



**Dr. M.G.R.**  
**EDUCATIONAL AND RESEARCH INSTITUTE**  
**(Deemed to be University)**

Maduravoyal, Chennai - 600 095. Tamilnadu. India.

(An ISO 9001 : 2015 Certified Institution)

University with Special Autonomy Status



**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**INTERNET OF THINGS (IOT) LAB –CENTRE OF EXCELLENCE**

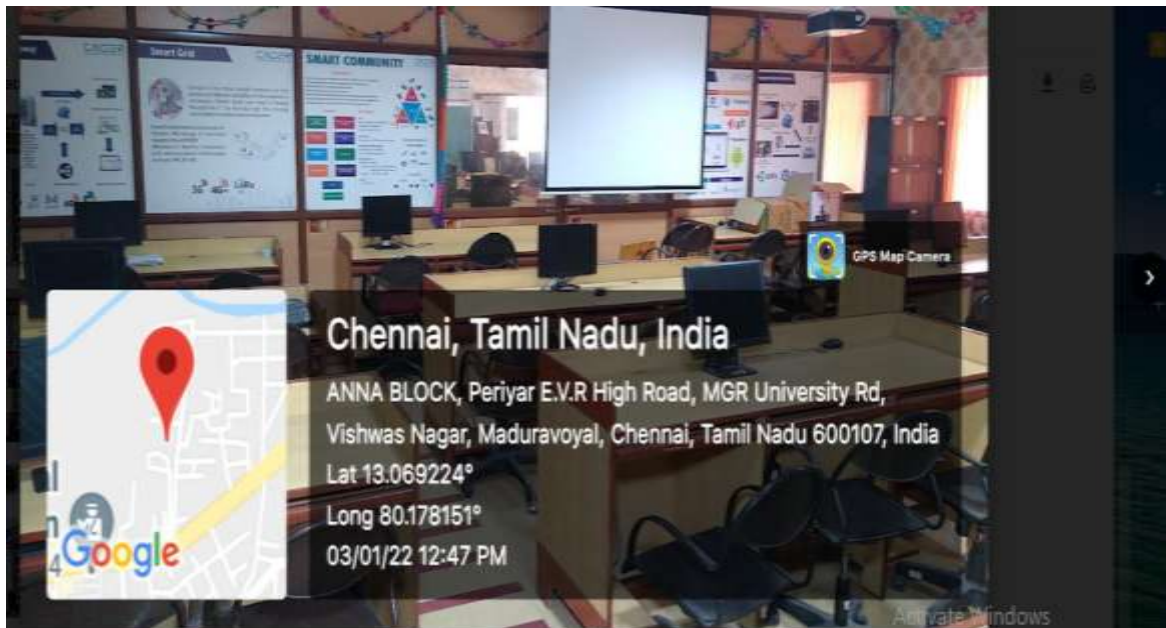
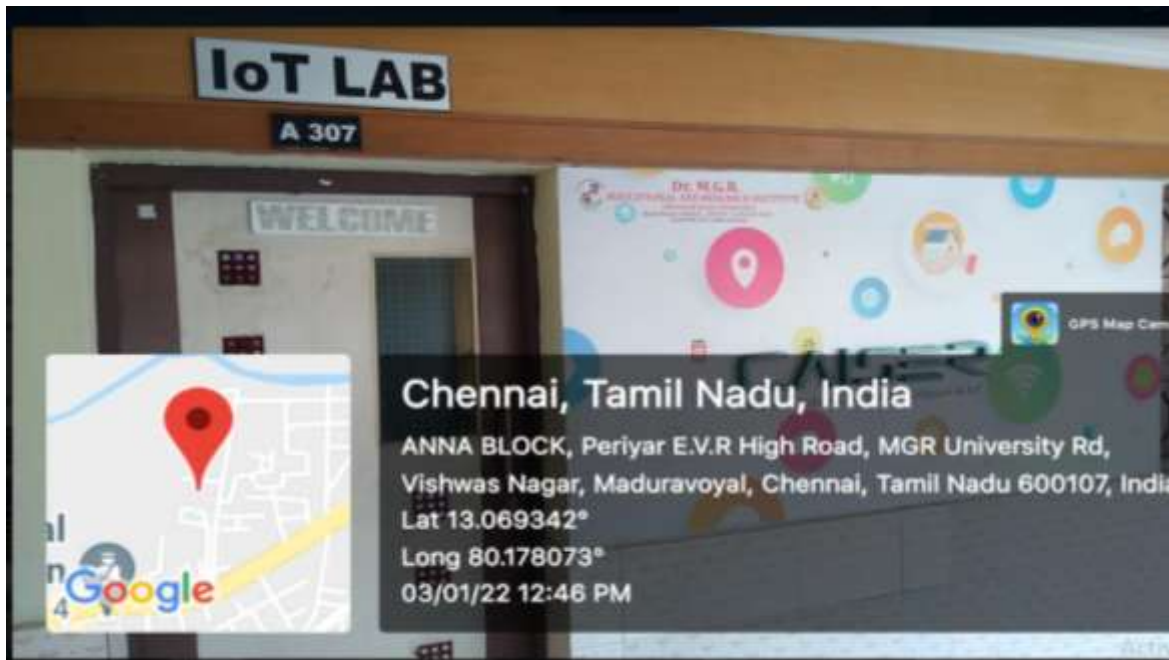
***“MAKE EVERYTHING SMART”***

CENTRE OF EXCELLENCE – IOTLAB provides end to end IoT Solutions

Create Value through our high performance Analytics to realize the benefits of IoT



## IOT LAB – CENTRE OF EXCELLENCE



***About :***

The IoT Centre of Excellence was established as the fervor within the IoT community at our university. The IoT Centre of Excellence provides a raised area for rendezvous and teamwork.

Our Centre of Excellence aims for reigning towards supremacy in Internet of Things and promising technologies with a comprehensive approach that caters to the active nature of the domain, including staffing, talent evolution and globalization.

***Research :***

Internet of Things has emerged as a leading technology around the world. It has gained a lot of popularity in lesser time. Also, the advancements in Artificial Intelligence and Machine Learning have made the automation of IoT devices easy. Basically, AI and ML programs are combined with IoT devices to give them proper automation.

