Lab 07 - IoT data cloud communication systems- Tinker CAD Arduino

Name of student (Batch No / Roll No)

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Performance of Experiment	Journal Submission	Total Marks	Remarks	Instructor Sign

Aim: To sense the data from sensors and send it to cloud system in simple text files, excel sheets or databases system using Raspberry Pi/ ESP8266 boards / Beagle board/ Arduino Uno. You may use ThingSpeak or Ubidots cloud for this lab

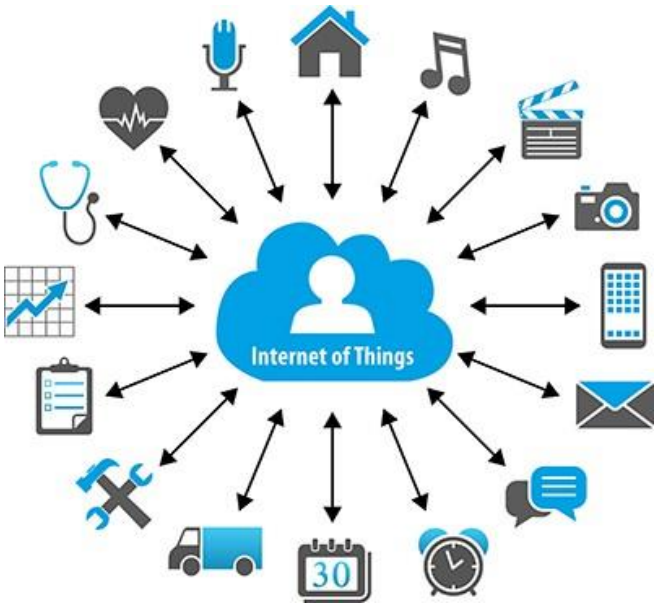
Objectives:
1. To understand how sensor data is sent to the cloud
2. To learn various public cloud platforms

Journal content- Theory and frequently asked questions and experiment
Theory:
- Explain use of Cloud in IOT Applications
- Explain various communication technologies used in IoT
- What is Edge computing and Fog computing in IoT?
- Explain DHT22 temperate sensor and its interfacing to Raspberry Pi / Arduino
- Draw block diagram to show Raspberry Pi/ Arduino connected to cloud system
- List and state IoT Cloud platforms.

- **Lab Sketch : Prepare labeled Lab sketch with TinkerCAD**
- **Program Code**
- **Conclusions**

1. Explain use of Cloud in IOT Applications

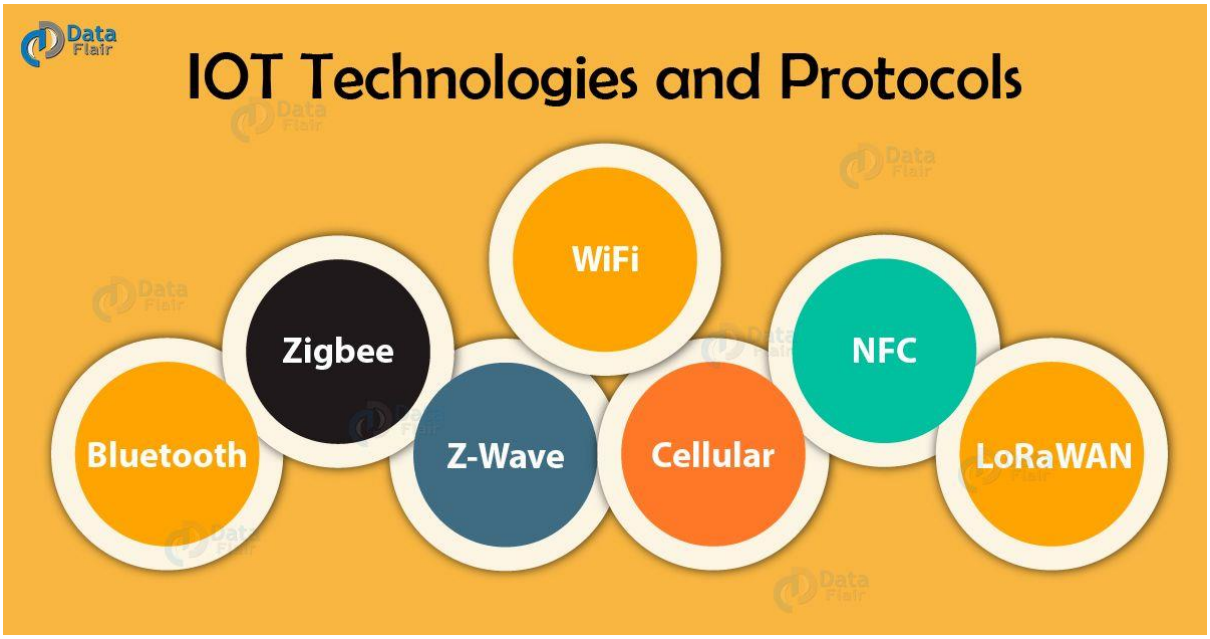
The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
Breaking it down, the internet of things meaning can be as simple as a person with a heart monitor implant or an automobile that has built-in sensors which alert the driver of imminent danger. Any object which is man-made or natural that can be designated an IP address and provided with the ability to transfer data over a network comes under the umbrella of IoT.
IoT has evolved with the greater generation of data. Internet of Things Cloud Service creates excessive communication between inexpensive sensors in the IoT which means even greater connectivity; billions of connected devices and machines will soon join human-users.



