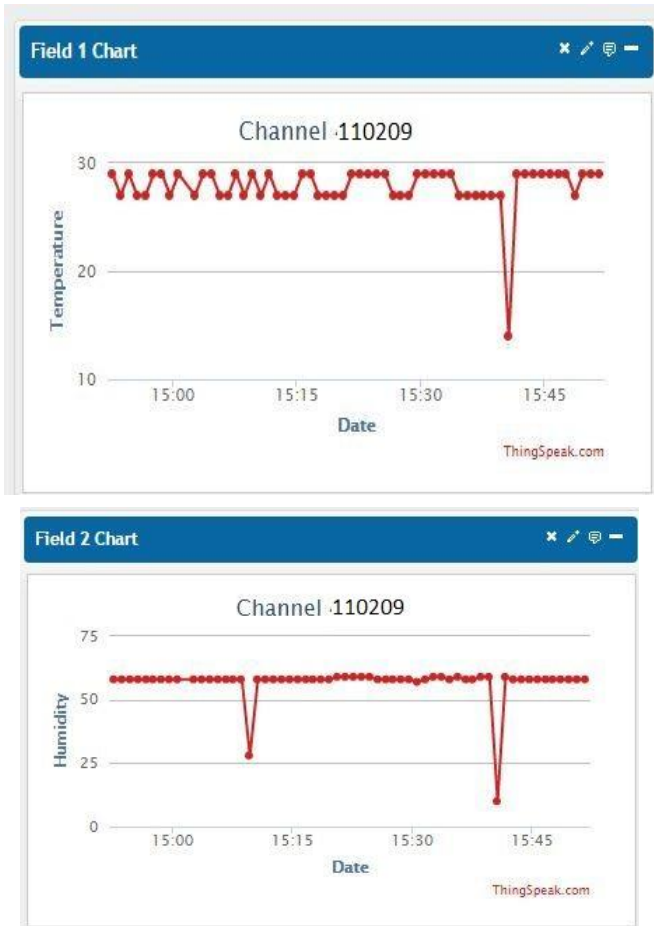
Just go toThingspeak.com and open the channel Created.

Fig 7.1: Chart that shows Temperature and humidity.

REFERENCES

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