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|----------|-----------------------------|---------|-----------------|
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# I N D E X

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## Internet of things :

It is the network of physical object that contain embedded technology to communicate and sense or interact embed with their internal states or the external environmental.

- Internet technology connecting devices, machines and tool to the internet by means of wireless technologies.
- Over 9 billion 'Things' connected to the internet as of now.
- Things connected to the internet are projected to cross 20 billion in the near future.
- Unification of technologies such a lower power embedded systems, cloud computing, big-data machine learning & networking.

## Origin of Technology :

In the 2000's we are heading into a new era of ubiquity, where the users of internet will be counted in billions and where humans may become the minority as generators and ~~sens~~ receivers to traffic instead, most of the traffic will flow between devices and all kind of things thereby creating a much wider and more complex internet of things.

### Characteristics :

- Efficient, scalable & associated architecture.
- Unambiguous naming and addressing.
- Abundance of sleeping nodes, mobile and non IP devices.
- Intermittent connectivity.

### IoT market share :

- Business Manufacturing - Real time analysis of supply chains and equipment, robotic machinery.
- Healthcare - Portable health monitoring, electronic, record keeping, pharmaceutical safeguards.
- Retail - Inventory tracking, smartphone purchasing, anonymous analytics of consumer choices.
- Security - Biometric & facial recognition locks, remote sensors.

### Evolution of connected Devices :

- ATM - These ubiquitous money dispensers went online for the first time way back in 1974.
- Web - Worldwide web made its debut in 1991 to revolutionize computing and communications.

- Smartmeters - The first power meters to communicate remotely with the grid were installed in the early 2000s.
- Digital Locks - Smartphones can be used to lock and unlock doors remotely and business owners can change key codes rapidly to grant or restrict access to employees and guests.
- Smart Healthcare - Devices connect to hospitals, doctors and relatives to alert them of medical emergencies and take preventive measures.
- Smart Vehicles - Vehicles self-diagnose themselves and alert owners about system failures.
- Smart Dust - Computers smaller than a grain of sand can be spread or injected almost anywhere to measure chemicals in the soil or to diagnose problems in the human body.
- Baseline Technologies - A number of technologies that are very closely related to IoT include -
  - Machine-to-Machine (M2M) communication
  - Cyber-Physical System (CPS)
  - Web of Things

## IoT and M2M difference :

- M2M refers to communication and interactions between machine and devices.
- Such interaction can occur via a cloud computing infrastructure (eg. devices exchanging information through a cloud information)
- M2M offers the means for managing device and devices interaction while also collecting machine or sensor data.
- M2M is a term introduced by the communication services providers and pays emphasis on machine interaction via one or more telecom communication networks. (eg 3G, 4G, 5G satellite public networks)
- M2M is part of the IoT while standards have a prominent place in the IoT standards landscape.
- However IoT has a broader scope than M2M, things with applications and people with applications.
- IoT also enables the compositions of work flow comprising all of the above interactions.
- IoT includes the notion of internet connectivity (which is provided in most of the networks outlined above) but is not necessarily focused on the use of telecom networks.

## IoT and WoT difference :

From a developers perspective, the WoT enables access and control over IoT resources and applications using mainstream web technologies (such as HTML 5.0, Javascript, Ajax, PHP, Ruby on Rails)

- The approach to building WoT is therefore based on restful principles and rest APIs, which enables both developers and deployers to benefit from the popularity and maturity of web technologies.
- Still building the WoT has various scalability, security etc. challenges, especially as part of a roadmap towards a global WoT.
- While IoT is about creating a networks of objects things, people, system and applications layer, WoT tries to integrate them to the web.
- Technically speaking, WoT tries can be thought as an option of an applications layer added over the IoT's network layer. However, the scope of IoT applications is broader and includes systems that are not accessible through the web (e.g. Conventional WSN and RAID System).

