Sri Lanka Institute of Information Technology

Internet of Things and Big Data Analytics (IT4021)

Continuous Assignment – 2024, Semester 1

Initial Document

GROUP ID: *2024-12*

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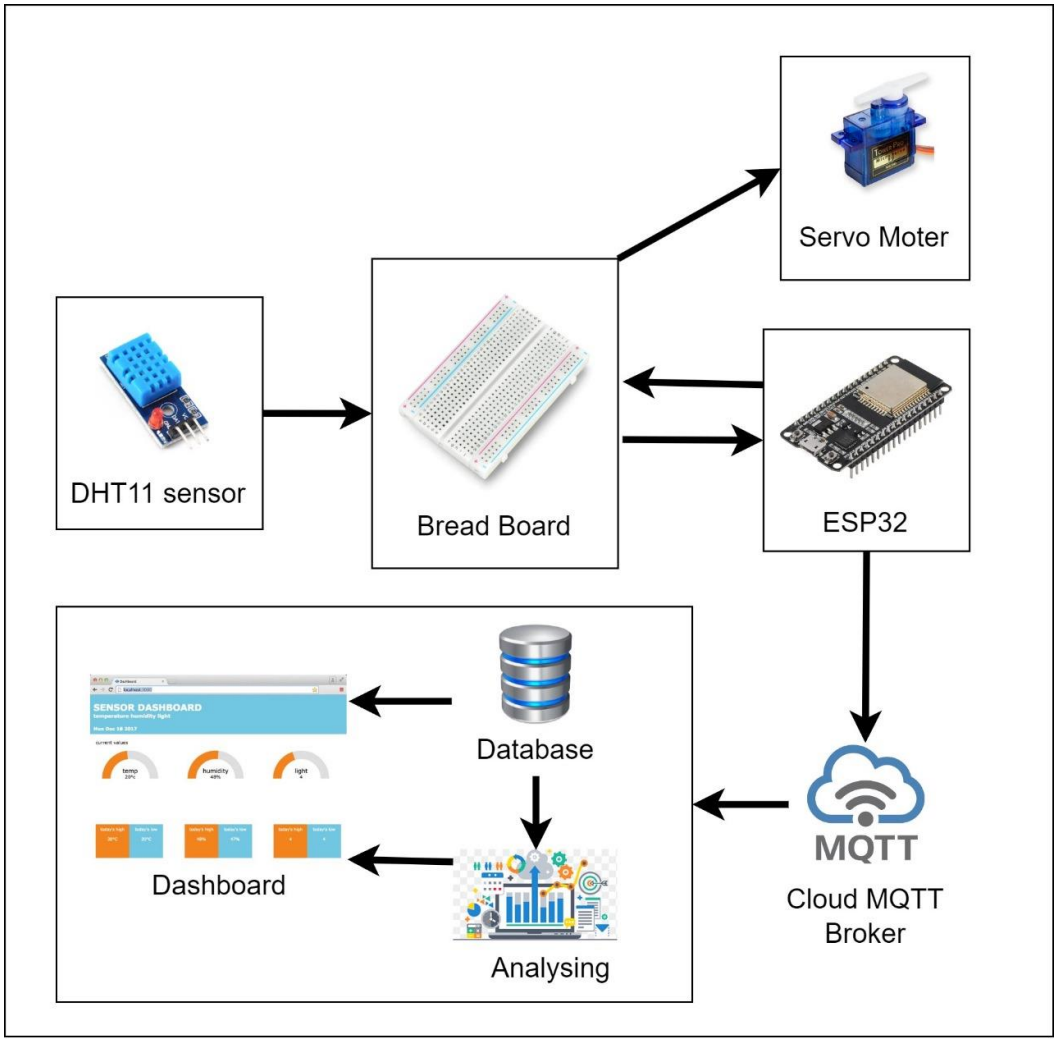
Project description

The IoTBDA Assignment aims to develop a smart home model that can monitor and manage the internal temperature and humidity levels by automatically controlling the opening and closing of windows. The system will calculate the heat index based on temperature and relative humidity readings, and adjust the window openings accordingly to maintain a comfortable indoor environment.

