

INDUSTRIAL IOT AND AUTOMATION

LAB MANUAL

Date:

Experiment No: 1

Introduction and Architecture to IoT

IoT (Internet of Things)

<u>IoT</u> means Internet of Things. This is representative of the connection with the superior ability to increase efficiency, influence, save time and costs for organizations. Sensitive connections from devices in the enterprise without human intervention are the highlight that IoT brings to your company.

IoT technology will provide better quality insights to all parts of the business. From the supply of raw materials to inventory control, asset information to assess and prepare for maintenance work, improve the quality of goods in production, and closely monitor the delivery of goods. and a fleet of delivery vehicles, ensuring the quality of customer service experience, etc. Cloud-based IoT applications also allow organizations and businesses to directly access external and internal data in real-time, making decisions faster.

IIoT (Industrial Internet of Things)

<u>IIoT</u> is the Industrial Internet of Things. This is a network of smart devices with their computing capabilities, connected to industry-level data collection, monitoring, exchange, and analysis systems. The main focus of IIoT is on industrial applications such as manufacturing, power plants, agriculture, oil, and gas.

Industrial Internet of Things is a part or can be said to be a subset of Internet of Things, i.e. IIoT under IoT mainly focused on industrial applications. Smart devices play an important role in IIoT, helping to communicate important information in a better way and analyze and capture data in real-time. Using IIoT, business decisions can be made more quickly and accurately. IIoT also helps companies grow by understanding business processes in a better way and making them more efficient.

Difference between IIoT and IoT:

| SI. No | ΙΙΟΤ | ΙΟΤ |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | IIoT is more focused on improving the performance of a device, a machine, or an entire business | Consumer IoT is deployed to enhance or improve aspects of individuals' daily lives |
| | process. | such as smartphones, smart homes, and smart cities. |
| 2. | Use more complex instruments to scale to provide more detailed visibility and enable automated controls and perform complex analyses. These are systems where failure often leads to life-threatening or other emergency situations. | IoT tends to be consumer-grade devices with a low risk of failure. Incidents also do not create an immediate emergency. |
| 3. | IIoT connects critical machines and sensors across industries at scale. | IoT can be used at the consumer level. |
| 4. | Can be programmed remotely onsite. | Provides easy off-site programming. |
| 5. | Processing very large data due to industrial scale. | Handling volumes from very small like Wearable devices to objects you use in everyday life, such as thermostats, irrigation pumps, kitchen appliances, TVs with Internet |
| 6. | Strong security requirements to protect data. | Requires identity and privacy. |
| 7. | There are strict requirements. | Moderately required attribute. |
| 8. | Has a very long life cycle. | Has a short product life cycle. |
| 9. | Has a very long life cycle. | Reliability is getting better and better. |

<u>1.Introduction to Arduino :</u>



<u>Arduino</u> is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

1.A) Introduction to Software :

Installing Arduino IDE

The first thing you need is the Arduino IDE. If your computer doesn't have Arduino IDE installed, then visit the official Arduino download page and download the installation file for your preferred operating system

Link: https://www.arduino.cc/en/software

Downloads



Arduino IDE 2.1.1

The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger.

For more details, please refer to the **Arduino IDE 2.0** documentation.

Nightly builds with the latest bugfixes are available through the section below.

SOURCE CODE The Arduino IDE 2.0 is open source and its source code is hosted on **GitHub**.

DOWNLOAD OPTIONS

Windows Win 10 and newer, 64 bits Windows MSI installer Windows ZIP file

Linux AppImage 64 bits (X86-64) Linux ZIP file 64 bits (X86-64)

macOS Intel, 10.14: "Mojave" or newer, 64 bits macOS Apple Silicon, 11: "Big Sur" or newer, 64 bits

Release Notes

Click and Win 10 and newer and install the software.

Installing the Microcontroller Board in Arduino IDE 1.ESP 32

There's an add-on for the Arduino IDE that allows you to program the ESP32 using the Arduino IDE and its programming language. We'll show you how to install the ESP32 board in Arduino IDE.

After Installing Arduino IDE open the IDE and Click on Files and select Preference.



| Preferences | Settings Network | × |
|------------------------------|-----------------------------|-----------|
| Sketchbook location: | | |
| c:\Users\Admin\Documents\A | rduino | BROWSE |
| Show files inside Sketches | | |
| Editor font size: | 14 | |
| Interface scale: | ✓ Automatic 100 % | |
| Theme: | Light ~ | |
| Language: | English ~ (Reload required) | |
| Show verbose output during | 🗌 compile 🗌 upload | |
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| Verify code after upload | | |
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Copy this link and Paste it in the Additional Boards Manager URLs Box as shown Below <u>https://dl.espressif.com/dl/package_esp32_index.json</u>

| | Settings Network | |
|-----------------------------|----------------------------------------------------------|-----------------------|
| Sketchbook location: | | |
| c:\Users\Admin\Documents\A | rduino | BROWSE |
| Show files inside Sketches | | |
| Editor font size: | 14 | |
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| Verify code after upload | | |
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| Editor Quick Suggestions | | |
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And Click on OK.



