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# Review on Temperature & Humidity Sensing using IoT

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***Abstract— Internet of things is an emerging trend where usage of Internet extends beyond just utilising the World Wide Web. A novel method is presented in this work through using IoT for sensing Temperature and Humidity with the help of scripting on RaspberryPi. The advantages of RaspberryPi have been enlisted along with the working methodology. The results are obtained in the graphical form, which are vividly represented. At the end of the section, paper concludes with a Conclusion note. This work is in the form of Review of the existing technology of using IoT for sensing and plotting Temperature and Humidity.***

***Keywords—RaspberryPi, IoT, Python, Temperature Sensing, Humidity Sensing***

## I. INTRODUCTION

The Internet of Things (IoT) is referred to as a network of physical objects which includes embedded technology for communication, sense or interacts with the internal states or the external environment [1].

IoT is short for Internet of Things.

The Internet of Things (IoT) refers to the ever-growing network of physical objects that displays an IP address for internet connectivity, and a certain kind of communication that occurs between these objects and other Internet-enabled devices and allied systems.

The Internet of Things extends internet connectivity beyond traditional devices like desktop and laptop computers, smart phones and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet The Internet of Things extends internet connectivity beyond traditional devices like desktop and laptop computers, smart phones and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet [2].

The **Internet of Things** (**IoT**) is termed as network of physical objects or "things" embedded within network connectivity, electronics, software or sensors, which enables the objects to collect as well as exchange data simultaneously. The Internet of Things permits objects to be sensed and controlled remotely across an existing network infrastructure, thence, creating opportunities for more direct integration between the physical world and computer-based systems. Consequently, it results in improved efficiency, accuracy and economic benefits. The IoT's veritable value lays in the data during interconnected items sharing. With Internet of Things, the cost of connectivity is decreasing. As a result, we can access anything around the world. By the means of this technology, we can make machines to directly interact with each other without any human involvement.

The Internet of Things (IoT) encompasses many aspects of life from interconnected cities and homes to connected cars and roads, which eventually connects roads to devices that track an individual's behaviour. The data is collected for push services. According to statistics, one trillion Internet-connected devices by 2025 and define mobile phones as the eyes and ears of the applications connecting all of those connected things [3].

By means of these internet of things billions objects are capable for communication around the world within a public and private internet protocol network. In 2010, the number of everyday physical objects and devices connected to the Internet was around 12.5 billion. For the development, the government of Europe, Asia and America has considered the Internet of Things as a major area of innovation and growth. Public safety, Smart cities, Smart cars, Smart Industries and Environmental Protection has been given the highest priority for future protection. Many visionaries have seized on the phrase Internet of Things to refer to the general idea of things, especially everyday objects, that are readable, recognisable, locatable, addressable, and/or controllable via the Internet, irrespective of the communication means (whether via RFID, wireless LAN, wide- area networks, or other means).Radio Frequency Identification (RFID) and sensor network technologies will rise to meet this new challenge, in which information and communication systems are invisibly embedded in the environment around us. This result in the generation of enormous amounts of data which have to be stored processed and presented in a seamless, efficient, and easily interpretable form [4]. Many researchers have utilised IoT concepts to devise different kinds of models. IoT has been used for communication and how temperature affects it [6]. An extension to it can be how humidity and temperature can be sensed with low cost devices like DHT11 or LM35. Another scholar have utilised wireless sensor network for measuring temperature which unnecessarily increases the cost for the model [7]. Rather RaspberryPi could have been used which also have great accuracy

Hence, keeping in mind the versatilities of the IoT, we have implemented the Temperature and Humidity Sensing Model using IoT while keeping the basic implementation using software interfacing of RaspberryPi.

**RaspberryPi:**

The Raspberry Pi is a low cost, credit-card sized computer which plugs into a computer monitor or TV, and requires a standard keyboard and mouse. It has capability of a little device that allows people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games [5].

The Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras.

The paper is divided within 5 sections where the next 2nd section underlines the *Applications* of IoT and RaspberryPi. The 3rd section covers the *Working Methodology* and followed by *Experimental Results.* The final 5th section contains the *Conclusion* of the paper proposed.