Few identified key areas to watch for IoT patent filings are :

- Healthcare
- Autonomous/Driverless Vehicle Technology
- IoT Smart Cities
- Autonomous/Driverless Vehicle Technology
- Electrical Grid Industry,
- Industrial IoT (IIoT), etc.

***IoT Lab Equipments and Facilities :***

The IoT Centre of Excellence is equipped with the latest hardware, softwares, tools, etc., to induce profound learning in students and keep them edgy towards current developments.

## Intel Galileo Boards :

Intel is committed to providing the ultimate processors, boards, and tools to its community. The first initiative by Intel is the introduction of Intel Galileo and Intel Galileo Gen 2 boards, which are compatible with the Arduino headers and reference APIs. They also opened the Intel maker forum and created Intel Arduino IDE.

Intel Galileo boards are open source and open hardware; in other words, all the source code and hardware schematics are available online, which you can download, use, and modify.

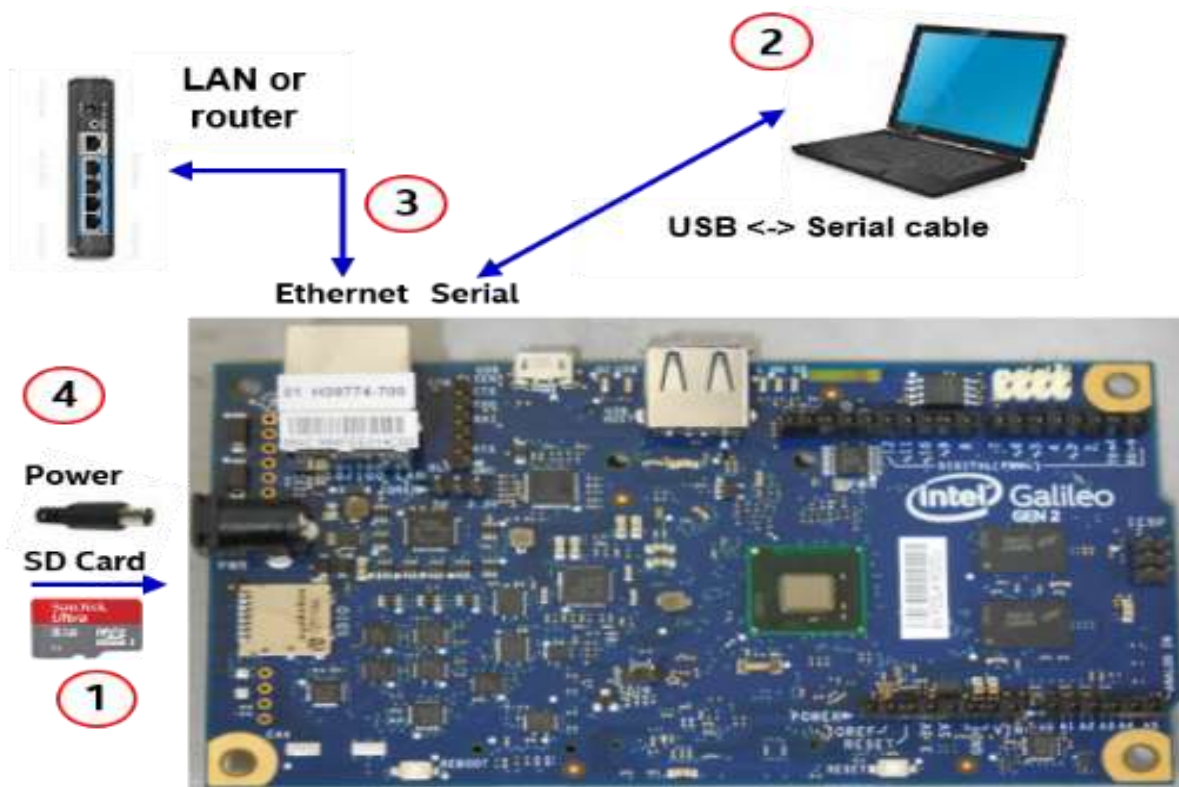
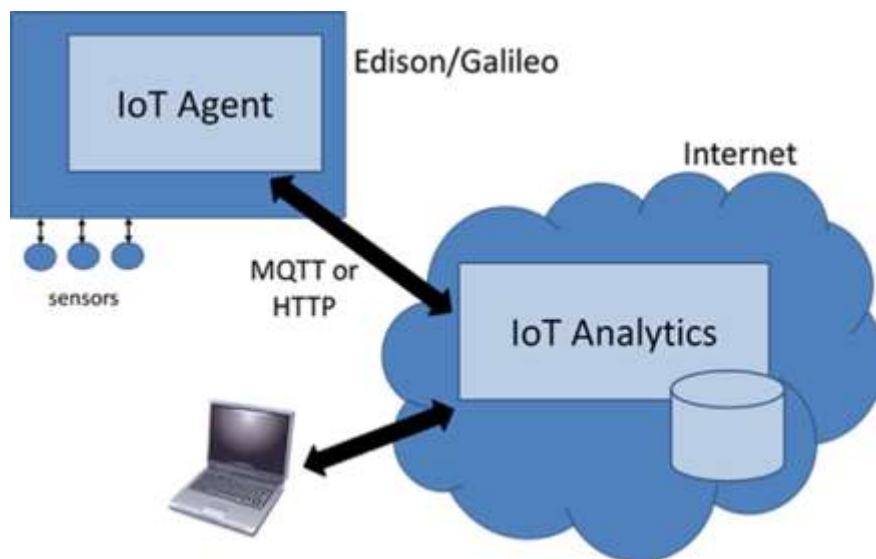
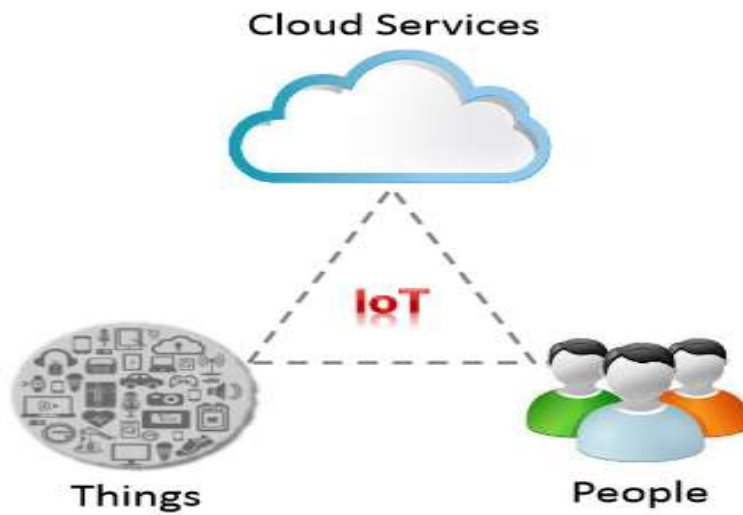
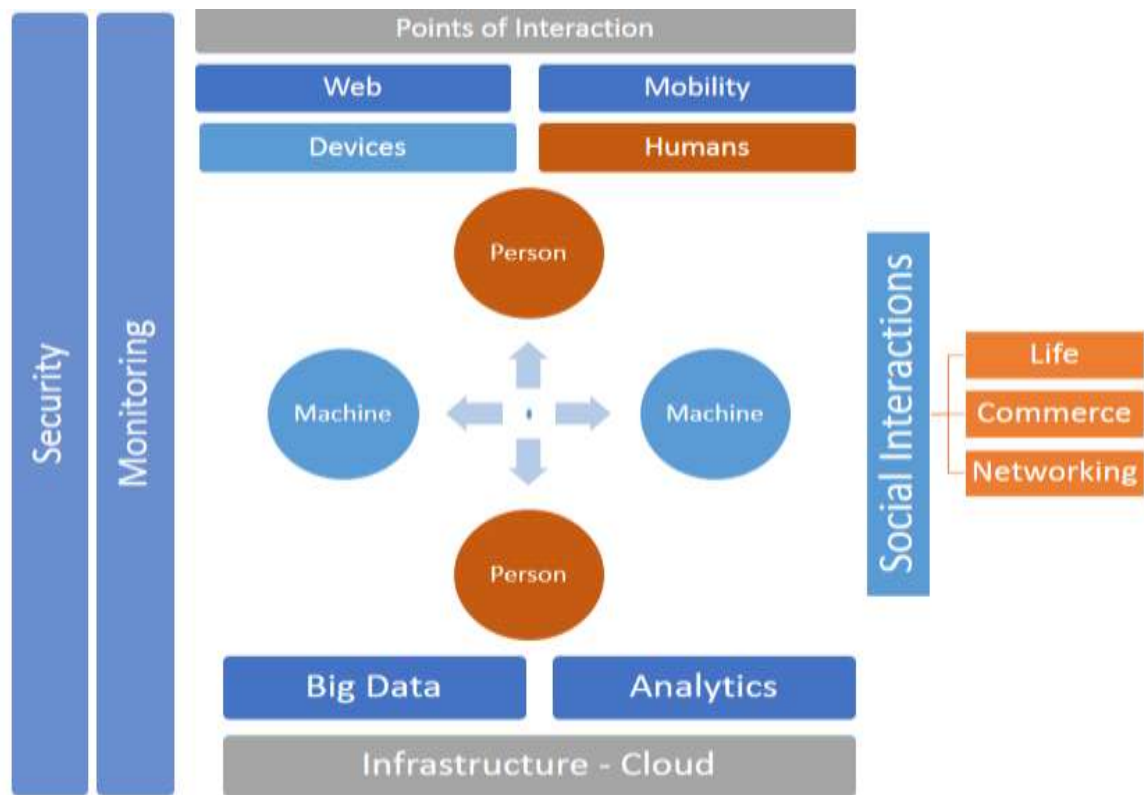