Then click on Boards Manager as shown.

Type ESP32 in Search Bar and click on second one and click Install as shown below.

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| | | DOIT ESP32 DEVKIT | V1 |
| Ľ | | BOARDS MANAGER | ske |
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| | 7 | Arduino ESP32 Boards by Arduino | |
| Ľ, | > | Boards included in this package: Arduino Nano ESP32 More info | |
| 0 | 2 | 2.0.11 V INSTALL | 1 |
| | | esp32 by Espressif | |
| | | Boards included in this package: ESP32 Dev Board, ESP32-S2 Dev Board, ESP32-S3 Dev Board, More info | |
| | | 2.0.11 ~ INSTALL | |

Now ESP32 Board is successfully installed in Arduino IDE and ready to use.

```
Program:
constint led = 2;
void setup() {
pinMode(led, OUTPUT);
}
void loop()
{
digitalWrite(led, HIGH);
delay(1000);
digitalWrite(led, LOW);
delay(1000);
digitalWrite(led, HIGH);
delay(1000);
digitalWrite(led, LOW);
delay(1000);
}
```

OUTPUT:

Wait a few seconds while it uploads. Afterward, you should see the LED connected to pin 13 blinking.

<u>(ii) Pulsing LED</u>



LED Fade Exercise Circuit Layout

Result:

Conclusion:

Viva Questions:

Date:

Experiment No: 2

1. Measurement of Temperature and Pressure using ESP32



Note : Make the connections as per the image shown above

| Coung Part | 2.1.0 Arduino IDE 2.1.0 | | | | | |
|-----------------------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------|--|--|--|--|
| <u>Library Installation :</u> (Download the below Library as shown below) | File Edit Sketch Tools Help ODIT ESP32 DEVKIT V | | | | | |
| | | LIBRARY MANAGER | | | | |
| <u>Code :</u> (Copy below Code and Paste it on your Arduino IDE and upload) | | Type: All ~ Topic: All ~ | | | | |
| | ¢∆ © | Adafruit BMP085 ···· Library by Adafruit 1.2.2 installed | | | | |
| | Q | A powerful but easy to use BMP085/BMP180 Library A powerful but easy to use More info | | | | |
| | | 1.2.2 × REMOVE | | | | |

Coding Part

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```
#include <Adafruit_BMP085.h>
Adafruit_BMP085 bmp;
void setup() {
 Serial.begin(9600);
 if (!bmp.begin()) {
 Serial.println("Could not find a valid BMP085 sensor, check wiring!");
 while (1) {}
 }
}
 void loop() {
  Serial.print("Temperature = ");
  Serial.print(bmp.readTemperature());
  Serial.println(" *C");
  Serial.print("Pressure = ");
  Serial.print(bmp.readPressure());
  Serial.println(" Pa");
  Serial.println();
  delay(500);
}
```

After successfully Uploading the code, you just Open the serial monitor in the Arduino IDE and see the Output of the Sensor Value.

2. Modules and Sensors Interfacing (IR Sensor, Ultrasonic Sensor ,Soil Moisture Sensor) using ESP32.

2.A).Interfacing IR Sensor and LED with ESP32.

Hardware Connection



IR Sensor OUT pin -- ESP32 GPIO4 LED Pin -- ESP32 GPIO 27

Code :

_(Copy below Code and Paste it on your Arduino IDE and upload)

```
#define IRSensor = 14; // connect ir sensor to arduino pin 2
#define LED = 27; // conect Led to arduino pin 13
void setup()
{
    pinMode (IRSensor, INPUT); // sensor pin INPUT
    pinMode (LED, OUTPUT); // Led pin OUTPUT
    Serial.begin(9600);
}
void loop()
{
    bool statusSensor = digitalRead (IRSensor);
    if (statusSensor == 1){
```

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digitalWrite(LED, LOW); // LED LOW
Serial.println("Obstable Not Detected, LED OFF");
}
else
{
digitalWrite(LED, HIGH); // LED High
Serial.println("Obstable Detected, LED ON");
}

2.B).Interfacing Ultrasonic sensor with ESP32.



Code :

_(Copy below Code and Paste it on your Arduino IDE and upload)

```
const int trigPin = 5;
const int echoPin = 18;
void setup() {
Serial.begin(9600); // Starts the serial communication
 pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
 pinMode(echoPin, INPUT); // Sets the echoPin as an Input
}
void loop() {
// Clears the trigPin
 digitalWrite(trigPin, LOW);
 delayMicroseconds(2);
 // Sets the trigPin on HIGH state for 10 micro seconds
 digitalWrite(trigPin, HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin, LOW);
 long duration = pulseIn(echoPin, HIGH);
 float distance = duration * 0.034/2;
 Serial.print("Distance : cm");
 Serial.println(distance);
 delay(1000);
```

}

2.C).Interfacing Soil Moisture sensor with ESP32.

Hardware Connection



Measuring soil moisture in terms of percentage.

Here, the analog output of the soil moisture sensor is processed using ADC. The moisture content in

terms of percentage is displayed on the serial monitor.

The output of the soil moisture sensor changes in the range of ADC value from 0 to 4095.

Code :

(Copy below Code and Paste it on your Arduino IDE and upload)



3.Modules and Actuators Interfacing (Relay, Motor, Buzzer) using ESP32 3.A).Interfacing Relay with ESP32



Hardware Connection

