Real-Time Air Quality and Weather Monitoring

Created by

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GitHub URL: https://github.com/tusaunyapat/embed-lab-project.git

Introduction

This IoT device is used to measure humidity, temperature, and PM 2.5 levels. It transmits the data to a website for real-time updates and , providing information to the public in line with Governor Chadchart Sittipunt's policy.

Policy

According to Governor Chadchart Sittipunt's policy of "**Forecast, Alert, and Prevent PM2.5 Dust**" detailed real-time measurements of PM2.5 dust levels by area are provided, along with alerts on dust-related news and other factors affecting PM2.5 levels. There are also guidelines on how to act when dust levels are too high, such as wearing a mask, using an air purifier, and determining the appropriateness of outdoor activities.

Based on this policy, our group has decided to create a device that measures dust, humidity, and temperature, which are factors affecting PM2.5 levels. The device can measure and transmit the data to be displayed and send alerts via a webpage in real time. Additionally, it features a function to activate an air purifier.

Role and Responsibility:

System Architecture - Warintorn Surapolchai 6530360521

1. Brainstorming and Policy Selection

   The project begins with brainstorming sessions to generate ideas and select a suitable policy to implement. This initial step is crucial as it sets the direction for the entire project by determining the specific goals and objectives that the project aims to achieve.

2. Conceptual Design

   Once the topic is decided, the next phase involves designing the circuit and identifying the necessary sensors required for the project. This stage includes creating detailed schematics and ensuring that the selected components will work together effectively to meet the project's objectives.

3. Assembly and Integration

   After acquiring all the components, the assembly process begins. The first task is to connect the temperature and humidity sensor, along with the dust sensor, to a breadboard. These sensors are then connected to the STM32 microcontroller to facilitate data collection from both sensors, laying the foundation for further integration.

4. Sensor Configuration

   For the dust sensor, PC0 is designated as the ADC (Analog-to-Digital Converter) to read the sensor data, while PC1 is configured as a GPIO output. For the temperature and humidity sensor, PA10 is used to receive data from the sensor. These configurations are essential to ensure accurate data acquisition from each sensor.

5. Communication Setup

   The final step involves setting up communication between the NodeMCU and the STM32 to enable data transmission to a database. This is achieved by linking the Rx (receive) and Tx (transmit) pins of both devices. Specifically, D1 on the NodeMCU is used to receive data from D8 on the STM32, establishing a reliable data transfer pathway between the microcontroller and the database system.

Embedded System Development - Panupong Nantasung 6530310121

1. Brainstorming and Selecting a Policy for the Project
   Brainstorm ideas and select policies to be used in the project, focusing on policies applicable to embedded systems.

2. Connecting to Sensors
   Connecting temperature/humidity sensor and dust density sensor to Nucleo401-RE board. Writing code in STM32CubeIDE to command the board to receive values from sensors via UART2.

3. Connecting to Temperature and Humidity Sensor
   Beginning with the sensor for measuring humidity and temperature. Searching for information on the internet and adapted example code to fit this project, ensuring that values could be sent and received correctly. Since the values obtained from the sensor are raw data, a slight conversion is necessary.

4. Connecting to Dust sensor
   Connect the dust sensor. Searching for sensor information and converting the raw data obtained into accurate values, as same as the humidity and temperature sensor's process.

5. Sending Data to NodeMCU
   Sending the data to the nodeMCU in string format through UART1, which includes three values: humidity, temperature, and dust density.

6. Connect NodeMCU to Nucleo401-RE
   Connecting NodeMCU and Nucleo401-RE. Writing code in Arduino IDE command NodeMCU to receive data from Nucleo401-RE via UART1.

Front-end Development - Aunyapat Nitijarasrat 6530428621

1. Brainstorming and Selecting a Policy for the Project
   Before diving into development, it's essential to brainstorm and select a policy that aligns with the project's objectives. This step involves identifying the core ideas and goals that the website will aim to showcase.

2. Creating a Website to Showcase Results
   The primary objective is to develop a website that effectively presents the project's outcomes. Utilizing HTML, CSS, JavaScript, React, and TailwindCSS, we aim to craft a visually appealing platform that accurately reflects the project's achievements.

3. Designing the Webpage
   To kickstart the development process, we'll begin by designing the webpage layout. This involves integrating the desired outcomes into the design, ensuring that the website's structure and elements effectively communicate the project's key points. Emphasis will be placed on creating a visually pleasing and easily understandable layout.

4. Writing Code and Developing Components
   With the design in place, we'll proceed to write code, including various components and functions. This step involves translating the design concepts into actionable code, implementing features and functionalities that enhance the user experience and effectively showcase the project's results.

5. Creating Visually Appealing and Responsive Design
   Throughout the development process, special attention will be given to making the website visually appealing and responsive. By leveraging modern design principles and techniques, we'll ensure that the website adapts seamlessly to different screen sizes and devices, providing users with an optimal viewing experience across all platforms.

Back-end Development - Pavee Jeungtanasirikul 6530249621

1. Policy Selection for the Project
   First, brainstorm and select a policy that fits the project goals. Options include environmental monitoring (tracking air quality, temperature, humidity), smart agriculture (intelligent irrigation based on soil moisture), or health and wellness (monitoring vital signs of elderly individuals).

2. Setting Up Firebase
   Create a Firebase project and enable necessary services like Firestore or Realtime Database. Integrate the Firebase SDK into your web application to interact with the backend.