## Modern Day IoT applications

- Smart Parking
- Structural Health
- Noise Urban Maps
- Smartphone Detection
- Traffic Congestion
- Smart Lighting
- Waste management
- Smart Roads
- Forest fire detection
- Air Pollution
- Snow level monitoring
- Earthquake early detection
- Water leakages
- Radiation levels
- Explosive and Hazardous Gases
- Supply chain control
- NFC Payment
- Intelligent shopping application
- Smart product management
- River floods
- Tank level
- Water flow
- Smart Grid
- Liquid Presence
- Perimeter Access Control
- Photovoltaic Installations
- Silos Stock Calculation

## Exercise 1 : LED "On" Project

### • Components Required :

- (i) Arduino UNO Board.
- (ii) One red LED
- (iii) Arduino USB cable

### • Steps to follow :

- i. Connect the Positive of LED on 13 pin on arduino and Negative of LED on GND.
- ii. Run Arduino software
- iii. Create sketch for LED project.
- iv. Connect the USB cable with Arduino and computer.
- v. Click on upload option to download the program in Arduino.

### • Program :

```
void setup {
```

```
  Pin mode (13, output);
```

```
}
```

```
void loop ( )
```

```
{
```

```
  Digital writer (13, HIGH);
```

```
}
```

## Exercise 2 : LED "Blink" Project

### • Component Required

- (i) Arduino UNO Board
- (ii) One red LED
- (iii) Arduino USB cable

### • Steps to follow

- i. Connect positive of LED on 13 pin on Arduino & -ve of LED on GND.
- ii. Run arduino software.
- iii. Create sketch for LED project.
- iv. Connect the USB cable with Arduino and computer.
- v. Click on upload option to download the programme in Arduino.

### Program :

```
Void setup ( )
```

```
{
```

```
Pin Mode (13 output)
```

```
}
```

```
Void loop ( )
```

```
{
```

```
digital writer (13 High);
```

```
delay (2000);
```

```
digital writer (13 low);
```

```
delay (2000);
```

```
}
```

### Exercise 3: Integrating temp and humidity sensor and reading environmental value.

#### Components Required :

- (i) Arduino UNO Board
- (ii) DHT 11 (Temp. & Humidity sensor)
- (iii) Arduino USB cable
- (iv) 4.7 k ohm resistor
- (v) Bread board
- (vi) Jumper wire M.M.

#### Steps to follow

- (i) Connect DHT 11 on E10 to E13 where in pin 1 of DHT 11 on E10 and Pin 4 of DHT 11 on E13.
- (ii) Connect a 4.7 k ohm resistor between B10 & B11 of bread board. (Between VCC & data pin of DHT 11)
- (iii) Connect jumper wire b/w A13 of bread board & GND of Arduino.
- (iv) Connect jumper wire b/w A11 of bread board on pin 5 on Arduino.
- (v) Connect jumper wire b/w A10 of bread board to 5V on Arduino.
- (vi) Import library for DHT lib in Arduino IDE Software.
- (vii) Open sketch for DHT, Test in DHT lib examples in Arduino IDE.
- (viii) Connect the USB cable with Arduino and computer & then upload the program.
- (ix) Open the serial communication window and check the value.

## Exercise 4: Reading Environmental values on Android Smartphone.

### • Components Required :

- (i) Arduino UNO board
- (ii) DHT 11 (Temp. and Humidity sensor)
- (iii) Arduino USB cable
- (iv) HC-05 (bluetooth module)
- (v) 4.7 K ohm resistor
- (vi) 2.2 K ohm resistor
- (vii) 1 K ohm resistor
- (viii) Bread board
- (ix) Jumper wire MM.

### • Steps to follow :

- Connect a jumper between A10 of bread board to positive terminal of bread board.
- Mount the HC-05 Bluetooth module, between J25 to J30 where in state pin on J25 & EN Pin on J30.
- Connect a 2K ohm resistor between I26 & I28.
- Connect a 1K ohm resistor between H26 & D26.
- Connect a jumper wire between (GND) of Arduino to H28 of bread board.
- Connect jumper between G27 to Rx (Pin10) on Arduino.
- Connect jumper between G26 to Tx (Pin1) on Arduino.
- Connect jumper wire between G26 to positive terminal of bread board.
- Connect Jumper positive terminal of bread board to 5V of Arduino.
- Open sketch for Arduino - DHT 11 in Arduino IDE.