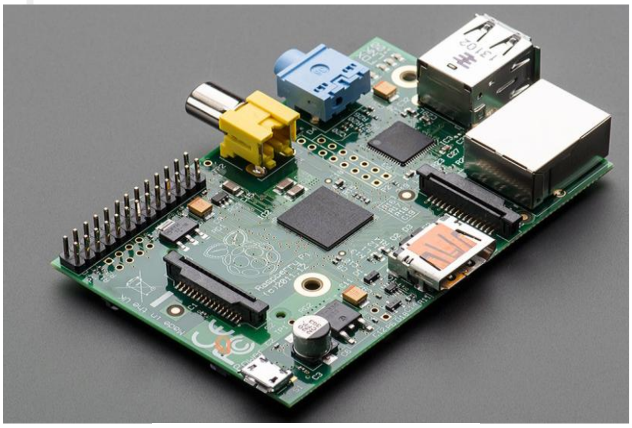

Fig. 1 A RaspberryPi Model B

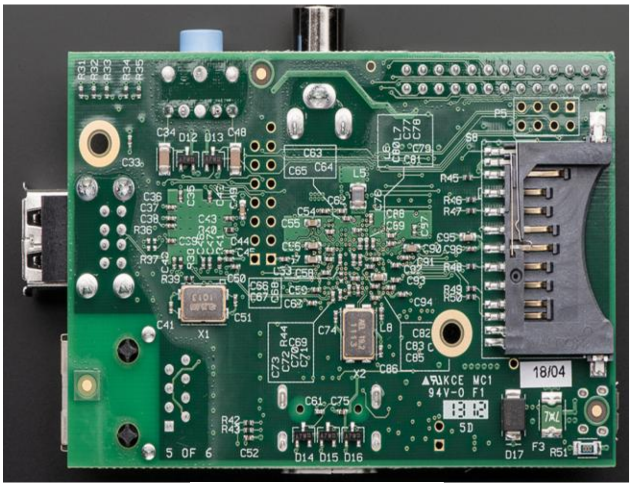

Fig. 2 Working Module

**ThingSpeak:**

ThingSpeak is referred as "open data platform for the Internet Of Things". At an initial stage, one needs to create a *channel* that specifies the main plotting - title, range, number of fields, etc. One can then update data in their channel with an HTTP request of the form:

{ https://api.thingspeak.com/update?api_key=YOUR_CHANNEL_API_KEY&field1=99 }

The data stream itself can be viewed at the following URL:

{ https://api.thingspeak.com/channels/YOUR_CHANNEL_ID }

ThingSpeak enables a lot of options for displaying the channel's data - make it public/private, changing extents, layouts, etc. The only limitation is the rate of data updates - it has to be no more frequent than *15 seconds*. The major advantage of it is that t1he whole software is Open Source. [9].

**DHT11:**

DHT11 sensors have capability to measure temperature and relative humidity. In the electronics market, they are economically viable and cheap. These are perfect for a first project. The DHT11 is not what is called "scientifically" accurate but it is good enough to monitor my basement. While we were at it, we figured it might as well add a light sensor to know if we left the lights on. Another simple and cheap solution, all we need to use is a photo resistor [11].

 

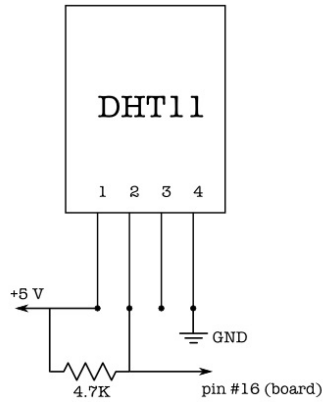


Fig. 3 DHT11 Pin Configuration

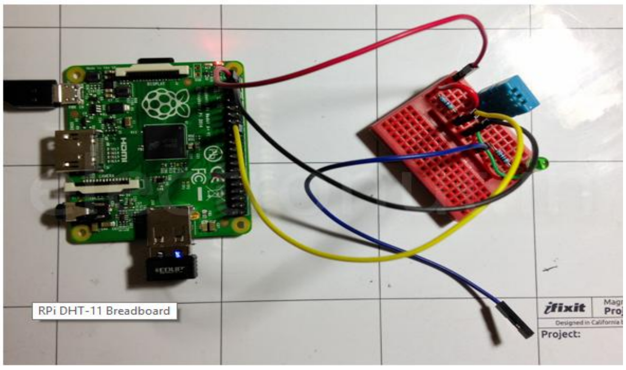


Fig. 3 DHT11 Pin Configuration

## II. APPLICATIONS

There are various enlisted noteworthy applications of IoT, wherein some are the following:

1. *Smart Parking:* Monitoring of parking spaces availability in the city.
2. *Structural health:* Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
3. *Noise Urban Maps:* Sound monitoring in bar areas and centric zones in real time.
4. *Smartphone Detection*: Detect iPhone and Android devices and in general any device which works with WiFi or Bluetooth interfaces.
5. *Eletromagnetic Field Levels*: Measurement of the energy radiated by cell stations and and WiFi routers.
6. *Traffic Congestion*: Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
7. *Smart Lighting:* Intelligent and weather adaptive lighting in street lights.
8. *Waste Management*: Detection of rubbish levels in containers to optimize the trash collection routes.
9. *Smart Roads:* Intelligent Highways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

And many more

Utilising the concept of RaspberryPi has its own advantages owing to its utility and user-friendly applications. Some of the widespread areas, where RaspberryPi is largely used are:

1. Mod My Pi
2. Make your own Pi case
3. Living room PC
4. ZX Spectrum Pi
5. Retro Pi
6. Arcade Pi
7. Windows 3.0 on a Pi
8. Robotics
9. Scratch the Pi
10. Spectrum BASIC for RPi
11. Pi Hacker
12. Firefox OS on Pi

## III. WORKING METHODOLOGY

***Step 1: Requirements of the project***

We have built this on a breadboard, so no need to worry about soldering, or a designing PCB. Once we are happy with the design we can do that [10].

*Hardware:*

- Raspberry PI 2 & SD Card with Raspbian Operating System
- USB Power Supply
- USB Cable
- Breadboard & Jumper Wires
- 2 x DHT 11 sensors
- 2 x 10K Resistors
- 2 x Photocells
- 2 x 1uF Capacitors

***Step 2: Prep the Raspberry PI***

Once your Raspberry Pi is up and running we setup Python to talk to the GPIO pins. The GPIO pins are our interface to the DHT11 Temp/Humidity sensor and the photocell.

***Step 3: Configuring Python***

Not all the libraries we need to make this project are pre-loaded on the Raspberry Pi. We required the Adafruit GPIO Python library and the Adafruit DHT 11 library.

***Step 3: Raspberry PI - Understanding GPIO Pins***

Different versions of the Raspberry Pi have a different amount of GPIO pins. In early versions of the Raspberry Pi there were 26 pins and the more recent versions have 40 pins. Even though more pins were added, pins 1 through 26 are the same on all versions. At a reference for Raspberry Pi GPIO pins, several notations for each pin are found. Most commonly, one reference for the physical name of the pin (1 to 40) and the other for the GPIO Name (GPIO1, etc) is witnessed. The physical name is just like the physical ordered number of the pin. With Python we used the GPIO reference for our pin identification. The GPIO Name is designated from the chip set and more commonly used in advanced projects. Referencing the wrong GPIO Pin number is very common.

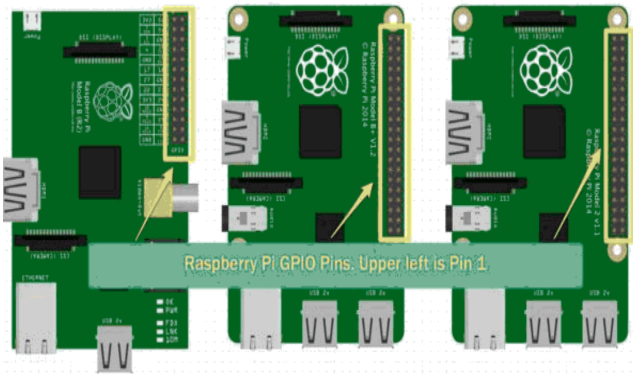


Fig. 5 Understanding the GPIO Pins

| | Physical Pin Number | | |
|---|---|---|---|
| 3.3V | 1 | 2 | 5V |
| GPIO2 | 3 | 4 | 5V |
| GPIO3 | 5 | 6 | GND |
| GPIO4 | 7 | 8 | GPIO14 |
| GND | 9 | 10 | GPIO15 |
| GPIO17 | 11 | 12 | GPIO18 |
| GPIO27 | 13 | 14 | GND |
| GPIO22 | 15 | 16 | GPIO23 |
| 3.3V | 17 | 18 | GPIO24 |
| GPIO10 | 19 | 20 | GND |
| GPIO9 | 21 | 22 | GPIO25 |
| GPIO11 | 23 | 24 | GPIO8 |
| GND | 25 | 26 | GPIO7 |
| DNC | 27 | 28 | DNC |
| GPIO5 | 29 | 30 | GND |
| GPIO6 | 31 | 32 | GPIO12 |
| GPIO13 | 33 | 34 | GND |
| GPIO19 | 35 | 36 | GPIO16 |
| GPIO26 | 37 | 38 | GPIO20 |
| GND | 39 | 40 | GPIO21 |
| | Key | | |
| | Power+ | | |
| | GND | | |
| | GPIO | | |

Fig. 6 The PIN configuration Table Figure

***Step 4: Building the circuit***

We are keeping the circuit simple and building it on a breadboard using our components and jumper wires. Before connecting anything to your Raspberry PI, disconnect the power.