The key features and objectives of the project are as follows:

I. Heat Index Calculation: The system will calculate the heat index, which is a measure of how hot the air feels based on the combination of temperature and relative humidity. The heat index calculation will be based on a predefined formula or algorithm.
II. Automated Window Control: Depending on the calculated heat index, the system will automatically open or close the windows of the smart home model to regulate the indoor temperature and humidity levels. The windows will open or close in stages based on the heat index classification levels (e.g., normal, moderate, high).
III. Heat Index Prediction: Using the provided datasets, the system will predict the heat index for the next six months and the past six months. This prediction will help the occupants of the smart home plan and prepare for upcoming temperature and humidity conditions.
IV. Visualization with Node-RED: The predicted heat index values for the next six months and the past six months will be visualized using Node-RED, a flow-based programming tool for the Internet of Things (IoT). This visualization will provide a user-friendly interface for monitoring and analyzing the heat index trends.
V. Sensor Integration: The smart home model will incorporate temperature and relative humidity sensors to collect real-time data for heat index calculation and window control.
VI. Actuator Integration: The system will integrate actuators or mechanisms to physically open and close the simulated windows in the smart home model based on the calculated heat index levels.

Overall architecture diagram



Overall architecture description

The architecture consists of an ESP32 microcontroller board connected to a DHT11 temperature and humidity sensor, and a servo motor to simulate window opening and closing. The key functionalities are:

- Sense the current ambient temperature (T) and relative humidity (RH) within the smart home using the DHT11 sensor.
- Calculate the Heat Index (HI) based on the T and RH values. Depending on the HI level, manipulate at least one window of the smart home by controlling the servo motor to open/close proportionately, aiming to maintain a comfortable temperature.
- Display a visualization on a Node-RED dashboard, including: a. Current HI data based on real-time sensor readings b. Predicted past 12 months' HI c. Predicted HI for the next 12 months

The ARIMA (Autoregressive Integrated Moving Average) model is used for predicting past and future HI values, leveraging the provided datasets.

Sensor data is transmitted to a cloud MQTT broker, stored in a database, and analyzed. The heat index is calculated, and the ARIMA model is employed for HI predictions using the provided datasets. The analyzed data, including real-time HI and predictions, is visualized through the Node-RED dashboard for monitoring and system performance tracking.

The architecture integrates embedded systems, sensors, cloud computing, data analysis using the ARIMA model, and Node-RED visualization to create a smart home model that automatically manages indoor temperature and humidity by controlling window openings based on the calculated heat index, while providing real-time monitoring and predictions.

Team Members Contributions

Sewwandi W.M.C - IT20298494

- Set up the ESP32 microcontroller and breadboard
- Connect and configure the DHT11 temperature and humidity sensor
- Implement the code for reading sensor data and calculating the heat index

Munasinghe M.G.P - IT20667450

- Integrate the servo motor with the ESP32
- Develop the logic and code for controlling the servo motor based on heat index levels
- Simulate the opening and closing of windows using the servo motor

Purnamal M C P – IT20655334

- Set up the MQTT broker and establish communication between the ESP32 and the cloud
- Implement data storage and retrieval from the database
- Develop the code for implementing the ARIMA model for heat index prediction

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- Design and develop the Node-RED dashboard
- Implement real-time visualization of sensor data and heat index
- Integrate the ARIMA model predictions into the Node-RED dashboard for visualizing past and future heat index

Shared Responsibilities:

- Document the project, including the overall architecture and component descriptions
- Maintain GIT Repository
- Integrate and test the complete system, ensuring seamless communication and functionality
- Prepare the final demonstration and presentation of the smart home model

List Of Hardware

ESP32 Development Board:

The ESP32 board is the central controller, responsible for reading sensor data, calculating heat index, and controlling the servo motor based on heat index levels. It offers wireless connectivity for IoT integration and MQTT communication.

Temperature and Humidity Sensor - DHT11:

The DHT11 is a compact digital sensor that measures temperature and relative humidity, providing essential data for calculating the heat index. It has a digital output for easy interfacing with the ESP32.