- (xi) Connect the USB cable with Arduino and computer.
- (xii) Click on upload option to download the programme in Arduino.

Note :-

While downloading the programme we have to disconnect the Rx & Tx jumper wire from Arduino board, Once we finish the download the reconnect the Rx & Tx jumper wire.

- (xiii) Download the Android APP from google playstore in smartphone.
- (xiv) Run this Android Application software.
- (xv) App will ask us to enable the bluetooth, Allow it.

Search for the Bluetooth device HC-05 (Cntrp No), Once connect Red LED on bluetooth module will blink once per second instead of fast blinking.

### Exercise 5: Voice controlled Home Automation.

• Component Required :

- (i) Arduino UNO Board
- (ii) HC-05 Bluetooth Module
- (iii) Three LEDs (Red, Yellow, Green)
- (iv) One 1k ohm resistors.
- (v) One 2k ohm resistor
- (vi) Arduino USB cable.
- (vii) Bread board.
- (viii) Jumper wires M-M.

Steps to follow :

- (i) Connect negative of red LED on C<sub>4</sub> & negative of C<sub>10</sub>.
- (ii) Connect negative of yellow LED on C<sub>14</sub> & negative on C<sub>15</sub>.
- (iii) Connect negative of green LED on C<sub>14</sub> positive on C<sub>20</sub>.
- (iv) Connect jumper wire blue negative terminal of bread board (GND) & A<sub>9</sub>.
- (v) Connect jumper wire blue negative terminal of bread board (GND) & A<sub>14</sub>.
- (vi) Connect jumper wire blue negative terminal of bread board (GND) & A<sub>19</sub>.
- (vii) Connect a jumper wire from Arduino GND to bread board negative (GND) terminal strip.
- (viii) Connect jumper wire Arduino pin 13 & D<sub>10</sub>.
- (ix) Connect jumper wire between Arduino pin 12 & D<sub>15</sub>.
- (x) Connect jumper wire between Arduino pin 11 & D<sub>10</sub>.
- (xi) Open the sketch for voice activation arduino program.
- (xii) Connect the USB cable with Arduino & computer.
- (xiii) Click on upload option to download the program in Arduino.

While downloading the program please disconnect the R<sub>x</sub> & T<sub>x</sub> jumper wire from Arduino board once we finish with the download. Then reconnect the R<sub>x</sub> & T<sub>x</sub> jumper wire.

(xiv) Then control the devices from our voice command on AMR - voice app.

(v) Voice commands to be used light on, light off, fan on, fan off, ac on & ac off.

## Exercise 6: Control devices using local host web server for automation.

### • Components Required:

- (i) Arduino UNO board
- (ii) Ethernet shield
- (iii) Three LEDs
- (iv) 5V relay module
- (v) USB Cable
- (vi) Bread board
- (vii) Ethernet cable
- (viii) Jumper wires M-M & M-F

### • Step to follow:

- i Mount Ethernet shield on Arduino UNO properly.
- ii Connect LAN cable with Ethernet shield & Laptop/router.
- iii Connect negative of LED Red on C<sub>9</sub> & +ve on C<sub>10</sub>.
- iv Connect positive of yellow LED on C<sub>14</sub> & negative on C<sub>15</sub>.
- v Connect negative of green LED on C<sub>16</sub> & positive on C<sub>17</sub>.
- vi Connect jumper wire between negative terminal of bread board (GND) & A<sub>9</sub>.
- vii Connect jumper wire between -ve terminal of bread board (GND) & A<sub>14</sub>.
- viii Connect jumper wire between -ve terminal of bread board (GND) & A<sub>19</sub>.
- ix Connect a jumper wire from Arduino GND (via Ethernet shield) to bread board -ve (GND) terminal strip.
- x Connect jumper wire between Arduino pin 6 & D<sub>10</sub>.