Figure : Intel Galileo Gen 2 Board

## Cloud-Based Analytics System For The Internet-Of-Things (IOT) :







Different Types Of Sensors :



### **API supported**

- Intel® XDK IoT Edition
- Yocto Linux system

### **Supported libraries**

- GCC
- Python
- Node.js
- OpenCV

### **Intel Galileo Gen 2 Specifications :**

- SoC- Intel Quark SoC X1000 single core, single-thread application processor @ 400 MHz, with 12KB embedded SRAM
- System Memory – 256MB DDR3
- Storage – 8MB NOR, 8KB EEPROM, and micro SD card slot (up to 32GB)
- Connectivity – 10/100M Ethernet
- USB – 1x USB 2.0 host port, 1x micro USB 2.0 device port used for programming Debugging / Programming
- 6-pin 3.3V USB TTL UART header

### **Arduino Uno R3 headers that support most Arduino shields:**

- 20x digital I/O (12x fully native speed)
- 6x analog inputs
- 6x PWMs with 12-bit resolution

- 1x SPI master
- 2x UARTs (1 shared with console UART)
- 1x I2C master

Galileo is compatible with Arduino Uno shields and is designed to support 3.3V or 5V shields, following the Arduino Uno Revision 3, including:

- **14 digital input/output pins**, of which 6 can be used as Pulse Width Modulation (PWM) outputs
- Each of the 14 digital pins on Galileo can be used as an input or output, using `pinMode ()`, `digitalWrite ()`, and `digitalRead ()` functions.

Hardware Components Of The IOT :

- Intel® Galileo Board



- MicroSD Card



- Ethernet Cable



- Serial to D9 Cable

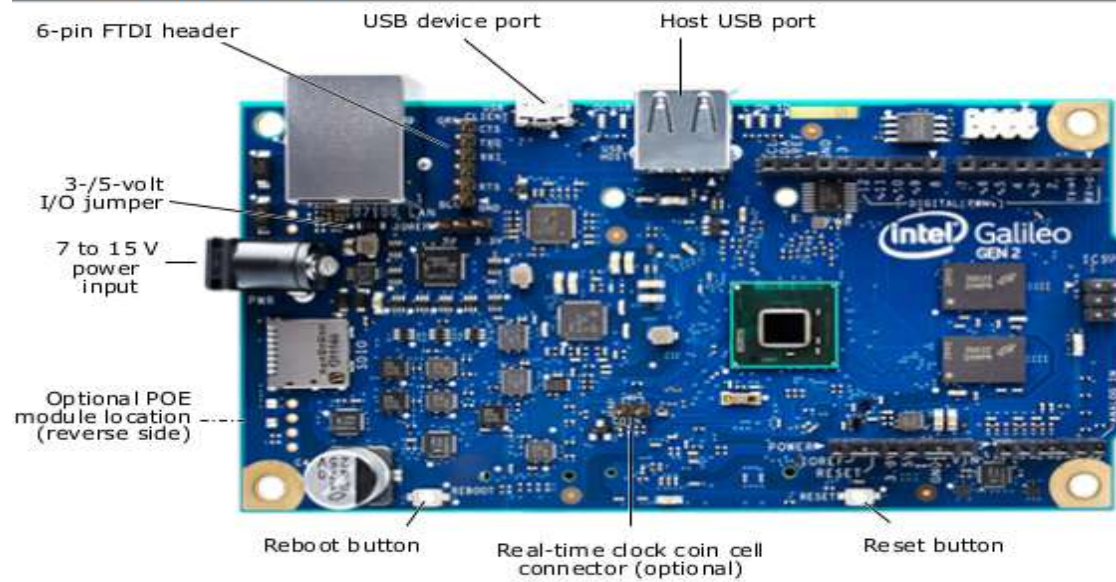


- USB to Serial Cable



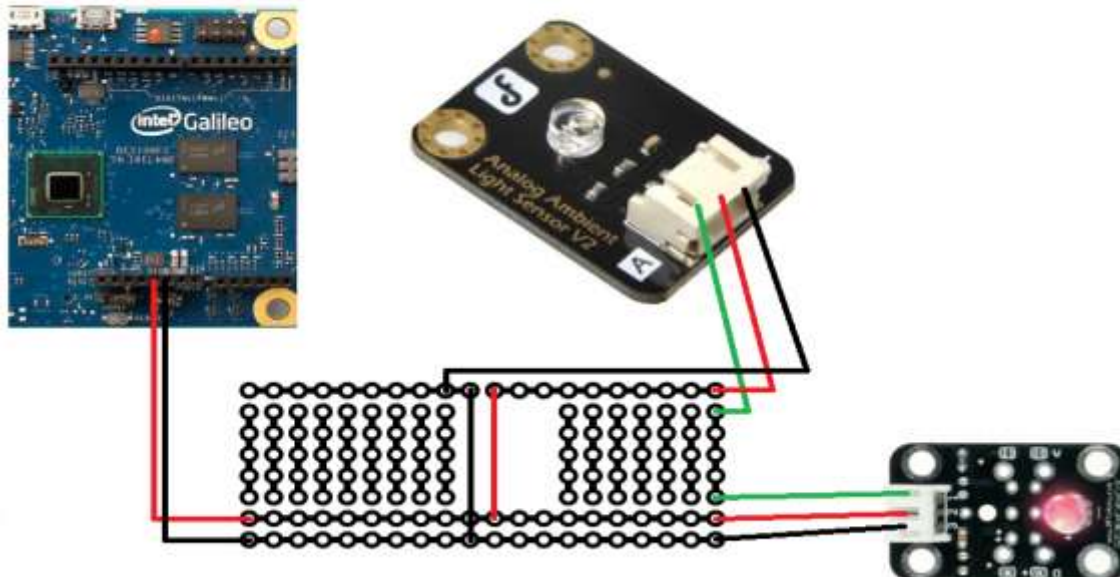


## Intel® Galileo Gen 2 board

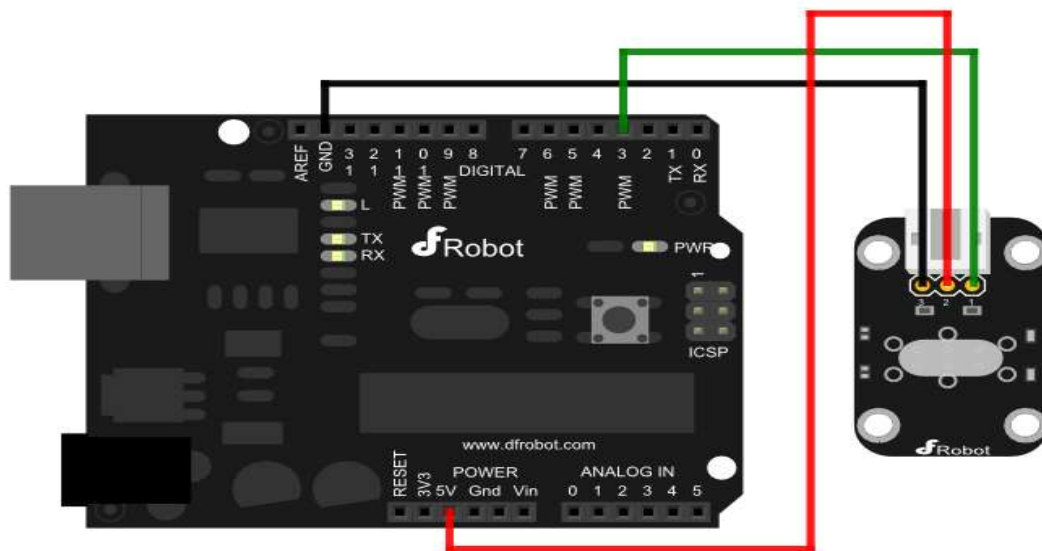


Placing Sensors Using Breadboard :

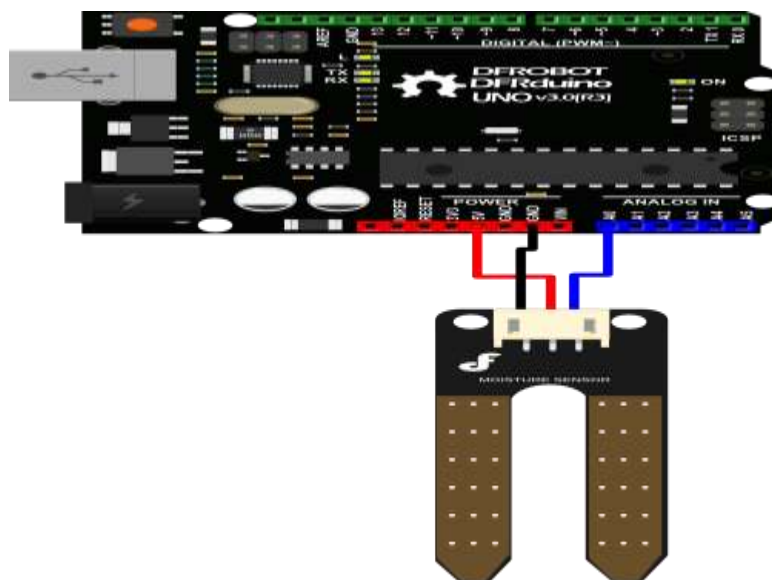
## Intel® Galileo Board



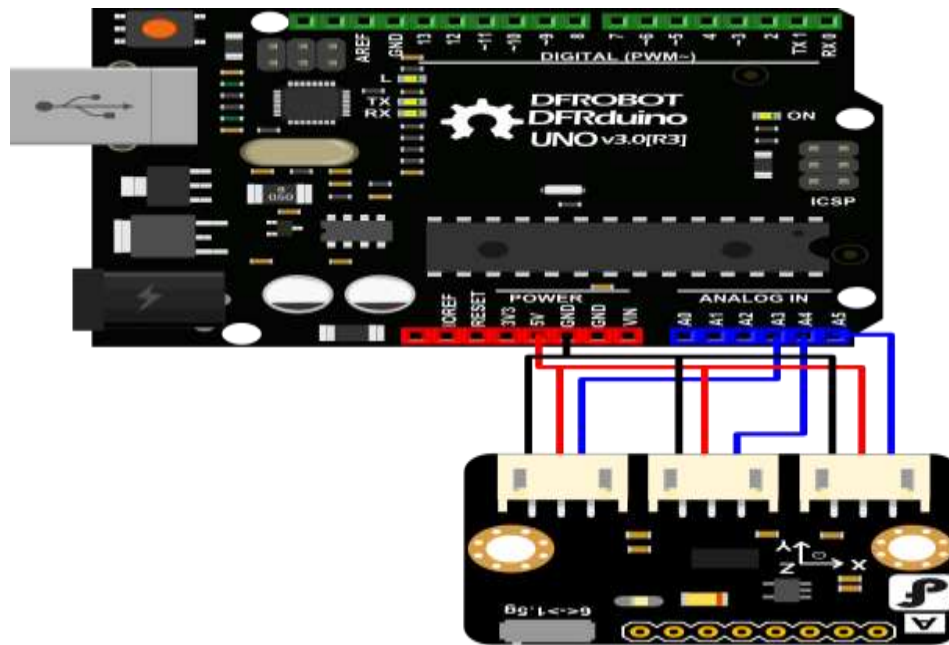
Digital Tilt Sensor :



Interfacing And Connection With Moisture Sensor :



## Interfacing And Connection With Accelerometer Sensor :



### A0 – A5 - 6 Analog Inputs :

- Each of the 6 analog inputs, labeled A0 through A5, provides 12 bits of resolution (i.e., 4096 different values). By default they measure from ground to 5 volts.
- **The Galileo Gen 2 uses a Texas Instruments ADS108S102 ADC, which allows for a 4x increase in ADC sampling performance in Linux compared with Galileo Gen1**
- **I2C\* bus, TWI**, with SDA and SCL pins that are near to the AREF pin.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- **VIN**.The input voltage to the Galileo board when it's using an external power source (as opposed to 7-15 volts from the regulated power supply connected at the power jack). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V output pin**. This pin outputs 5V from the external source or the USB connector. Maximum current draw to the shield is 800 mA

- **3.3V output pin.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw to the shield is 800 mA

### **Memory :**

Galileo features 256 MB of memory. By looking at the schematic of Intel® Galileo, it seems possible that RAM capacity may increase to 1GB (2x512MB) Only time will tell.

### **HeadPhone Jack :**

A 3.5mm Audio Jack is included on-board. Care must be taken as it is not speaker or Headphone compatible. It is for serial UART RS-232 signals only.

### **Software Serial Library Support :**

Support for SoftwareSerial Library on Galileo is available but not suggested as the board cannot sustain the emulated baud rates. Be ready to change your libraries (GPS, GSM/GPRS etc.) to use hardware UART port instead of SoftwareSerial.

### **Power Supply :**

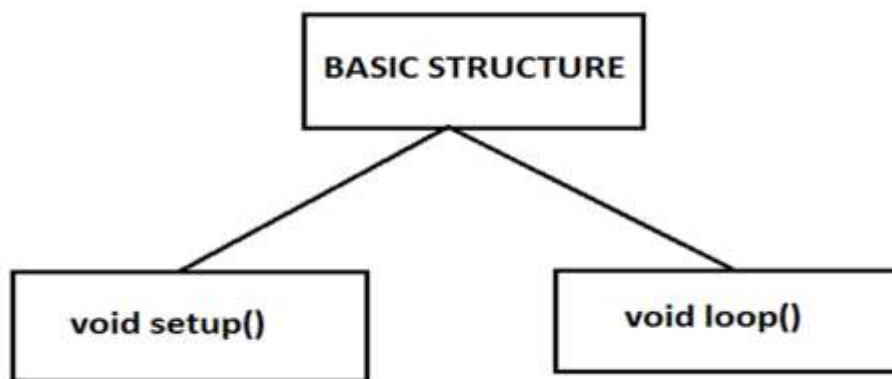
A compatible power supply 7 – 12 V comes with the board.

### **Intel Galileo Connected With Power Supply :**



### Basic program structure :

```
void setup()
{
  statements;
}
void loop()
{
  statements;
}
```



### Library Functions :

Functions	Usage	Example
<b>pinMode</b>	It is used in void setup() to configure a digital pin to behave as input or output.	pinMode(pin, OUTPUT);
<b>digitalRead(pin)</b>	reads the value from a pin with result = HIGH or LOW.	Value = digitalRead(pin, HIGH);
<b>digitalWrite(pin)</b>	Turns a pin on or off, i.e. HIGH or LOW.	digitalWrite(pin, LOW);

Functions	Usage	Example
<b>pinMode</b>	It is used in void setup() to configure a digital pin to behave as input or output.	pinMode(pin, OUTPUT);
<b>analogRead(pin)</b>	Reads the value from a analog pin (only pins 1- 5) with 10-bit resolution.	Value = analogRead(pin);
<b>analogWrite(pin, Value)</b>	Outputs a PWM signal on the PWM pin. A 0 value generates 0V and 255 generates 5V at the pin	



### ***Industrial Collaborations :***

The collaboration between universities and the industry is progressively more perceived as a vehicle to augment modernism through acquaintance barter. This is palpable by a trivial increase in studies that explore the topic commencing diverse perspectives.

For Training and Development of IoT projects in collaboration with industrial partner “CAISER” more than 100 students from various departments benefited. Many Research projects are being incubated and journals were published using the facilities of CENTRE OF EXCELLENCE – IOT LAB

Our IoT Centre of Excellence proudly presents the following research and completed projects via prideful Industrial Collaborations -

### **PROJECTS COMPLETED :**

#### **1) IIoT Gateways**

Abstract :

Gateway is a data communication device to connect through the internet, the gateway is implemented at the boundary of a network to manage all the data communication that is routed internally or externally from that network. An IIoT gateway may also be referred to as an intelligent gateway, it is a physical device that serves as the connection point between the cloud and controllers, sensors and intelligent devices. It is a software program or a dedicated hardware appliance. The proposed model of the gateway to use the nodemcu8266 interface with sensors will act as sensor node. Which communicate to the gateway using MQTT Protocol to post the data to the cloud, thus acting as bridge. Finally given an implementation of prototyping system and system validation, *Arduino Uno, MQTT, NodeMCU, Gateway*

The screenshot shows the phpMyAdmin web interface. The left sidebar displays the database structure, with 'gateway\_data' selected. The main panel shows the 'Structure' tab for the 'gateway\_data' table. The table has three columns: 'id' (INT), 'hostname' (VARCHAR), and 'ip' (VARCHAR). The 'Data' tab is also visible, showing three rows of data. The status bar at the bottom indicates 'Showing rows 1100 - 1103 (1104 total). Query took 0.0015 seconds'.

id	hostname	ip
1100	192.168.1.1	192.168.1.1
1101	192.168.1.2	192.168.1.2
1102	192.168.1.3	192.168.1.3

## 2) Smart Air Purifier Based On IOT

### Abstract :

The designed air purifier, has got the PM 2.5 detection and filtration based on both mechanical and electronic sensing aid systems. The smart air purifier based on IoT sends the streaming data to the Web Panel for visualization. The necessary data is a real time data based on the current detection and processing done by the Arduino and Node MCU controllers involved in the project. The Web Panel also displays the graph corresponding to the parameters involved on the project. The Smart air purifier has got many sensors to collect data's like temperature, humidity and dust level that are processed by sequential algorithmic procedures for real time data streaming to the web through the Node MCU interface.

The Smart air purifier may also be upgraded to a room size greater than 150 sq. feet where it can be fitted with a suction pump and the exhaust model seen in larger presentation halls so that they can act as room air purifiers. The Purifier functionality is based on active PM sensing and passive PAD filtration coupled with low level compression of air.

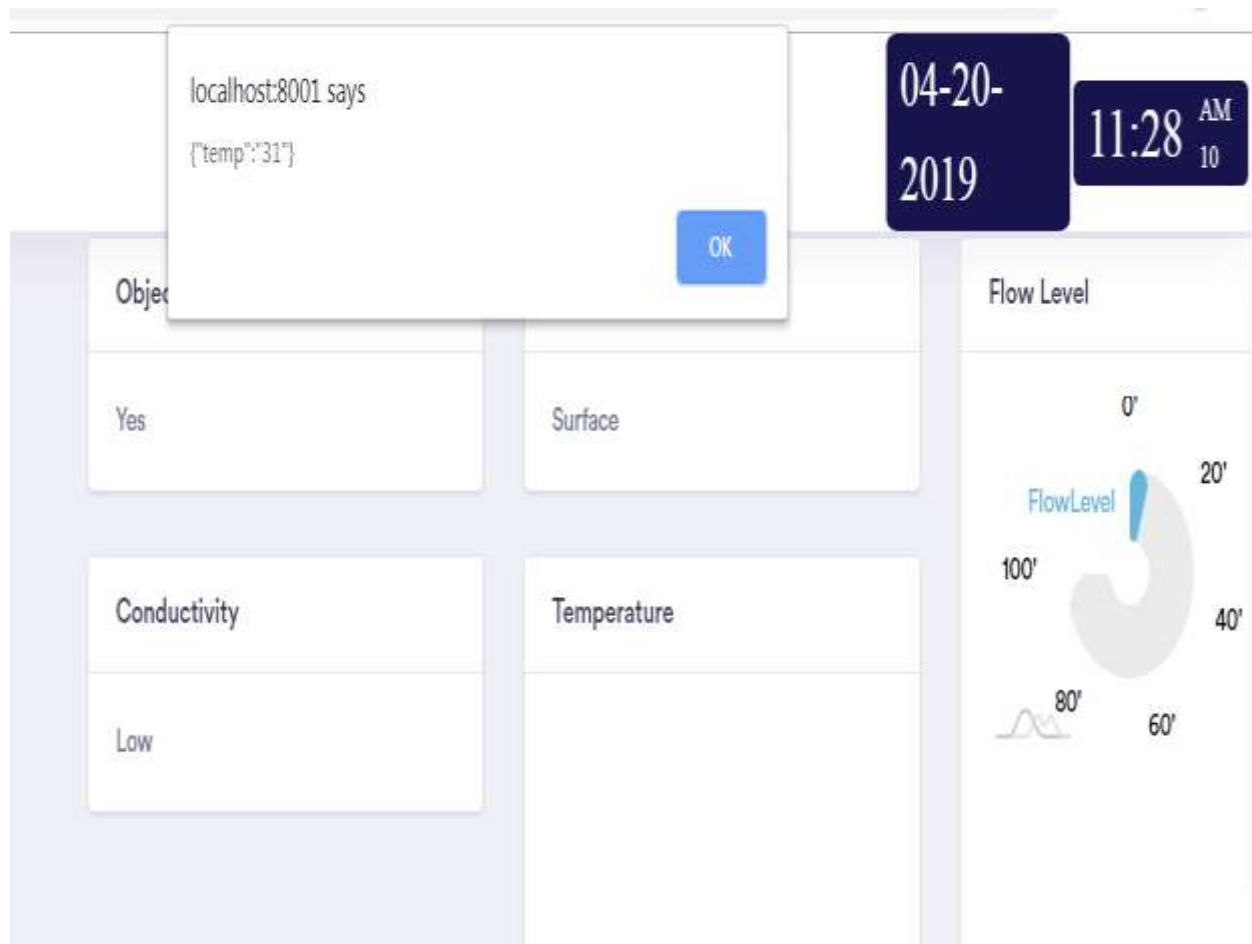
### Project Setup :



### 3 ) Smart Water Quality Monitoring System

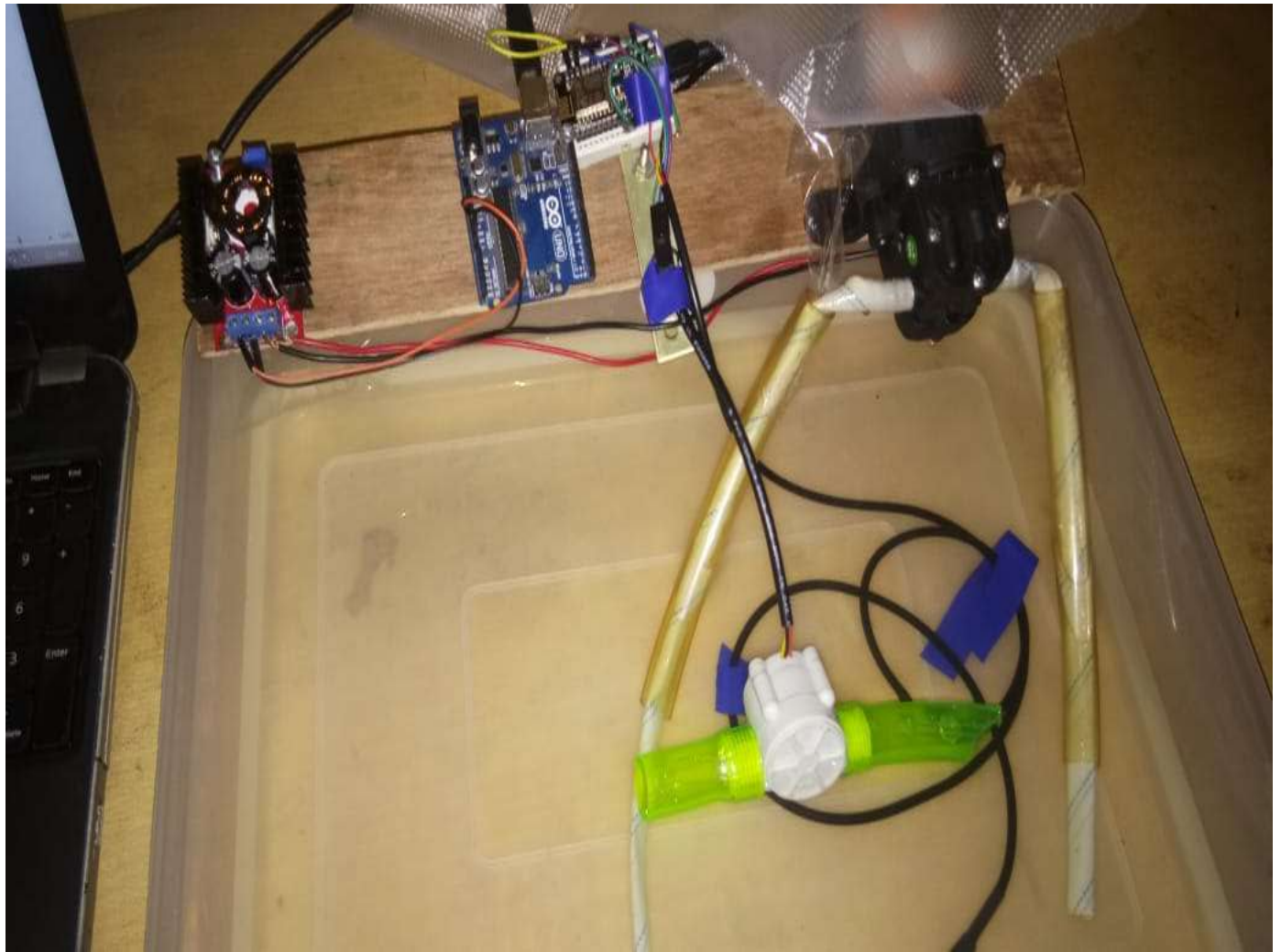
The Proposed Underwater Detection Project Is Aimed At Classification Of The Water Region Based On Data From Many Sensors. Water Region Is One Of The Most Important Hydro Indicators Of Conducting Field. Systems Using Camera Use Spatial, Spectral And Temporal Resolutions Have The Capacity To Quantify Such Regions. But Not Just Enough For Chemical And Gas Emission From Such Areas. Accumulated Precipitation And Lake Area Fluctuation In River Basins Is An Example. Highest Biomass Occurs Under Some Temperate Conditions With Mixed. Nutrient Concentrations ( $\text{NH}_4\text{N}$  And  $\text{NO}_3\text{N}$ ) In The Upper Water Region Are Also A Hazard To The Surrounding When Left Unmonitored.

The Underwater Region Project Sends Cumulative Data To The Processing Unit Where The Decision Making Algorithms Detect The Zones Or Area Depending On The Classification Chart. The Data Is Streamed Into Iot And Web Panel Is Outlined For Visualization.



Id	Flow Level Represented (L/Min)	Temperature
1	5	31
2	9	31
3	8	31
4	8	31
5	1	31
6	7	31
7	9	31
8	8	31

Project Setup :





## PRODUCT DEVELOPED IN IOT LAB:

### 1) Smart Switch - Architecture Framework

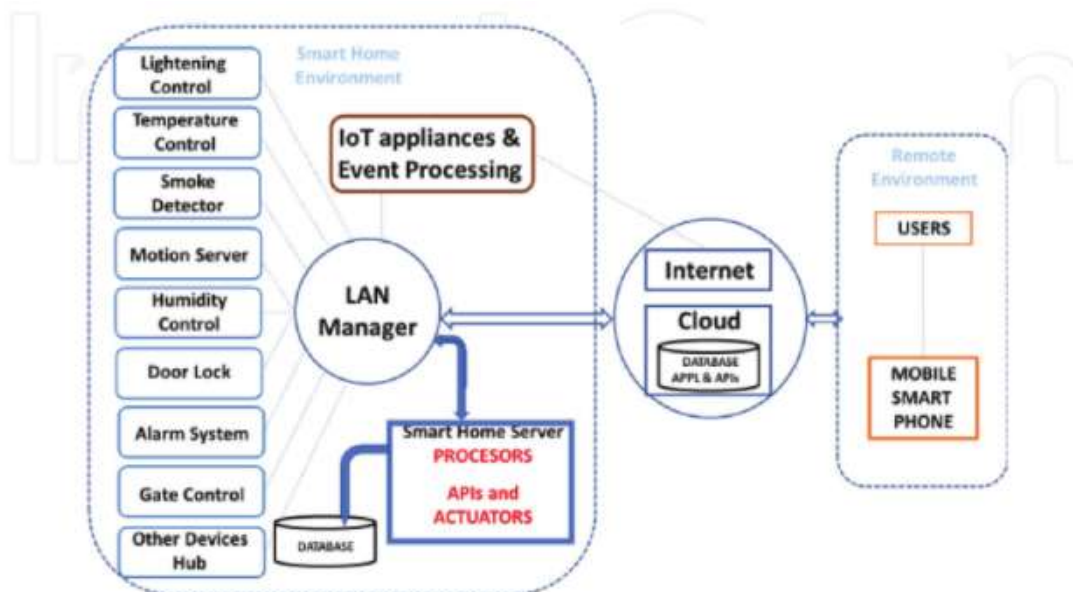


This smart switch is still a light switch, but with advanced features that will help automate your home. A direct replacement for your traditional built-in switches. They are installed using your existing in-wall back boxes. Smart switch's still work as a regular light switch, but also provide you with new ways to control your home lighting and switch-wired devices. Smart switches can control lights, hardwired appliances like waste disposal units and fireplaces, even the ceiling and bathroom fans throughout your home. True remote-control through a dedicated app, connected over your home Wi-Fi network, so you can access your switches from anywhere, anytime. This is an innovative product which helps to save energy thereby reducing the damages to the environment. Further, it eases the operability – i.e., fully automated [manual operations is also available]. The main thing this smart switch provides is convenience, enabling you to easily control your lights with your smartphone. This Smart Switch for Home Automation is a reliable smart replacement which gives remote ON or OFF scheduling. This device comes out good at controlling. This smart switch system allows us to control all the electronics of home through mobile application from anywhere around the world

## 2 )Smart Grocery System Management With IoT Enabled Applications

The Internet of Things (IoT) technology presents an opportunity for sending a message to the shop to refill the groceries item. It enables AI-sensor in the partition box intimate the retail store to refill the items. The smart kitchen develops an infrastructure that makes physical things such as mobile phones, shopping baskets; store shelves, digital displays, and, even the product itself smart, allowing real-time interaction with customers both in the physical and the virtual groceries store. The IoT technology is configured with Alexa and google assistant to open the grocery storing-cupboards. The aim of this IoT project is to expand understanding of how IoT can create value in the retail grocery choice situation. It also senses the level of the gas cylinders and it intimate to the LPG refilling gas station.

Raw End-Look Of The Product :



## 3) Smart Gate System Management For IoT Applications

Smart home gate systems with IoT AI-enabled Alexa to achieve great popularity with comfort and increase the quality of life. Most smart home systems are controlled by smartphones and

microcontrollers. A smartphone application is used to control and monitor the smart gate function by using GPS technology to explore the concept of the smart gate with the integration of IoT services and cloud computing to it, by embedding intelligence into sensors and actuators, networking of smart things using the corresponding technology, facilitating interactions with smart things using cloud computing for easy access in different locations and it automatically opened the smart gate when a user approached it close enough for the AI-sensors to detect and open the door. In this IoT project, we present a composition of multiple components to build a robust approach to an advanced smart home concept and implementation.

Raw End-Look Of The Product :



### ***Certificates :***

In grateful recognition for our students enduring commitment to exceptional involvement in IoT technologies, the following certificates were presented as appreciation :



**Picture Courtesy : Sample Certificates of Caiser Training In Our IOT Centre Of Excellence Laboratory**

### ***Publications :***

There is immense bearing to research in education. In receipt of a research project published in an accredited journal holds benefits for both the researcher and the institution hosting the journal. Apart from ensuring an profound knowledge over a topic, scientific and historical research papers also contribute to the world of knowledge.

The IoT Centre of Excellence accolades the following publications to mention a few carried out successfully at the IOT Lab :

1. 1. F.Jerald,M.Anand,N.Deepika      Design Of An Industrial Iot Architecture Based On MQTT Protocol For End Device To Cloud CommunicationInternational Journal Of Recent Technology And Engineering
2. Swarna M, GodhavariTCOAP Based Congestion Control Mechanism For Low Power IoT Networks International Journal of Innovative Technology and Exploring Engineering (IJITEE)
3. K.Saravanan,M.Swarna,study on dual stack, tunneling and translation techniques for migration of IPV4 to IPV6 Network International Journal On Recent Researches in Science ,Engineering and Technology
4. Ann Roseela, J&Godhavari, T 2019, 'Biometric and RFID based authentication system for exam paper leakages detection using IoT technology', Indonesian Journal of Electrical Engineering and Computer Science, vol. 20, no. 3
5. Ann Roseela.J, Godhavari.T, Rm.Narayanan, P L Madhuri,'Design and deployment of IoT based underwater wireless communication system using electronic sensors and materials ',Materials Today: Proceedings
6. SenthilKumar,K and Kavitha,G,Detection of Diabetes by Monitoring Pancrease using NIR SensorInternational Journal of Innovative Technology and Exploring Engineering (IJITEE)
7. Dr.K.S.Thivya,Mrs.S.ElakkiyaMrs.S.Anandhi,Smart Air Purifier Based On IOT Journal of The GujaratResearch Society

**The IoT Centre of excellence takes pride in stating that the patent has been filed for project titled “Smart Air Purifier Based on IOT” which was developed in our IoT Lab.**