Sri Lanka Institute of Information Technology

Internet of Things and Big Data Analytics (IT4021)

Continuous Assignment – 2023, Semester 1

Initial Document

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1. Brief project description

The network of physical objects (things) embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet can be described as the Internet of Things (IoT) [1]. IoT can also enable businesses to collect and analyze vast amounts of data in real time, leading to insights and innovations that can improve operations and decision-making.

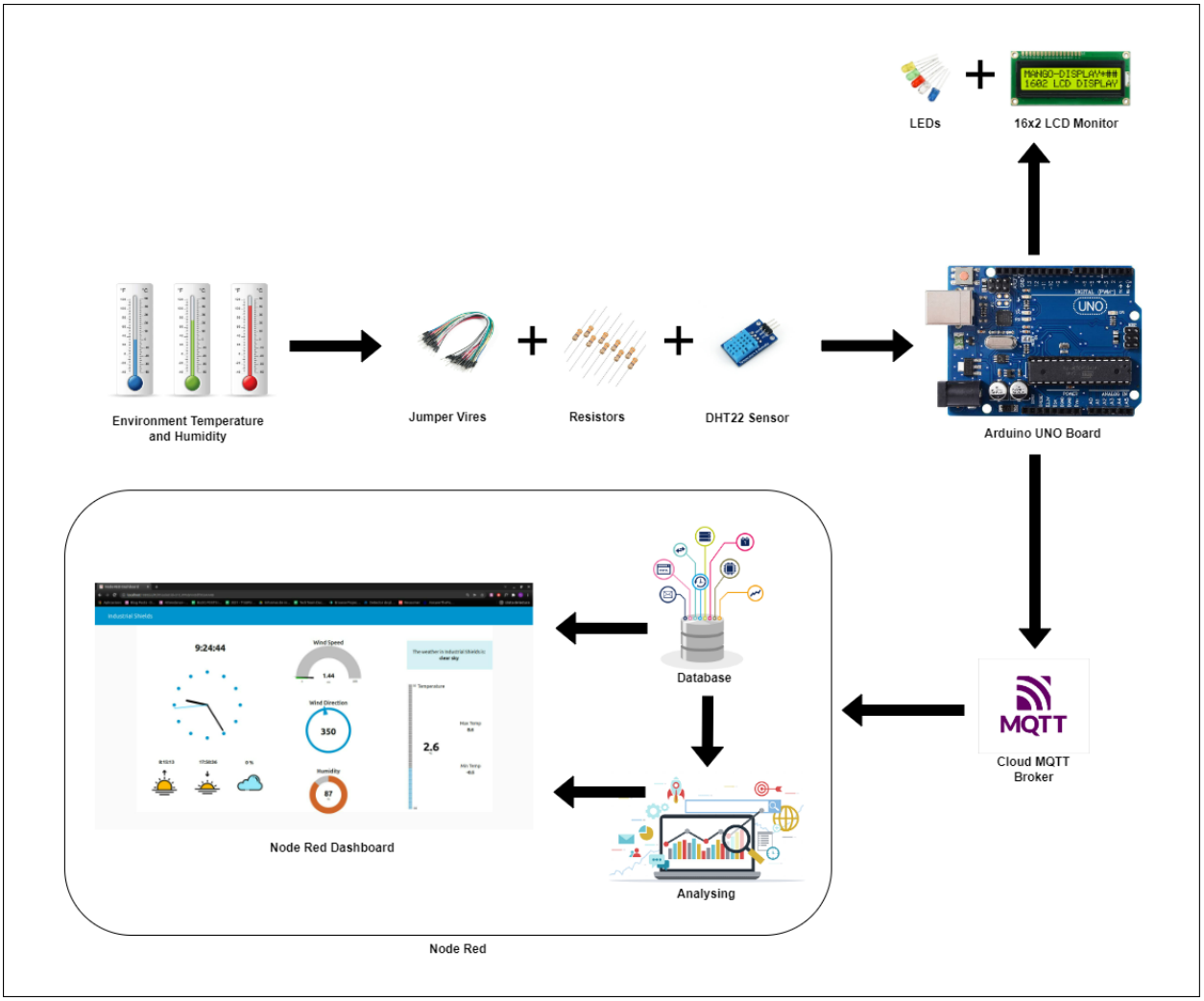
The IoT system designed here can provide real-time information on the current heat index of an environment, indicating whether the conditions are healthy for human occupancy. The project focuses on measuring the current ambient temperature and indicating if the current heat index of an environment is healthy. A temperature sensor will be used to sense the current ambient temperature and relative humidity. Here we must develop basic c IoT-based temperature monitoring and predicting systems using Arduino Uno, node-red, a sensor and an actuator with python for backend development.