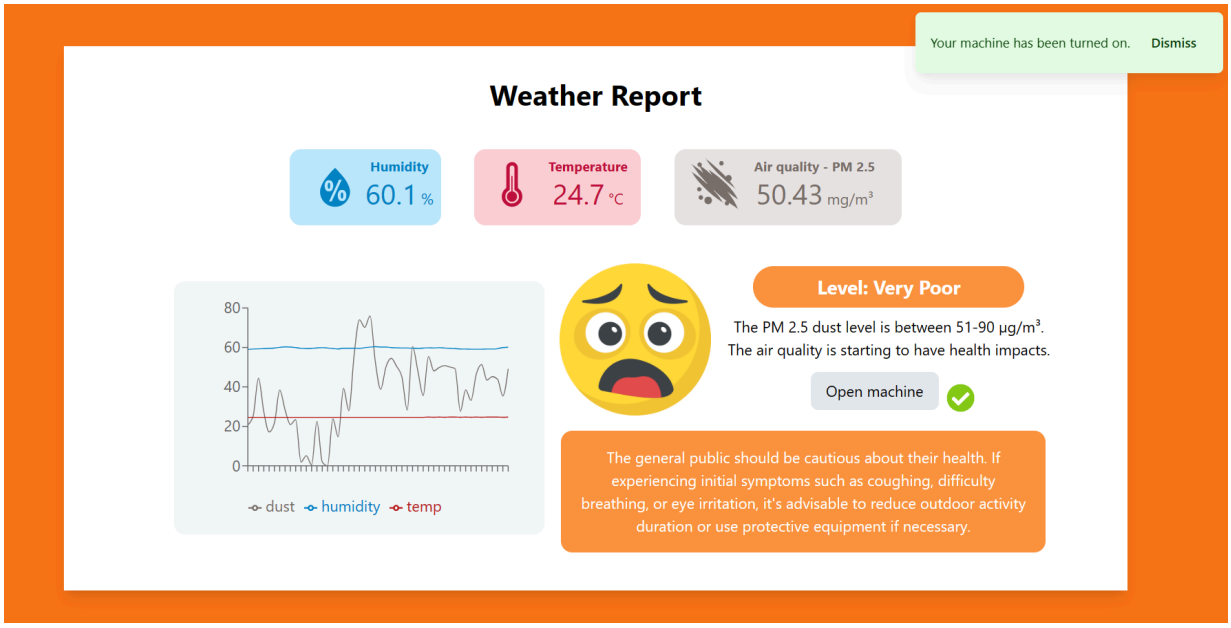
3. Connecting Firebase with Frontend
   Initialize Firebase in the frontend using the SDK. Fetch data from Firebase and display it on the website. Implement real-time listeners to update the site whenever Firebase data changes, ensuring dynamic and current content.

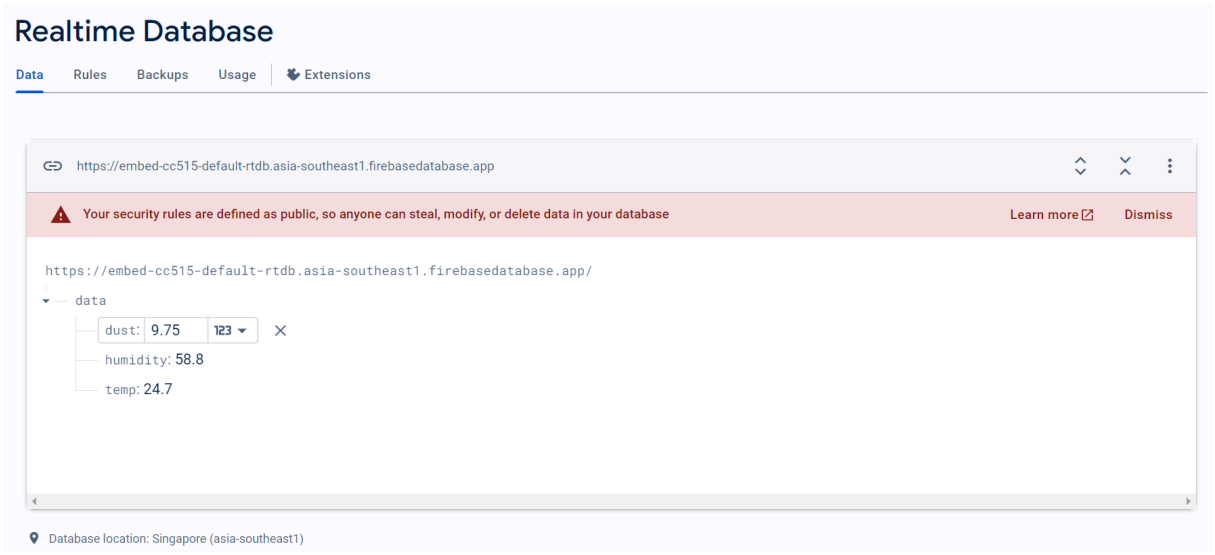
4. Connecting NodeMCU to Firebase
   Setup ArduinoIDE and install libraries for NodeMCU and Firebase. Write code to read sensor data from NodeMCU, trim unnecessary characters, and send the numeric values to Firebase. This allows for real-time data collection and storage.

5. Handling Sensor Data
   Receive sensor data as a string, trim excess characters to leave only numeric values, and store these values in variables. Save the cleaned data into the Firebase database to maintain accuracy and readiness for real-time updates.

6. Writing Code to Connect Arduino with Firebase
   Include the Firebase library in ArduinoIDE. Configure WiFi for NodeMCU to connect to the internet. Write Arduino code to send sensor data to Firebase regularly. Implement error handling to ensure reliable data transmission, facilitating seamless hardware-cloud integration and real-time data monitoring.

Our website and database





Embedded-sys-project.vercel.app

github.com/tusaunyapat/embed-lab-project

Pictures