There is an evident need of internet of things. IoT has practically taken many industries around the world including precision agriculture, healthcare, energy, transportation, building management and the likes. The connectivity options by internet cloud services are increasing by huge amounts for electronic engineers and application developers. Work is being done on products and systems of the IoT which will help in greater development with ease.

Greater connectivity of the devices in itself does not provide the benefits to people, however the devices connected to the network to provide information they gather from the environment is what makes IoT the next step to success. Connectivity provided by cloud services help the devices to provide valuable information by reaching out and acting upon the world. The devices connected are not limited to certain devices which organizations own, but can span from personal devices every individual uses to the big ones through internet cloud services.

2. Explain various communication technologies used in IoT



Several Communication Protocols and Technology used in the internet of Things. Some of the major IoT technology and protocol (IoT Communication Protocols) are Bluetooth, Wifi, Radio Protocols, LTE-A, and WiFi-Direct. These IoT communication protocols cater to and meet the specific functional requirement of an IoT system.

There are various IoT Communication Protocols/ Technology some of them are described below :-

Bluetooth

An important short-range IoT communications Protocols / Technology. Bluetooth, which has become very important in computing and many consumer product markets. It is expected to be key for wearable products in particular, again connecting to the IoT albeit probably via a smartphone in many cases. The new Bluetooth Low-Energy (BLE) – or Bluetooth Smart, as it is now branded – is a significant protocol for IoT applications. Importantly, while it offers a similar range to Bluetooth it has been designed to offer significantly reduced power consumption.

Zigbee

ZigBee is similar to Bluetooth and is majorly used in industrial settings. It has some significant advantages in complex systems offering low-power operation, high security, robustness and high and is well positioned to take advantage of wireless control and sensor networks in **IoT applications**. The latest version of ZigBee is the recently launched 3.0, which is essentially the unification of the various ZigBee wireless standards into a single standard.

Z-Wave

Z-Wave is a low-power RF communications IoT technology that primarily design for home automation for products such as lamp controllers and sensors among many other devices. A Z-Wave uses a simpler protocol than some others, which can enable faster and simpler development, but the only maker of chips is Sigma Designs compared to multiple sources for other wireless technologies such as ZigBee and others.

Wi-Fi

WiFi connectivity is one of the most popular IoT communication protocol, often an obvious choice for many developers, especially given the availability of WiFi within the home environment within LANs. There is a wide existing infrastructure as well as offering fast data transfer and the ability to handle high quantities of data. Currently, the most common WiFi standard used in homes and many businesses is 802.11n, which offers range of hundreds of megabit per second, which is fine for file transfers but may be too power-consuming for many IoT applications.

3. What is Edge computing and Fog computing in IoT?

Both fog computing and edge computing provide the same functionalities in terms of pushing both data and intelligence to analytic platforms that are situated either on, or close to where the data originated from, whether that's screens, speakers, motors, pumps or sensors.

"Fog computing and edge computing are effectively the same thing. Both are concerned with leveraging the computing capabilities within a local network to carry out computation tasks that would ordinarily have been carried out in the cloud," said Jessica Califano, head of marketing and communications at Temboo.

Both technologies can help organizations reduce their reliance on cloud-based platforms to analyze data, which often leads to latency issues, and instead be able to make data-driven decisions faster. The main difference between edge computing and fog computing comes down to where the processing of that data takes place.

“Edge computing usually occurs directly on the devices to which the sensors are attached or a gateway device that is physically “close” to the sensors. Fog computing moves the edge computing activities to processors that are connected to the LAN or into the LAN hardware itself so they may be physically more distant from the sensors and actuators.” said Paul Butterworth, co-founder and CTO at Vantiq.
So, with Fog computing, the data is processed within a fog node or IoT gateway which is situated within the LAN. As for edge computing, the data is processed on the device or sensor itself without being transferred anywhere.

4. Explain DHT22 temperate sensor and its interfacing to Raspberry Pi / Arduino

The DHT22 sensor is used to measure the temperature and humidity. It is also known as AM2302. This sensor is cheap and also has better accuracy.