Warning - you can destroy your Raspberry Pi with a short circuit from a wrong connection. Just be careful and double check everything before powering back on.

To connect from the Raspberry PI to breadboard I like to use Dupont Cables, they are jumper wires that have a female side and a male side. The female side connects right to the male header pins of he Raspberry Pi and the male side plugs right into the Breadboard.

For this circuit we need to use the 3.3v out from the Raspberry Pi Pin 1 (do not use the 5v on Pin 2) and we need Ground (GND) of course. Connect these from the Pi to the Breadboard.

The DHT 11 has 4 Pins. Pin 1 is VCC, Pins 2 is Data, Pin 3 is NOT USED, Pin 4 is Ground.

- Connect DHT 11 Pin 1 to 3.3v
- Connect DHT 11 Pin 2 to Raspberry PI Pin 16/GPIO 23 and connect a 4.7 or 10k resistor from DHT 11 Pin 2 to DHT Pin 1
- Connect DHT 11 Pin 4 to Ground

The photo resistor has 2 pins

- Connect one pin to 3.3.v
- Connect the Other Pin to Raspberry Pi Pin 18/GPIO 24

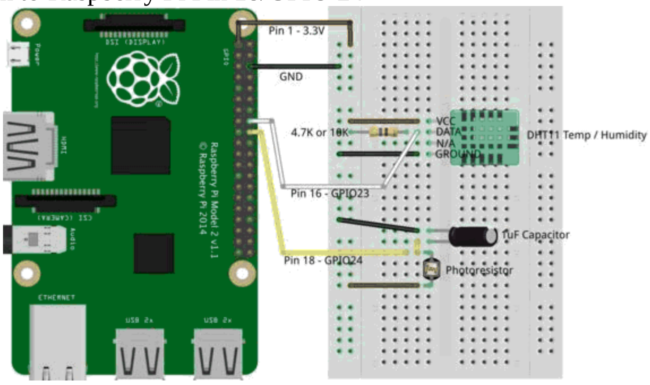


Fig. 5 Connections of the circuit

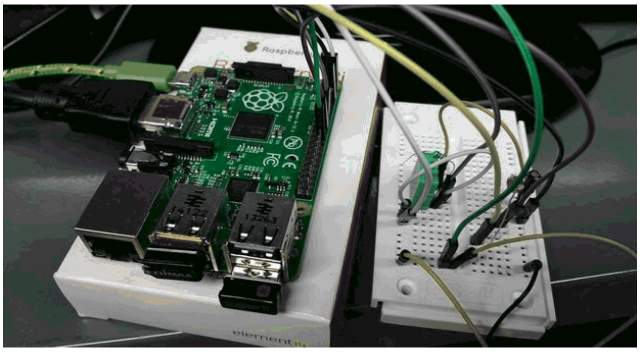

Fig. 6 Workable Model

Our working model was similar to the above shown in Fig.5 and 6. All the connections were carefully checked and connected. Since, a little careless mistake may short-circuit the RaspberryPi circuit.

## IV. EXPERIMENTAL RESULTS

The Sensor was subjected to different conditions and the graphs for Temperature vs. Time and Humidity vs. Time were plotted which displayed almost exact results with ±10% error. The data from RaspberryPi was processed. The following scenarios and graphs display the collected data.