```
#define RELAY1 25
void setup() {
    // put your setup code here, to run once:
    pinMode(RELAY1, OUTPUT);
    Serial.begin(9600);
    }
void loop() {
    // put your main code here, to run repeatedly:
    digitalWrite(RELAY1, HIGH); // turn the RELAY1 on (HIGH is the voltage level)
    Serial.println(" RELAY1 ON ");
    delay(2000); // wait for a second
}
```

3.B) Interfacing Motor with ESP32.

Hardware Connection

In our examples we'll connect the signal wire to GPIO 13. So, you can follow the next schematic diagram to wire your servo motor.





Select BaudRate as 115200

Enter the Number of Degrees to which the motor needs to rotate in Serial Monitor.



3.C) Interfacing Buzzer with ESP32.

Hardware Connection

```
#define BUZZER 13
void setup() {
// put your setup code here, to run once:
 pinMode(BUZZER, OUTPUT);
 Serial.begin(9600);
}
void loop() {
// put your main code here, to run repeatedly:
 digitalWrite(BUZZER,HIGH); // turn the RELAY1 on (HIGH is the voltage level)
 Serial.println(" BUZZER ON ");
 delay(1000);
 digitalWrite(BUZZER,LOW); // turn the RELAY1 on (HIGH is the voltage level)
 Serial.println(" BUZZER OFF ");
 delay(1000);
                        // wait for a second
}
```

Result:

Conclusion:

Viva Questions:

Date:

Experiment No: 3

1. Demonstration of MQTT Communication

MQTT Protocol

The MQ Telemetry Transport (MQTT) is a protocol for publish and subscribe style messaging. It was originally invented by IBM as part of the MQSeries family of products but since has become an industry standard governed by the Oasis standards group. The latest specification version is 3.1.1.

Being Pub/Sub, this means that there is a broker (an MQTT Broker) to which subscribers can register their subscriptions and publishers can submit their publications. Publications and subscriptions agree on the topics to be used to link the messages together. A client can be a publisher, a subscriber or both.

The value of MQTT is that it can be used to deliver data from an application running on one machine to an application running on another. Immediately we seem to see an overlap between MQTT and REST calls but there are some major differences. In a REST environment, when you form a connection from a client to a server, the server must be available in order for the client to deliver the data. With MQTT that is not necessarily the case. The client can publish a message which can then be held by the broker until such time as the receiving application comes on-line to retrieve it.

This is a store and forward mechanism. Every published message must have a topic associated with it that is used to determine which subscribers would be interested in receiving a copy.

The structure of a topic is broken into topic levels separated by a "/". Subscribers can include wild cards in their topic selections of copies of messages that they would like to receive:

• + – Single topic level wild-card

eg. a/+/c

would subscribe to a/b/c and a/x/c.

• # – Multi topic level wild-card

eg. a/#

would subscribe to a/.<anything>

MQTT is commonly implemented on top of TCP/IP. Clients connect to the broker (not to each other) over a TCP connection. There is a quality of service requested by a client. This is encoded in the QoS field:

• QoS=0 – Send at most once. This can lose messages. At most once means perhaps never.

• QoS=1 – Send at least once. This means that the message will be delivered. Saying this

another way, a message will not be discarded or lost. However, duplicates can arrive ... i.e.

the message can be delivered twice or more.

• QoS=2 – Send exactly once. This means that the message will not be lost and will be

delivered once and once only. MQTT also has the capability to buffer messages for subsequent delivery. For example, if a client subscriber is not currently connected, a message can be queued or stored for delivery to the client when it eventually re-connects. We call a client that is not connected an off-line client. For a subscription, we have the choice to deliver all the queued messages for a client or just the last message. To understand the difference, we can imagine a published message that says "I sold your stock for price" ... we want all such messages sent to the client because they are all of interest.

"Experiencing the Value of Technology"

However if we think of a published message of "Today's forecast is sunny and warm" then there may be no need for old messages and only the current weather forecast is of interest to us. During publishing we can declare that a message is eligible for retention and this is called the "retained message". When a client subscribes, it can ask to receive the last retained message immediately ... so even if a subscription takes place after a previous publication, it can still receive data immediately.

Clients make their status known to the broker so the broker can tell if a client is connected. This is achieved via a keep-alive/heartbeat. When forming a connection to a broker, the client provides a keep-alive interval (in seconds). If the broker hasn't received a message from the client in this interval then the broker can disconnect the client assuming it to have been lost/disconnected. If the keep-alive interval is set to 0, then there will be no validation from the broker.

If a client connection is lost because of a network disconnection, the broker can detect that occurrence. This is where we get morbid. We define this as the client having "died". In the real world, when someone dies, there may be a last "will and testament" which are the desired instructions of what the person wanted to happen when they die. MQTT has a similar concept. A client can register a message to be published in the event of the clients death. This is remembered by the broker and in the event of the client dyeing, the broker will perform the role of the attorney and publish the last registered "will and testament" message on behalf of the deceased client.

The default port number for an MQTT broker is 1883

Experience to send the DHT11 data via MQTT protocol and control the Appliance via MQTT protocol



Hardware Connection

×

| Туре | Name | Notes |
|---------------|------------------|----------------------------------------------|
| int | cmd | |
| struct mg_str | payload | The payload of a received message. |
| uint8_t | connack_ret_code | Used on MG_EV_MQTT_CONNACK. |
| uint16_t | message_id | Used on MG_EV_MQTT_PUBLISH. |
| char * | topic | The topic on which the message was received. |

Library Installation :

💿 Library Manager

| All | ~ | Topic | All | ~ | pubsub | |
|-----------------------------------------------|--------------------------------------------------------|----------------------------|---------------------------------------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| | | | | | | Install |
| bSubCl ie | nt | | | | | |
| | | | | | | |
| y Nick O' client lib | Leary Vers | ion 2. QTT m | 8.0 INSTAL essaging, N | ILED AQTT is a | lightweight messaging protocol ideal for | small devices. This library allows you to |
| y Nick O' client lib end and needed. | Leary Vers rary for Mo receive MQ It supports | QTT me TT me s all A | 8.0 INSTAL essaging, M essages, It rduino Ethe | AQTT is a supports f rnet Clien | lightweight messaging protocol ideal for the latest MQTT 3.1.1 protocol and can b t compatible hardware, including the Inte | small devices. This library allows you to e configured to use the older MQTT 3.1 el Galileo/Edison, ESP8266 and TI |



Code :