Specifications of DHT22

The specifications of the temperature and humidity sensor DHT22 are as follows:

• Temperature range is from -40 to 125 degree Centigrade with accuracy of ±0.5°C.

• Humidity range is from 0 to 100% with accuracy of ± 2-5%.

• Sampling rate is 0.5 Hz.

•Operating Voltage is 3-5V.

• Maximum Current while measuring is 2.5mA

Connect DHT22 with the Raspberry Pi as described below

DHT22 Pin	Raspberry Pi
VCC	5V
Data Pin	Connect to GPIO 23 and also connect to 5V through 10K resistor
GND	GND

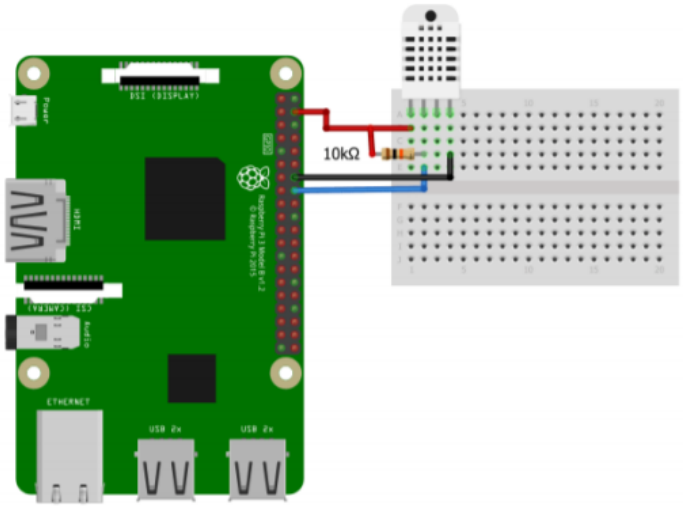


Fig: DHT22 and Raspberry Pi Interfacing

Installing the DHT22 Library

1. Enter the below command to clone the library git clone
https://github.com/adafruit/Adafruit_Python_DHT.git

2. Then enter in to the installed directory using the below command

cd Adafruit_Python_DHT

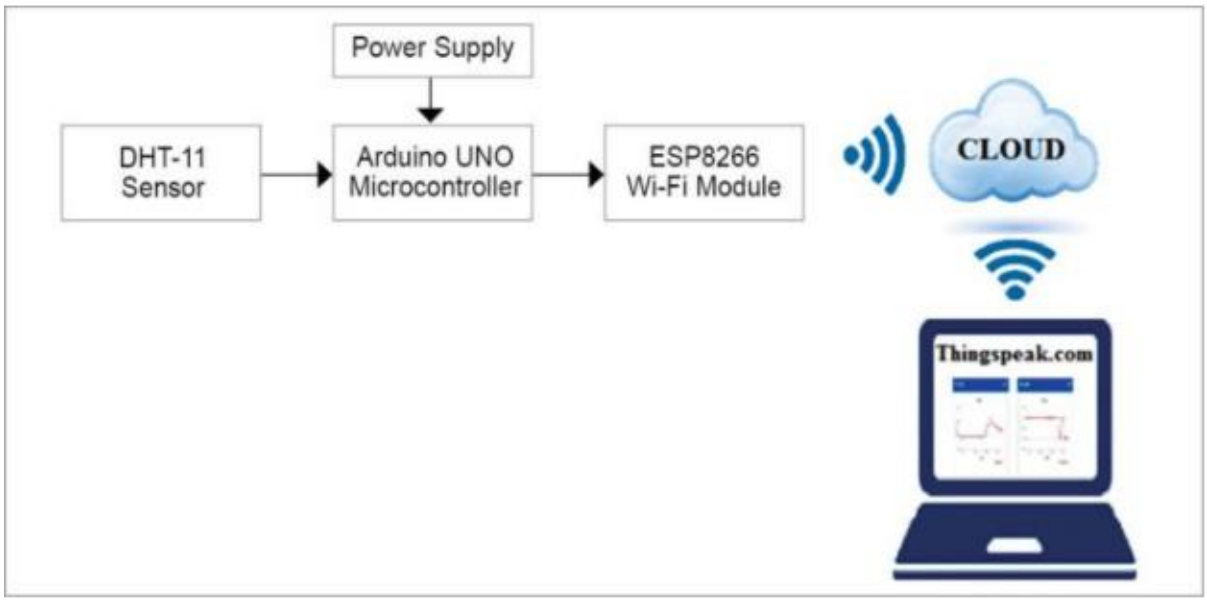
3. Now download the required modules using the below command

sudo apt-get install build-essential python-dev

5. Then install the library using the below command

6. sudo python setup.py install

5. Draw block diagram to show Raspberry Pi/ Arduino connected to cloud system



6. List and state IoT Cloud platforms.

- Amazon Web Services IOT Platform :-

  Amazon dominates the consumer cloud market. They were the first to really turn cloud computing into a commodity way back in 2004. Since then they've put a lot effort into innovation and building features, and probably have the most comprehensive set of tools available.