***Case 1: Near Gas Burner***

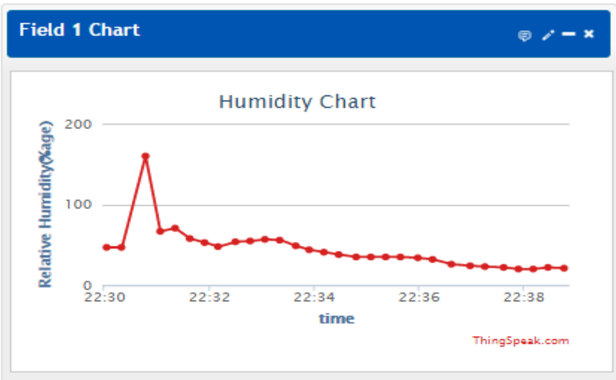


Fig. 7 Graph for Humidity vs. Date

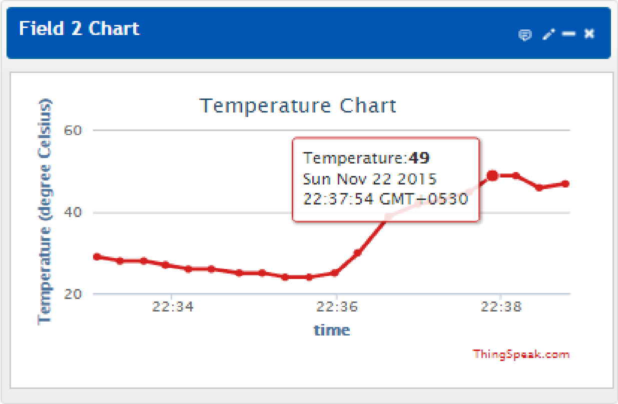


Fig.8 Graph for Temperature vs Date

***Case 2: At room temperature (25ºC)***

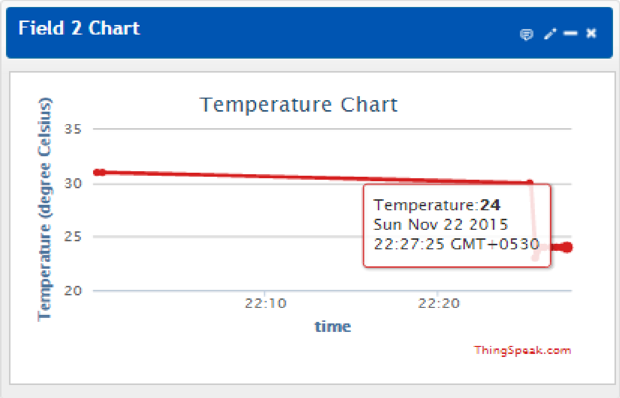


Fig.8 Graph for Temperature vs Date

***Case 3: Near Boiling Water***

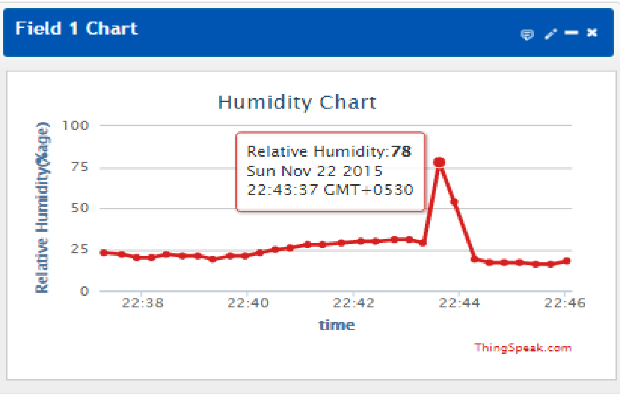


Fig.9 (a) Graph for Humidity vs. Date (b) Graph for Temperature vs Date

***Case 4: At Body Temperature***

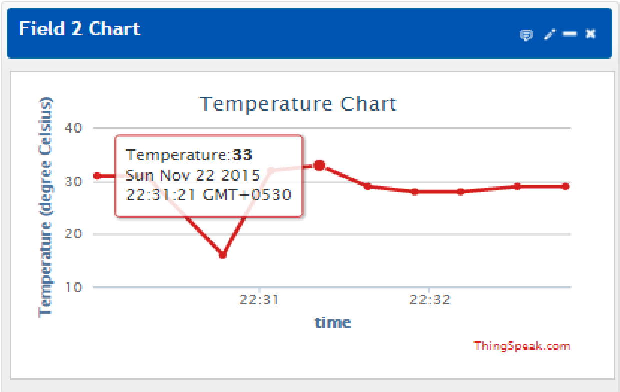


Fig.10 Graph for Temperature vs Date

 

## V. CONCLUSIONS

With the proposed methodology, we were able to interface and synchronize the RaspberryPi. Consequently, we with help of ThingSpeak software, we were able to observe the requisite graphs and results. Section 4 displays the obtained graphs. Therefore, a novel method of Sensing Temperature and humidity was reviewed.

## ACKNOWLEDGMENT

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