```
#include <Arduino.h>
#include <WiFi.h>
#include <PubSubClient.h>
#include "DHT.h"
WiFiClient wifiClient;
PubSubClient mqttClient(wifiClient);
#define DHTPIN 4 // Digital pin connected to the DHT sensor
#define DHTTYPE DHT11 // DHT 11
DHT dht(DHTPIN, DHTTYPE);
const char* ssid = "Types your SSID";
const char* password = "Your Password";
char *mqttServer = "broker.hivemq.com";
int mgttPort = 1883;
void setupMQTT() {
mqttClient.setServer(mqttServer, mqttPort);
mgttClient.setCallback(callback);
}
void reconnect() {
Serial.println("Connecting to MQTT Broker...");
while (!mqttClient.connected()) {
Serial.println("Reconnecting to MQTT Broker..");
String clientId = "ESP32Client-";
clientId += String(random(0xffff), HEX);
if (mqttClient.connect(clientId.c_str())) {
Serial.println("Connected.");
// subscribe to topic
mqttClient.subscribe("esp32/message");
}
}
}
void setup() {
Serial.begin(9600);
Serial.println("DHT11 test!");
dht.begin();
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("Connected to Wi-Fi");
pinMode(2, OUTPUT);
setupMQTT();
}
void loop() {
if (!mqttClient.connected())
```

reconnect(); mqttClient.loop(); long now = millis(); long previous time = 0; if (now - previous_time > 1000) { previous_time = now; float h = dht.readHumidity(); float t = dht.readTemperature(); if (isnan(h) || isnan(t)) { Serial.println("Failed to read from DHT sensor!"); return; } char tempString[8]; dtostrf(t, 1, 2, tempString); Serial.print("Temperature: "); Serial.println(tempString); mqttClient.publish("esp32/temperature", tempString); char humString[8]; dtostrf(h, 1, 2, humString); Serial.print("Humidity: "); Serial.println(humString); mqttClient.publish("esp32/humidity", humString); delay(2000); } } void callback(char* topic, byte* message, unsigned int length) { Serial.print("Callback - "); Serial.print("Message:"); String messageTemp; for (int i = 0; i < length; i++) { Serial.print((char)message[i]); messageTemp += (char)message[i]; } Serial.println(); if (String(topic) == "esp32/message") { Serial.print("Changing output to "); if(messageTemp == "on"){ Serial.println("on"); digitalWrite(2, HIGH); } else if(messageTemp == "off"){ Serial.println("off"); digitalWrite(2, LOW); } } }



| Connection | connected >> | |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Publish | COM4 | |
| Topic Qos esp32/message 0 + Message on Messages | Retain Publish Humidity: 68.00 Temperature: 30.80 Bumidity: 68.00 Calibook - Message:on Changing output to on Temperature: 30.80 Bumidity: 68.00 Humidity: 68.00 Humidity: 68.00 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Temperature: 30.80 Humidity: 68.00 Humidity: 68.00 Humi | |
| 2022-08-20 17:22:00 Topic: 0sp32/humidby 68:00 | Cos. 0 Autoscroll Show timestamp Newline v 9600 baud v | C |
| 2022-08-20 17:22:08 Topic: esp32#emperature 30,80 | Got: 0 | |
| 2022-08-20 17:22:06 Topic: esp32/humidity 68.00 | Des: 0 | |
| 7012.08.70 17.72.06. Tonic conTillamonologic | Dest B | |

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| | 📧 HIVE MQ | Websockets Client Showcase |
|----|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Connection | connected |
| | Publish | COM4 – |
| D; | Topic QoS Retain esp32/message 0 + - Message off - | Publish Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Runidity: 60.00 Callback - Messageroff Changing output to off Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Kunidity: 60.00 Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Hunidity: 60.00 Temperature: 30.80 Feasure: 30.80 Temperature: 30.80 |
| | 2022-08-20 17:20 35 Tapic: esp32/burnidity Qos: 0 68:00 | Humidity: 68.00 Humidity: 68.00 Kewline V 9600 baud V |
| | 2022-08-20 17:20 35 Topic: esp32/temperature Cos: 0 30.80 | |
| | 2022-08-20 17:20:33 Topic: esp32/humidity Qas: 0 68.00 | |

Result:

Conclusion:

Viva Questions:

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Date:

Experiment No: 4

1. Visualization of Diverse Sensors data using Dashboard.

Hardware Connection



Creating a Blynk IoT Environment :

- 1. Open the URL https://blynk.cloud/
- 2. Signup in to this platform as shown below.
- 3. Create Template in Blynk IoT Cloud

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| | All Blueprints | ESP32 V WiFi V | |