Servo Motor:

A servo motor is a precise positioning actuator used to simulate the opening and closing of windows based on control signals from the ESP32 and calculated heat index levels.

Breadboard:

A breadboard is a solderless prototyping board used for connecting the ESP32, DHT11 sensor, servo motor, and other components through jumper wires, enabling easy circuit assembly and testing.

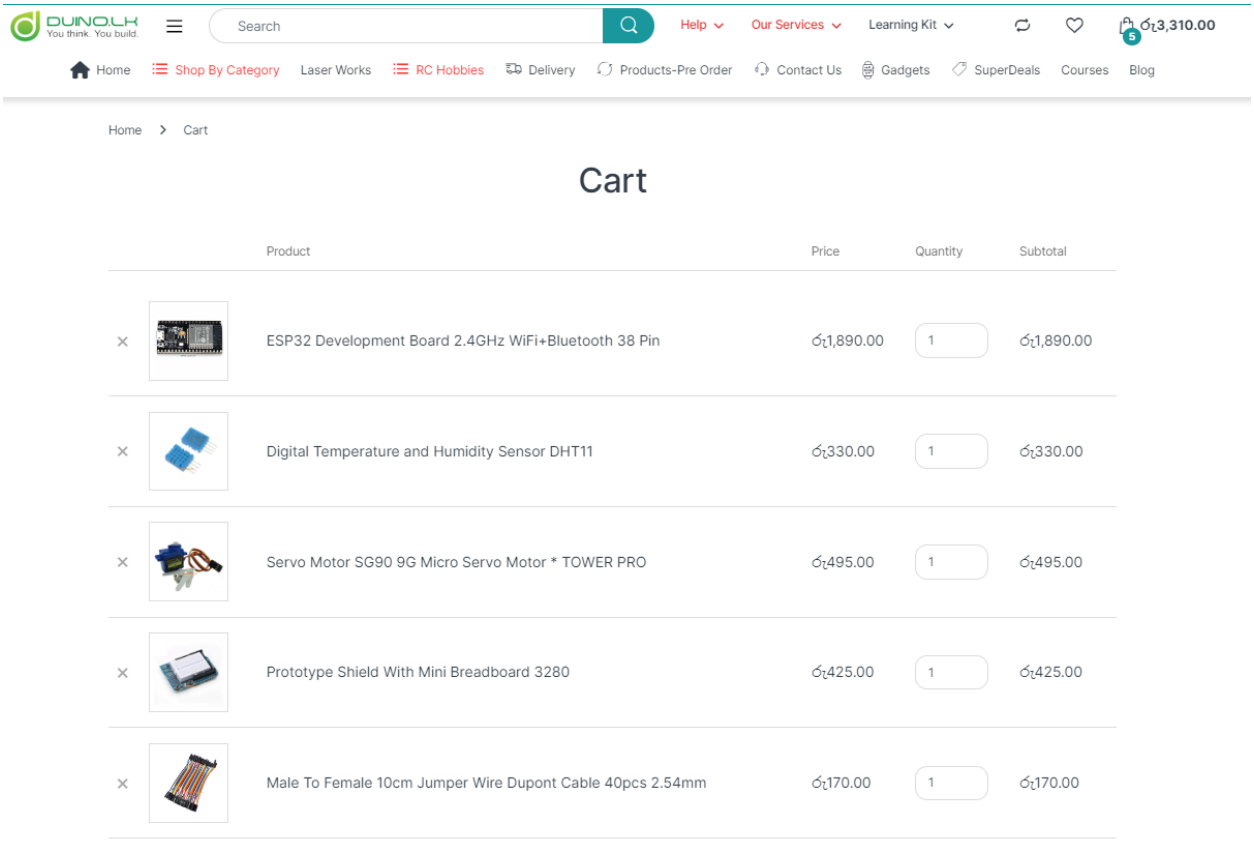
Jumper Wires:

Jumper wires are flexible, insulated wires used for making connections between components on the breadboard, facilitating the flow of power and data signals.

Power Supply:

A power supply, such as a USB cable or power adapter, provides the necessary electrical energy to operate the ESP32 board and other components in the smart home model.

Cost Breakdown



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