

PROGRAM 3

Board & Environment Setup (Raspberry Pi 4)

Board: Raspberry Pi 4

OS: Raspberry Pi OS (any lab version)

Language: Python 3 (ONLY)

Required Python Modules / Packages (Install BEFORE running program)

Run these commands in the terminal:

```
# Update system (recommended)
sudo apt update

# Install matplotlib for visualization
sudo apt install python3-matplotlib -y

# Install Adafruit Blinka (required for board module)
pip3 install adafruit-blinka

# Install DHT sensor library (Python 3 compatible)
pip3 install adafruit-circuitpython-dht
```

Note: Do NOT install `Adafruit_DHT`. It is legacy (Python 2 based).

Program Title

Temperature and Humidity Data Collection and Visualization using Raspberry Pi

Aim

To collect real-time temperature and humidity data using a DHT11 sensor interfaced with Raspberry Pi and visualize the variation over time using graphical techniques.

Components Used

- Raspberry Pi 4
- DHT11 Temperature and Humidity Sensor (3-pin module)

- Jumper Wires
 - Power Supply
-

Pin Configuration

DHT11 Sensor Wiring

DHT11 Pin	Raspberry Pi Physical Pin	GPIO / Board Name
VCC	Pin 2 / Pin 4	5V
DATA	Pin 7	GPIO4 / board.D4
GND	Pin 6	GND

Important: The DHT11 module is powered using **5V** for stable operation.

Working / Logic Explanation

1. Initialize the DHT11 sensor using CircuitPython library
 2. Read temperature and humidity values periodically
 3. Capture real-time timestamps for each reading
 4. Store temperature, humidity, and time values in lists
 5. Plot temperature and humidity variation with respect to time using matplotlib
-

Program Code (Python 3 – Final Version)

```
import time
import board
import adafruit_dht
import matplotlib.pyplot as plt

# Initialize DHT11 sensor on GPIO4
# board.D4 corresponds to GPIO4 (physical pin 7)
dht = adafruit_dht.DHT11(board.D4)

# Lists to store collected data
temperatures = []
humidities = []
timestamps = []

# Collect 10 samples
for _ in range(10):
```

```

try:
    # Get current time
    current_time = time.strftime("%H:%M:%S")

    # Read sensor values
    temperature = dht.temperature
    humidity = dht.humidity

    # Store values
    temperatures.append(temperature)
    humidities.append(humidity)
    timestamps.append(current_time)

    # Delay between readings (DHT11 requirement)
    time.sleep(2)

except RuntimeError as error:
    # Handle intermittent sensor read errors
    print(error)
    time.sleep(2)

# Plot Temperature and Humidity vs Time
plt.plot(timestamps, temperatures, label="Temperature (°C)", marker='o')
plt.plot(timestamps, humidities, label="Humidity (%)", marker='x')

plt.xlabel("Time")
plt.ylabel("Values")
plt.title("Temperature and Humidity Variation Over Time")
plt.legend()
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()

```

Output / Result

- A line graph is displayed showing:
- Temperature (°C) variation over time
- Humidity (%) variation over time
- X-axis represents time
- Y-axis represents temperature and humidity values

Possible Viva / Exam Questions

1. Why is 5V used to power the DHT11 sensor?

2. Why is delay required between consecutive readings?
 3. What is the purpose of exception handling in this program?
 4. Why is `adafruit-circuitpython-dht` preferred over `Adafruit_DHT`?
 5. What does `board.D4` represent?
 6. Why is matplotlib used for visualization?
-

Conclusion

The program successfully demonstrates real-time environmental data acquisition using Raspberry Pi and effective visualization of temperature and humidity trends over time.