| -11 | | DESCRIPTION | |
| P | | Monitoring Temperature and Humidity using DHT11 Sensor | |
| | | 54/128 | |
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Enter Template Name(DHT11) > Select Hardware(ESP32) > Select Connection (WiFi) >Done

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IV BTECH ECE

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| | | | | Enum Location UPGRA | DE | | | | | | |
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New Datastream > Select Virtual Pin >

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We have to create Two Datastreams because DHT11 Sensor will measure Both the Temperature and Humidity Values.

Enter Name(Temperature) > Select Pin (V0) > Select Unit(Celsius) > Select Range (Min & Max) > Click on Create. Now we created Temperature Datastream.

Now we have to Datastream for Humidity.

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Click on +New Datastream > Select Virtual Pin > Enter Name(Humidity) > Select Pin (V1) > Select Unit(%) > Select Range (Min & Max) > Click on Create. Now we created Humidity DataStream.

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Click on Web Dashboard > Scroll down the Widget Box and Select the Gauge and drag that Gauge Widget to the Dashboard area as shown below.

We Need Two Widgets One for Temperature and One for Humidity.



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Click on the Settings Icon on the Widget .

Enter the Title Name (Temperature) > Select Datastream(Temperature) > Save.

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Click on the Settings Icon on the Widget .

Enter the Title Name (Humidity) > Select Datastream(Humidity) > Save.

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Click on Save.

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Then Click on Search Icon > Click on +New Device > Click on From template.

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Select the Template name (Created template DHT11) > Click on Create.

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| Q | Search | | \bigcirc | 2 lob Ø Ad | iT Solution: d Tag | s 🗎 My | org / | #define BLYNK_TEMPLATE_ID #define BLYNK_TEMPLATE_NAM | "TMPL3HfNS_ E "DHT11" | DUk" | |
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After Creating Device > then Click on that Copy to Clipboard > Later we have to Paste this in Code.

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| (Copy below Code and Paste it on your Arduino IDE and upload) | | | DOIT ES | P32 DE |
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| top first three lines of below Code. | | Blynk by Shymans | y Volodymyr skyy | _ |
| 15 th and 16 th line Enter your W/iFi Name and Password | a B | lt support Cellular o | ts WiFi, Ether | net, Vorks |
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| | | 1.3.0 | | ALL |
| #define BLYNK TEMPLATE ID "TMPL3HENS DUK" | | | | |
| #define BLYNK_TEMPLATE_NAME "DHT11" | | | | |
| #define BLYNK_AUTH_TOKEN "ykXPf_HSryQV0PWD7lP-WZja4y_telry" | | | | |
| | | | | |
| #define BLYNK_PRINT Serial | | | | |
| #include <wifi.ii> #include <wificlient h=""></wificlient></wifi.ii> | | | | |
| #include <8lvnkSimpleEsp32.h> | | | | |
| | | | | |
| #include "DHT.h" | | | | |
| char auth[] - BLYNK AUTH TOKEN: | | | | |
| | | | | |
| char ssid[] = "IobiT Solutions"; // type your wifi name | | | | |
| char pass[] = "12345678"; // type your wifi password | | | | |
| #define DHTPIN 4 // Montion the digital pin where you connected | | | | |
| #define DHTTYPE DHT11 // DHT 11 | | | | |
| DHT dht(DHTPIN, DHTTYPE); | | | | |
| BlynkTimer timer; | | | | |
| | | | | |
| voia senasensor(){ float h = dbt readHumidity(); | | | | |
| float $t = dht$ readTemperature(): // or dht readTemperature(true) for E | hrenhe | it | | |
| if (isnan(h) isnan(t)) { | | | | |
| Serial.println("Failed to read from DHT sensor!"); | | | | |
| return; | | | | |
| } | | | | |
| Blvnk.virtualWrite(V0. t): | | | | |
| Blynk.virtualWrite(V1, h); | | | | |
| | | | | |
| Serial.print("Temperature : "); | | | | |
| Serial.print(t); | | | | |

IV BTECH ECE

Industrial IoT and Automation (20A04707)