A temperature sensor will be used to capture the current ambient temperature and relative humidity which will be taken as the main input for this monitoring system. Based on the read temperature in a build Depending on the current temperature and Relative Humidity, move an indicator on a display gauge to indicate the current heat index classification. This effect will be shown as follows.

- If the read temperature is between 80 Fahrenheit and 90 Fahrenheit, the effect will be shown as Caution.
- If the read temperature is between 90 Fahrenheit and 103 Fahrenheit, the effect will be shown as Extreme Caution.
- If the read temperature is between 103 Fahrenheit and 124 Fahrenheit, the effect will be shown as Danger.
- If the read temperature is e exceeds 125 the effect will be shown as Extreme Danger.

The read temperature will also be published on a node-red dashboard using MQTT. In addition to the current temperature display, the dashboard will contain a visualization of Current RH data coming from the sensors, Predicted past 12 months RH and Predicted RH 12 months ahead. An ARIMA model will be used to get the prediction of temperature levels.

2. Overall architecture diagram



3. Overall architecture description

The process begins with measuring the current ambient temperature and relative humidity. In this system, the Arduino Uno will act as the center point which will carry out all the tasks. we used the DHT22 as temperature sensor, and it will be used to get the input for the monitoring system to perform the required tasks. The Arduino Uno board use to analyze the temperature value and check the relevant temperature category it belongs to. If the temperature is between 80 Fahrenheit and 90 Fahrenheit the effect will be shown as Caution, if the temperature is between 90 Fahrenheit and 103 Fahrenheit the effect will be shown as Extreme Caution, if the temperature is between 103 Fahrenheit and 124 Fahrenheit the effect will be shown as Danger and it exceeds 125 the effect will be shown as Extreme Danger.

LEDs and 16 * 2 LCD Monitor are used to actuate the results. For temperature values in the Caution range, the Yellow color LED bulb will blink with a delay of 3 seconds and the 16 * 2 LCD Monitor display message as “Fatigue possible with prolonged exposure and/or physical activity”, when the temperature values in Extreme Caution range, the Yellow color LED bulb will blink with a one-second delay and 16 * 2 LCD Monitor display message as “Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity”, then the temperature values in Danger range, the Red color LED bulb will blink a one-second delay and 16 * 2 LCD Monitor display message as “Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity” and the temperature values in Extreme Danger range, the Red color LED bulb will light up without any blinking and 16 * 2 LCD Monitor display message as “Heat stroke highly likely”.

An ARIMA model will be built to predict the future temperature values temperature up to 12 months ahead and from the current date and 12 months before the current date. The model will be trained using a dataset that contains past temperature values of a given period.

A Node-Red dashboard will be built to visualize the past, present, and future temperature data as well as the predicted temperature data. The required data for the visualization process will be sent by the Arduino Uno board through the MQTT broker.

4. Individual contribution

Siriwardana S. S. A - Measuring/Sensing the current temperature of the environment.

This is a monitoring system which can measure the current temperature of the environment using temperature sensors. The values that are been read by the sensors are configured and sent to the Arduino Uno board. Then Arduino Uno board should be able to analyze and categorize the temperatures with pre-defined categories which have been provided by users. After that by using a 16x2 LCD display, it shows the current temperature and relevant heat index as "Caution", "Extreme Caution", "Danger" or "Extreme Danger" with a piece of advice.

Sandamini H. K. A. D - Forecast temperature.