  It's an extremely scalable platform, claiming to be able to support billions of devices, and trillions of interaction between them.

- Microsoft Azure IOT Platform :-

  Microsoft is taking its Internet of Things cloud services very seriously. They have cloud storage, machine learning, and IoT services, and have even developed their own operating system for IoT devices. This means they intend to provide a complete IoT solution provider.

  The pricing is done in 4 tiers based on how much data your devices will generate. Below 8,000 messages per unit per day is free. It does get complicated when you start to integrate with other Microsoft services, but they have a great pricing calculator to help you out.

- IBM Watson IOT Platform

  IBM is another IT giant trying to set itself up as an Internet of Things platform authority. They try to make their cloud services as accessible as possible to beginners with easy apps and interfaces. You can try out their sample apps to get a feel for how it all works. You can also store your data for a specified period, to get historical information from your connected devices.

Python Code and output screenshots

```
import sys
import urllib3
import random
import time

myAPI = 'BVT2WFPPJX3N9LUS'

baseURL = 'https://api.thingspeak.com/update?api_key=%s' % myAPI
def DHT22_data():
    temp = random.randint(20,40)
    humi = random.randint(50,80)
    return humi, temp

print("Exit data loggging with control+c" , end ="\n")
while True:
    try:
        humi, temp = DHT22_data()
        print('Temp={0:0.1f}*C Humidity={1:0.1f}%'.format(temp,humi))
        con = urllib3.PoolManager()
        response = con.request('GET',baseURL + '&field1=%s&field2=%s' % (temp,humi))
        print(response.status)
        time.sleep(15)
    except KeyboardInterrupt:
        exit()
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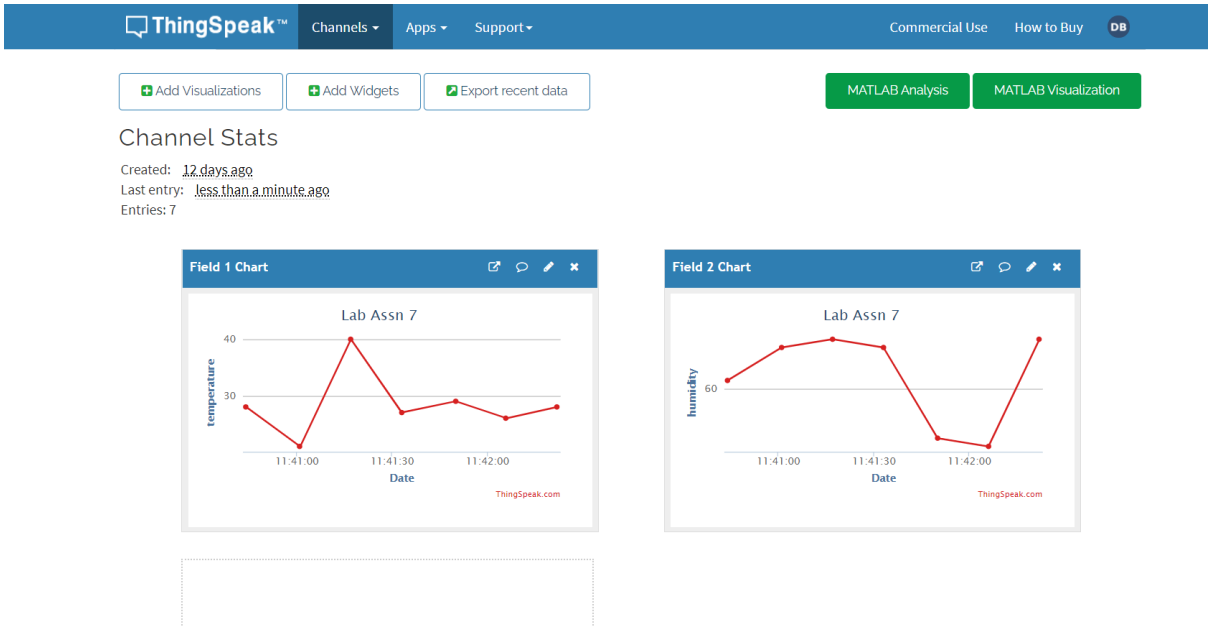

Conclusions

Thus we have studied how to sense the data from sensors and send it to cloud system in simple text files, excel sheets or databases system.