```
Serial.print(" Humidity : ");
Serial.println(h);
}
void setup(){
Serial.begin(115200);
Blynk.begin(auth, ssid, pass);
dht.begin();
timer.setInterval(1000L, sendSensor);
}
void loop(){
Blynk.run();
timer.run();
}
```

Result:

Conclusion:

IV BTECH ECE

Viva Questions:

IV BTECH ECE

Date:

Experiment No: 5

1. Device Control using mobile Apps or through Web pages.

Hardware Connection



Creating a Blynk IoT Environment :

Open the URL https://blynk.cloud/

1. Create Template in Blynk IoT Cloud

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Click on Template > New Template

Enter the Name (Relay) > Select Hardware (ESP32) > Select Connection (WiFi) > Click Done. VEMU INSTITUTE OF TECHNOLOGY, Dept of ECE

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Go to Datastream > Click on New Datastream > Select Digital Pin.

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Enter the Name(Relay) > Enter Pin Number (Enter Same Pin Mentioned in Program) >SelectPinMode(OUTPUT) > Click on Create.

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Click on Web Dashboard > Select Switch widget in Widget Box > Drag and drop to Dashboard asshown.

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Click on Settings of Switch widget > Enter the Title > Select Datastream > Enter ON & OFF Value >Click Save.

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IV BTECH ECE

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Select the Template you Created > Click on Create.

Industrial IoT and Automation (20A04707) IV BTECH ECE 🖸 Blynk/Console X 🗢 Remove Backg X | 🕲 Projects - Carri X | G esp32 pinout X | G servo motor pi X | Servo-Motor-F X | 🛇 upesy-esp32-v X | + ~ - 0 × $\leftarrow \rightarrow \mathbf{C} \quad \text{$ **a**blynk.cloud/dashboard/86885/global/filter/1176511/organization/86885/devices/777561/dashboardG 🖻 ☆ 🛛 🔍 : В \times 🔁 Click to copy Code My organization - 6433NA X RELAY Offline ← Back 0 🙎 lobiT Solutions 🏥 My org #define BLYNK_TEMPLATE_ID "TMPL3mV15E-6T" #define BLYNK_TEMPLATE_NAME "RELAY" 🖉 Add Tag Search 000 #define BLYNK_AUTH_TOKEN "uMmCU00fwUPX6v8wWFUI0k5Dpd Dashboard Timeline Device Info ↓Â 1 Device Template ID, Device Name, and AuthToken should be declared at the very top of the firmware code. Latest Last ... 6 Hou... 1 Day Documentation Copy to clipboard RELAY No Dashboard widgets P 0 ŝ 00 Region: blr1 Privacy Policy 🚈 🛱 🕐 🛱 🚱 🖪 🌀 🖉 😅 🕼 🙆 🖉 🖓 🖏 😵 Type here to search

After Creating you will get Three line code. Just copy those lines and Paste it on Code.

| <u>Code :</u> | |
|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Copy below Code and Paste it on your Arduino IDE and upload) | BYLNK_DHITT Arduino IDE 2.1.0 File Edit Sketch Tools Help DOIT ESP32 DEVKIT V1 |
| Library Installation | LIBRARY MANAGER blynk |
| Paste the Code we copied from Blynk Cloud Platform and Replace it on top first three lines of below Code. | Type: All ~ Topic: All ~ |
| 15 th and 16 th line Enter your WiFi Name and Password. | Blynk by Volodymyr Shymanskyy It supports WiFi, Ethernet, Cellular connectivity. Works with over 400 boards like More info 1.3.0 < INSTALL |

IV BTECH ECE

Industrial IoT and Automation (20A04707)