- xi). Connect jumper wire between Arduino pin 7 & D15.
- xii. Connect jumper wire between Arduino pin 8 & D20.
- xiii Connect GND of Arduino to GND (-ve) common terminal strip of bread board.
- xiv Connect I/P of relay to pin 9 of Arduino.
- xv Connect +5v of relay to +5v of Arduino.
- xvi Connect GND of Arduino to GND (-ve) common terminal strip of bread board.
- xvii Connect Arduino to laptop via USB cable.
- xviii Open the sketch of home server in Arduino.
- xix Find out the Ethernet module Mac address, Gateway IP, Subnet value and then enter in the program accordingly.
- xx Upload the program into Arduino.
- xxi To check your home server, simply enter the ethernet module IP in web browser.

Exercise 7 : Being social on twitter and update status on twitter through Arduino.

• Component Required :

- i Arduino UNO Board
- ii Ethernet Shield
- iii USB cable
- iv Ethernet Cable.

### Step to follow :

- i Sign up for a new account for thing speak  
[https:// www.thingspeak.com/users/new](https://www.thingspeak.com/users/new).
- ii Like your twitter account to the thing tweet App click on apps and then select thing tweet. Click on link twitter account.
- iii Copy the API key generated after linking twitter account.
- iv Mount Ethernet shield on Arduino UNO properly.
- v Connect LAN cable with Ethernet shield & laptop/router.
- vi Connect USB cable with Arduino & Laptop.
- vii Open the sketch of thingtweet.
- viii Enter the Mac address Ethernet shield IP address, default gateway IP etc in programme.
- ix Enter the thingtweet API key the program under String thingtweet API key = "02JS40WLLY2725VSS"  
: ← enter API here.
- x Upload the program in Arduino.
- xi Check your twitter Account

### Exercise 8: Send voltage or Analog data on cloud Server components.

#### • Component Required :

- I Arduino UNO Board
- II Ethernet shield
- III 10K Ohm preset
- IV USB cable
- V Ethernet Cable

Steps to follow:

- (i) Mount ethernet shield on Arduino UNO properly.
- (ii) Connect LAN cable with ethernet shield & laptop/router.
- (iii) Connect bottom two pins of IOK preset on I10 & I12 on breadboard & centre Top pin on GND.
- (iv) Connect a jumper wire from 5V of Arduino to I10 of breadboard.
- (v) Connect jumper wire from I11 of breadboard to A0 on Arduino.
- (vi) Log in to our things speak account & click on channel, then click on create new channel.
- (vii) Give a channel name, select field, and write volt in field: text then save.
- (viii) Now write API from API tab.
- (ix) Connect USB cable from Arduino to laptop.
- (x) Open the sketch for voltage upload and enter the API key & MAC address in program.
- (xi) Upload the program to Arduino & then check our things speak channel.

Example 9: Use Arduino to upload free data from environmental sensors to cloud server.

• Component Required:

- (i) Arduino UNO Board
- (ii) Ethernet Shield
- (iii) DHT 11
- (iv) 4.7 K Resistor
- (v) USB cable
- (vi) Ethernet cable and Jumper wire MTL.

### Steps To Follow :

- (i) Mount Ethernet shield on Arduino UNO properly.
- (ii) Connect LAN cable with Ethernet shield & Laptop/router.
- (iii) Repeat steps 1 and 2 from reading environment value project.
- (iv) Connect a jumper wire between A<sub>11</sub> of bread board to pin 5 on Arduino Ethernet shield.
- (v) Import DHT 11 Lib Arduino IDE Software.
- (vi) Login to our things peak account & click on channel.  
Then click on create new channel.
- (vii) Give channel name weather station select field 1 and write temperature in field 1 text field, select field 3 & write humidity in field 2 text field save.
- (viii) Note the write API from API Lab.
- (ix) Connect USB cable from Arduino to laptop.
- (x) Open the sketch for upload sensor data & enter the API key & MAC address in programme.
- (xi) Upload the programme to arduino and check our things speak channel.

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