

**National Textile University, Faisalabad**



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## **Assignment 2**

### **Question1:**

**What is the purpose of Webserver server(80); and what does port 80 represent?**

**Answer:**

It is used for creating a web server on the device. Allowing microcontroller (ESP 32) to act like website. While port (80) is the standard port for HTTP (pages.). It allows the user the user to open the website without typing any port number.

### **Question2:**

**Explain the role of server. On("/", handle Root); in this program.**

**Answer:**

It is used for setting route on web servers. If someone opens the home page(/) it tells the web server to execute the handle root function. It then sends a message/response to the user.

### **Question3:**

**Why is server.handleClient(); placed inside the loop() function? What will happen if it is removed?**

**Answer:**

It is placed inside the loop so that the user or server can continuously check the browser request. If we remove the loop() function then web server will not respond to the request. The web server will be connected but it will not load the web page.

### **Question4:**

**In handle Root(), explain the statement: server. Send(200, "text/html", html);**

**Answer:**

It is used for sending responses from webserver to browser.

**200 →** IT is HTTP standard code which indicates that the request is successfully received and proceeded.

**text/html →** It tells the browser that the incoming data is HTML webpage.

**html** → It is a variable where the full code of html is stored .For Example, headings, layout of page or text /buttons .

**Question5:**

**What is the difference between displaying last measured sensor values and taking a fresh DHT reading inside handle Root()?**

**Answer:**

**Displaying last measured sensor values:**

It uses the old (already read) values. It is faster than others server sends the response quickly. It does not use real time data.

**Taking a fresh DHT reading inside handle Root():**

It takes new reading from the sensor on each request. It gives the browser real-time ,updated data. It is slower than the other because sensor takes new reading each time.

## **Part B: Long Question**

### **1.ESP32 Wi-Fi Connection and Getting an IP**

First, the ESP32 connects to your Wi-Fi using the SSID and password. It keeps trying until it successfully connects. Once connected, the router gives it an IP address—think of it as the ESP32’s “home address” on your network. You can use this IP to open the ESP32 web page on your phone or computer.

### **2. Setting Up the Web Server**

After connecting to Wi-Fi, we start a web server on port 80 using Webserver server(80);. We tell the server what to do when someone opens the home page using server. On("/", handle Root);. The handle Root() function sends the webpage to the browser. In the loop(), we keep calling server.handleClient(); so the ESP32 always listens and responds to requests.

### **3. Button to Read Sensor and Update OLED**

You can add a button to take a fresh reading from the DHT sensor whenever you want. When the button is pressed, the ESP32 reads the temperature and humidity and updates the OLED display. This way, you can see real-time updates both on the display and on the web page.

### **4. Dynamic Webpage Creation**

When someone opens the ESP32 web page, it creates an HTML page on the fly showing the current temperature and humidity. The readings are added to the HTML in handleRoot(). Then the server sends it using server.Send(200, "text/html", html); so the browser always shows the latest values.

### **5. Why We Use Meta Refresh**

We can add <meta http-equiv="refresh" content="5"> in the HTML. This makes the page refresh automatically every 5 seconds, so the values on the web page stay updated without needing to manually reload.

### **6. Common Problems and How to Fix Them**

- Page not loading → Often because server.handleClient(); is missing. Make sure it's in the loop().
- ESP32 won't connect to Wi-Fi → Check your SSID and password. Use WiFi.status() to debug.
- Slow page updates → Reading the sensor every time in handleRoot() can slow things down. Using the last reading makes it faster.
- OLED not updating → Check your wiring, pins, and button logic.
- IP keeps changing → Use a static IP if you want to avoid tracking it every time.

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## ESP32 DHT22 Readings

**Temperature:** 24.3 °C

**Humidity:** 54.6 %

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Press the physical button to update readings on OLED and here.

## Blynk Cloud Interfacing (blynk.cpp)

### Part-A: Short Questions

#### Question1:

**What is the role of Blynk Template ID in an ESP32 IoT project? Why must it match the cloud template?**

#### Answer:

It is used to connect **Blynk Template ID** ESP32 to the specific project template of Blynk Cloud. It tells the ESP32 server which pins or widgets(graph, or buttons) should be used. If ID doesn't match the cloud template then the data will not be displayed in the app so that the device is not connected.