```
#define BLYNK_TEMPLATE_ID "TMPL3mV15E-6T"
#define BLYNK_TEMPLATE_NAME "RELAY"
#define BLYNK_AUTH_TOKEN "uMmCU0OfwUPX6v8wWFUI0k5Dpd-OkTJK"
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "lobiT Solutions"; // Enter your Wifi Username
char pass[] = "lobiT@2023"; // Enter your Wifi password
int ledpin = 2;
void setup()
{
 Serial.begin(9600);
 Blynk.begin(auth, ssid, pass);
 pinMode(ledpin,OUTPUT);
}
void loop()
{
 Blynk.run();
}
```

Result:

Conclusion:

IV BTECH ECE

Viva Questions:

Industrial IoT and Automation (20A04707) PL C PROCRAM EX

PLC PROGRAM EXECUTION

New ⇒ Create a blank document.

- ♦ Method 1: Click on "New" under the "File" function.
- ♦ Method 2: Click on the icon, □, on the tool bar.
- ♦ Method 3: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [N].

Open \Rightarrow Open the old documents in the drive.

♦ Method 1: Click on "Open" under the "File" function.

♦ Method 2: Click on the icon, 🖆, on the tool bar.

 Method 3: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [O].

Save ⇒ Save the file contents into the drive.

♦ Method 1: Click on "Save" under the "File" function.

 Method 2: Make use of the speedy key-in function, and simply type in the compound buttons 〔Ctrl〕+〔S〕.

Save as... \Rightarrow Save the current file with a different name.

♦ Method 1: Click on "Save as" under the "File" function.

♦ Method 2: Click on the icon, 📕, on the tool bar.

Close ⇒ Close the current file.

♦ Method: Click on "Close" under the "File" function.

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Industrial IoT and Automation (20A04707)

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COMMUNICATION with PC

The Method 1: Click on "PC $\langle = \rangle$ (PLC | HPP)" under the "Communication" function.

- ♦ Method 2: Click on the icon, [™], on the tool bar.
- Method 3: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [F1].
- Program verification ⇒ Verify whether the programs within PLC are the same as those in the process of editing.

Method: Click on "Program verification" under the "Communication" function.

■ Password ⇒ Setup or remove the PLC password.

♦ Method: Click on the "Password" under the "Communication" function.

- PLC Run ⇒ Execute the PLC.
 - ♦ Method 1: Click on "PLC Run" under the "Communication" function.
 - ♦ Method 2: Click on the icon, [™], on the tool bar.
 - Method 3: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [F5].
- PLC Stop ⇒ Stop the execution of PLC.
 - Method 1: Click on "PLC Stop" under the "Communication" function.
 - ♦ Method 2: Click on the icon, ¹, on the tool bar.
 - Method 3: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [F8].

■ Ladder diagram monitor start ⇒ Switch to the monitor mode of the ladder diagram. (Only effective under the ladder diagram mode)

Method 1: Click on "Ladder diagram monitor start" or "Ladder diagram monitor stop" under the "Communication" function.

- ♦ Click on the icon, ♣, on the tool bar.
- SFC monitor ⇒ Switch to the monitor mode of the SFC editing mode. (Only effective under the SFC editing)
 - Method 1: Click on "SFC monitor start" or "SFC monitor stop" under the "Communication" function.

♦ Click on the icon, ♣, on the tool bar.

Device monitor ⇒ Switch to the device monitor window to get to know the status and numeric values of the device to be monitored.

♦ Method 1: Click on "Device monitor" under the "Communication" function.

♦ Click on the icon, ♣, on the tool bar.

- Force ON/OFF ⇒ Force devices (Y, M, S, T and C) to be set as ON or OFF. (only effective under the ladder diagram mode or the device monitor mode)
 - ♦ Method 1: Click on "Force ON/OFF" under the "Communication" function.
 - Method 2: Place the editing box upon the device, and press the right button on the mouse to select "Force ON" or "Force OFF" function.

Change current value ⇒ Change the current value of the designated device register (T, C and D). (Only effective under the ladder diagram monitor mode or the device monitor mode)

- Method 1: Click on "Change current value" under the "Communication" function.
- Method 2: Place the editing box upon the device, and press the right button on the mouse to select "Change current value" function.
- Edit register ⇒ Proceed with functions such as read, write, print, file readout, and save the file within internal registers (T, C and D) of the PLC.
- ♦ Method 1: Click on "Edit register" under the "Communication" function.
- ♦ Method 2: Make use of the speedy key-in function, and simply type in the compound buttons [Ctrl] + [Alt] + [D].

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Industrial IoT and Automation (20A04707) 4.3 Editing Example

The Ladder Diagram



■ The Editing Operation Procedure of the Ladder Diagram:

| Procedure | The Ladder Symbols | Location of the Cursor | Input through the | e clicking on the Function Keys | Input through the Keyboard |
|-----------|-----------------------|------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------|
| 1 | \dashv \vdash | Row: 0, Line: 1 | + + ^{F1} *Footnote 1 | Device name: X Device number: 1 | LD X1 🚽 |
| 2 | —() | Row: 0, Line: 2 | -(| Device name: Y Device number: 1 | OUT Y1 🚽 |
| 3 | \dashv \vdash | Row: 1, Line: 1 | - - F1 | Device name: X Device number: 2 | LD X2 J |