The purpose of this sub section is to forecast the temperature up to 12 months ahead and from the current date and 12 months before from the current date using 'ARIMA' model. ARIMA is a statistical analysis model that uses time series data to forecast future trends based on the analysis. First, we need to perform data cleansing task on the dataset provided and thereafter we can feed the training data to the 'ARIMA' model. So, we use the ARIMA model for predictions. After training the model, we can visualize the predictions using node red dashboard. Installing time series library in node red will allow us to use the time series nodes to implement the model. Gathering information about MQTT will also be a contribution made to the project under this component.

Kachchakaduwa E. U - Node-RED dashboard implementation.

This is about building a dashboard to show the gathered information via visuals. [2] Node-RED is a tool developed by IBM for connecting hardware devices, web services and APIs as part of the internet that can be used for flow-based visual programming development. This dashboard is developed to visualize the current and future predicted temperatures with respective humidity levels. CSS AND JavaScript can be used to customize the visualization to make the dashboard more interactive and user-friendly. The necessary data will be sent by Arduino Uno board via Cloud MQTT broker for the visualization process.

Chiranjeewa H. P. R. C - Building the Sensor Circuit

DHT22 sensor is considered as the input sensor which can get the measurements for temperature and humidity. It is more affordable, compact and has a higher sampling rate. This sensor can sense temperatures in the range of -40 Fahrenheit (-40C) to 176 Fahrenheit (80C). The sensor also includes an NTC thermistor for measuring temperature. A thermistor is a type of resistor whose resistance varies with temperature. Technically, all resistors are thermistors in the sense that their resistance changes slightly with temperature, but the change is typically very small and difficult to measure. After getting relevant data via the DHT22 sensor, by using the Arduino UNO board build algorithm will categorize the temperature ranges accordingly. Then Head Index for the relevant temperatures will be calculated via the below-mentioned equation.

*HI = -42.379 + 2.04901523*T + 10.14333127*RH - .22475541*T*RH - .00683783*T*T - .05481717*RH*RH + .00122874*T*T*RH + .00085282*T*RH*RH - .00000199*T*T*RH*RH*

After that, it shows the relevant message that has been programmed for the relevant heat index.

5. List of hardware

a) Sensors

- DHT22 Temperature sensor [3] [4]

b) Actuators

- 16 x 2 LCD display [5]
- LED lights

c) Mother Board

- Arduino UNO [6]

d) Other Devices

- GL-12 project breadboard.
- Tactile push buttons
- Jumper wires (M to F, F to F)
- Power supply
- 9V Battery

6. Cost breakdown

Component	Cost
Arduino UNO Board	Rs. 3950.00
Breadboard	Rs. 490.00
LCD Display	Rs. 500.00
DHT22 Temperature and Humidity Sensor	Rs. 1800.00
Jumper Wires – M to M (Qty 40)	Rs. 290.00
Jumper Wires – M to F (Qty 40)	Rs. 280.00
LEDs (Qty 10)	Rs. 35.00
330 Ω Resisters (Qty 10)	Rs. 10.00
Switches (Qty 2)	Rs. 10.00
Power Adapter	Rs. 1000.00
9v Battery	Rs. 250.00
Total	**Rs. 8615.00**

7. References

[1] "Internet of Things (IoT): A Literature Review," [Online]. Available: https://www.scirp.org/html/56616_56616.htm. [Accessed 10 03 2023].

[2] "https://nodered.org/," [Online]. Available: https://nodered.org/. [Accessed 15 03 2023].

[3] "DHT11 Sensor (Temperature and Humidity)," [Online]. Available: https://mpython.readthedocs.io/en/master/classic/dht11.html. [Accessed 12 03 2023].

[4] "DHT11 vs DHT22 vs LM35 vs DS18B20 vs BME280 vs BMP180," [Online]. Available: https://randomnerdtutorials.com/dht11-vs-dht22-vs-lm35-vs-ds18b20-vs-bme280-vs-bmp180/. [Accessed 14 03 2023].

[5] "Liquid Crystal Displays (LCD) with Arduino," [Online]. Available: https://docs.arduino.cc/learn/electronics/lcd-displays. [Accessed 16 03 2023].

[6] "arduino-uno-rev3," [Online]. Available: https://store.arduino.cc/products/arduino-uno-rev3. [Accessed 13 03 2023].