#### Question2:

**Differentiate between Blynk Template ID and Blynk Auth Token.**

#### Answer:

The **Blynk Template ID** basically tells your ESP32 which Blynk project belongs to. It decides how the app looks, what widgets there are, and which virtual pins the device will use. The **Blynk Auth Token** is different—it's like a secret key for your ESP32 that proves to the Blynk Cloud that this device is allowed to connect. So, many devices can share the same Template ID because they follow the same project layout, but each device needs its own Auth Token to log in safely.

Simply put, the Template ID says, “This is the project I’m part of”, and the Auth Token says, “Yes, I’m allowed to connect!”

**Question3:**

**Why does using DHT22 code with a DHT11 sensor produce incorrect readings? Mention one key difference between the two sensors.**

**Answer:**

If you use DHT22 code with a DHT11 sensor, the readings will usually be wrong because the two sensors work differently. The DHT22 can measure a bigger range of temperature and humidity, and it sends data in a slightly different way than the DHT11.

**Main difference:**

- **DHT11:** Temp 0–50 °C, Humidity 20–80 %
- **DHT22:** Temp –40–80 °C, Humidity 0–100 %

So, the code expects DHT22 data, but DHT11 gives its own format, which makes the readings wrong or unreliable.

**Question4:**

**What are Virtual Pins in Blynk? Why are they preferred over physical GPIO pins for cloud communication?**

**Answer:**

Virtual Pins in Blynk are like cloud mailboxes for your ESP32. They let your device send and get data without using any physical pins. They’re handy because you don’t need wires, they work over the internet, and you can connect lots of widgets easily.

**For example:** physical pins are like passing a note by hand, while virtual pins are like putting a message in a cloud mailbox that any widget can check anytime.

**Question 5:**

**What is the purpose of using BlynkTimer instead of delay() in ESP32 IoT applications?**

**Answer:**

Delay() stops the program so the ESP32 disconnects from blynk. Blynktimer performs the execution without stopping the program. ESP32 handles the buttons properly. If we use Blynktimer than the ESP32 stays connected. Multiple tasks can run easily at different rates.

## **Part-B: Long Question**

**Question:**

Explain the complete workflow of interfacing ESP32 with Blynk Cloud to display temperature and humidity values.

**Answer:****1. Blynk Template and Datastream Setup:**

A Blynk template is first created on the Blynk Cloud to define the overall project setup. Inside this template, datastreams for temperature and humidity are created and linked to virtual pins. These virtual pins act as channels through which the ESP32 sends sensor data to the Blynk application.

**2. Role of Template ID, Template Name, and Auth Token:**

The Template ID is used to connect the ESP32 to the correct Blynk project. The Template Name helps identify the project on the Blynk Cloud. The Auth Token works like a secure key that allows safe communication between the ESP32 and the Blynk Cloud.

**3. Sensor Configuration Issues (DHT11 vs DHT22):**

Selecting the correct sensor type in the program is very important for accurate readings. If the code is written for a DHT22 sensor but a DHT11 is used (or vice versa), the output values may be wrong due to differences in accuracy, speed, and temperature range.

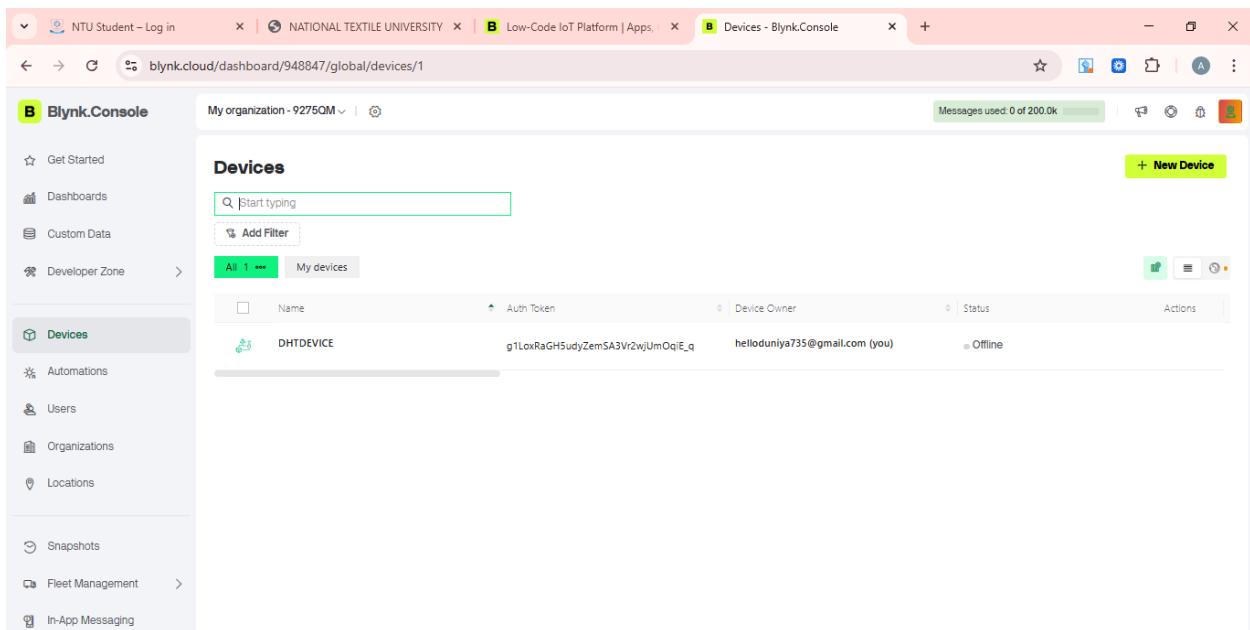
**4. Sending Data using Blynk.virtualWrite():**

The Blynk.virtualWrite() function is used to send temperature and humidity values from the ESP32 to the Blynk Cloud. Each value is sent on a specific virtual pin, allowing the data to be displayed live on the Blynk dashboard.

## 5. Common Problems and Their Solutions:

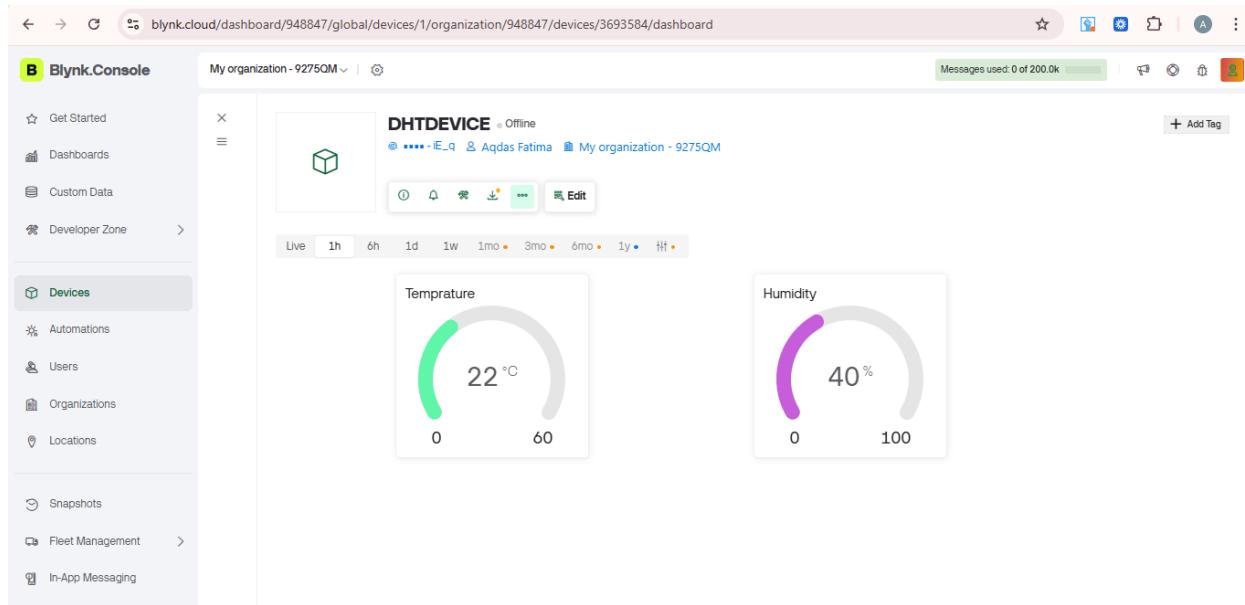
Some common issues include wrong cloud credentials, incorrect virtual pin selection, Wi-Fi connection problems, and mismatched sensor configuration. These problems can usually be solved by rechecking the Template ID and Auth Token, matching virtual pins in the code and app, and making sure the ESP32 is connected to a stable internet network.

## Web Dashboard:

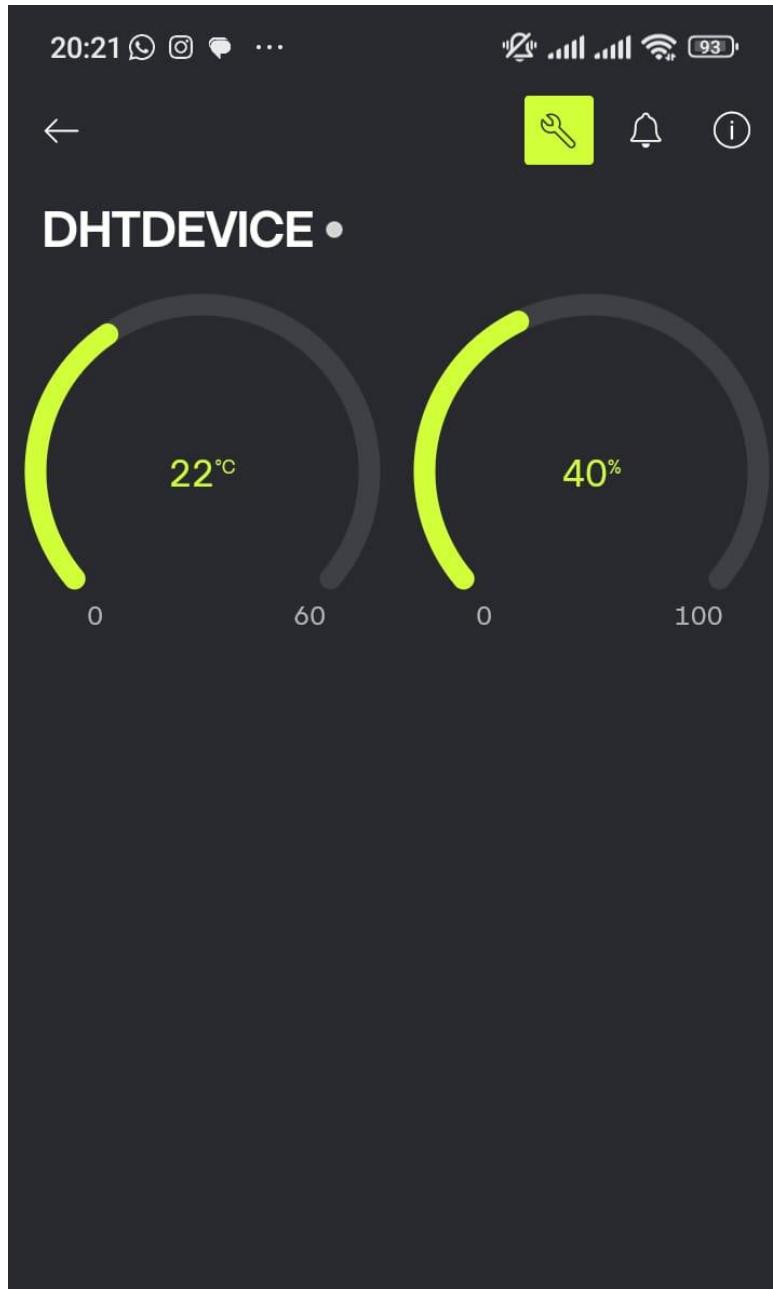


The screenshot shows the Blynk Console web interface. The left sidebar has a 'Devices' section selected. The main area is titled 'Devices' and shows a table with one row. The table columns are 'Name', 'Auth Token', 'Device Owner', and 'Status'. The single device listed is 'DHTDEVICE' with the auth token 'g1LoxRaGH5udyZemSA3Vr2wjUmOqIE\_q', owned by 'helloduniya735@gmail.com (you)', and is currently 'Offline'. There are buttons for 'New Device' and 'Actions' at the top right of the table.

Name	Auth Token	Device Owner	Status
DHTDEVICE	g1LoxRaGH5udyZemSA3Vr2wjUmOqIE_q	helloduniya735@gmail.com (you)	Offline



## Mobile Dashboard:



**Github repository:**

<https://github.com/aqsadfatima-123/Embedded-IOT-Systems.git>