| 4 | ļ | Row: 1, Line: 2 | F9 | | F9 |
| 5 | —() | Row: 1, Line: 2 | € F7 | Device name: Y Device number: 2 | OUT Y2 J |
| 6 | $\dashv \vdash$ | Row: 2, Line: 1 | - - F1 | Device name: X Device number: 1 | LD X1 J |
| 7 | $\dashv \vdash$ | Row: 3, Line: 1 | - - F1 | Device name: M Device number: 0 | لہ LD M0 |
| 8 | - | Row: 3, Line: 2 | F6 *Footnote 2 | Application command MOV Operand 1: D Device value: 1 Operand 2: D Device value: 2 | MOV D1 D2 J |
| Procedure | The Ladder Symbols | Location of the Cursor | Input through the | e clicking on the Function Keys | Input through the Keyboard |

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| 9 | 57 | Row: 4, Line: 0 | | Double click the mouse to input P0 | P0 → |
|----|-----|--------------------|------------------|----------------------------------------------------------------------------------------|---------------|
| 10 | ⊣+⊢ | Row: 4, Line: 1 | -∤↑ F3 | Device name: M Device number: 1 | LDP M1 🚽 |
| 11 | | Row: 4, Line: 2 | H.A. | | F9 |
| 12 | | Row: 4, Line: 2 | F6 | Counting command CNT Operand 1: C Device value: 0 Operand 2: K Device value: 100 | CNT C0 K100 🔒 |
| 13 | ⊣+⊢ | Row: 5, Line: 1 | ₩ F4 | Device name: M Device number: 1 | LDF M1 🚽 |
| 14 | | Row: 6, Line: 1 | F6 | Application command END | END - |

After the input is completed, the Ladder Diagram could be converted to the command code and the SFC diagram through compiling, and will look like what follows:

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*Footnote 1: Basic command input

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Date:

Experiment No: 6

1. LOGIC GATE SIMULATION

STATIC APPLICATION PANELS

The Static application panels (SAP) are Simulation modules of various applications that usually come across in Industrial Environment. Such as Motor Control, level controlling, Process Controlling, Industrial automation etc.

For each SAP dedicated panels are designed. Terminals to connect Input and Output are brought outside the panels. Input like switch or sensor will be defined using push buttons or toggle switches and outputs like Motor, Relay coil, contractor will be defined through LED's. Attractive stickers are designed with different colors to differentiate input and outputs with designations.

CONNECTION BETWEEN SAP & PLC

Each SAP module requires Digital input and digital output. In the Main Panel of PLC the

digital I/O's arebrought out to the panels and clearly designated for Eg.

Digital input as DI-0, DI-1, DI-2

Digital output as DO-0, DO-1, DO-2,.....

On all the SAP modules the required input and output are brought out to the terminals and designated accordingly. Match the inputs to inputs and outputs to outputs.

PLC PANEL

STATIC APPLICATION PANEL

<u>1. LOGIC GATE SIMULATION</u>

Logic Gate Panel:



Definition : Logic Gate Simulation panel is an experimental module where the program is written in LD to simulate the LOGIC GATES, such as INV, OR, NOR, AND, EX-OR for any two given inputs. Two LED's are given to indicate the status of output Q and invQ. If the LED's in ON it indicates 1 if LED is off it indicates 0.

Digital inputs DI -0 (X0) to DI-6 (X6) are used as two switches and DO-0 (Y0) and DO-1(Y1) is used as output to LED.

CONNECTION: Connect the Digital inputs from the PLC panel to the SAP panel using patch cards. Connect DI-0 and DI-1 on the PLC trainer to DI-0 and DI-1 on the application panel respectively. And DO-0 on the PLC trainer to DO-0 on the application panel. Connect 24V power supply and Ground to the respective terminals matching the terminal color.

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LOGIC GATE SAMPLE LADDER PROGRAM



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2. BOOLEAN ALGEBRA



Definition : Boolean Algebra (Demorgan's Theorem) panel is an experimental module where the program is written inLD to prove Demorgan's theorem that LHS of an equation is equal to RHS for three inputs. Two LED's are given to indicate the status of LHS and RHS of the equation. If the LED's in ON it indicates 1 if LED is off it indicates 0.

- Digital inputs DI -0 (X0) to DI-5 (X5) are used as two switches and DO-0 (Y0) toDO-3(Y3) are used as output to LED.
- **CONNECTION**: Connect the Digital inputs from the PLC panel to the SAP panel using patch cards. Connect DI-0 and DI-1 on the PLC trainer to DI-0 and DI-1 on the application panel respectively. And DO-0 on the PLC trainer to DO-0 on the application panel. Connect 24V power supply and Ground to the respective terminals matching the terminal color.

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LADDER PROGRAM FOR BOOLEAN ALGEBRA





Digital inputs DI -0 (X0) to DI-1 (X1) are used as two switches and DO-0 (Y0) are used as output to LED.

CONNECTION: Connect the Digital inputs from the PLC panel to the SAP panel using patch cards. Connect DI-0 and DI-1 on the PLC trainer to DI-0 and DI-1 on the application panel respectively. And DO-0 on the PLC trainer to DO-0 on the application panel. Connect 24V power supply and Ground to the respective terminals matching the terminal color.

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Ladder Diagram for Stair case



Result:

Conclusion:

Viva Questions: