CS983: Embedded, Cyber Physical Systems and IoT Security

Assignment: Smart Monitoring System

Total Points: 100

Group Size: 4 students/group

Submission Deadline: August 15, 2024, 11:59:59pm

Task 1:

Sita's modern apartment featured a Smart Home Energy Management System with temperature, PIR motion, and Ultrasonic sensors. This system intelligently adjusts heating, cooling, and lighting based on occupancy and environmental conditions, ensuring comfort year-round. It efficiently kept the apartment cool during hot summers and warm in chilly winters, all while reducing energy bills. Sita appreciated its seamless automation, making her home more comfortable and energy efficient.

Create a circuit on a simulator with a temperature sensor, PIR motion sensor, and ultrasonic sensor so that she can simulate a realistic environment for monitoring and prediction using Arduino Uno. Ensure that the output readings from all sensors are visible either on the serial monitor or an LED display for monitoring and analysis. With this setup, she can simulate conditions over specific days, predicting temperature changes based on sensor readings and providing a comprehensive virtual environment for testing and analysis.

Now help her out by making the exact environment on the below-mentioned simulator and executing the project:

Simulator: https://wokwi.com/

Components Needed from the Simulator:

1. Arduino Uno
2. Temperature Sensor
3. Passive Infrared (PIR) motion sensor.
4. HC-SR04 Ultrasonic Distance Sensor
5. LCD Display (Based on your requirement
6. 3 LEDs (1 for each sensor)

Expected functionality from your smart home simulation:-

1. Temperature Monitoring :

   The temperature sensor has sliders to adjust the readings. By clicking on the temperature sensor, you can see the slider, whose value can be seen on the Serial Monitor or LCD Display. The LED should glow at a designated threshold that should be decided by the group.

2. Motion Detection :

   On clicking on the PIR motion sensor, you will see the toggle button of **Simulate motion** after clicking on this; it should be visible on the Serial Monitor that the motion is detected.

   Make sure that triggering the sensor will output in 5 seconds and then go low again. The sensor will ignore any further output for the next 1.2 seconds (inhibit time), and then start sensing for motion again. An LED should glow whenever motion is detected.

3. Distance Measuring :

   Select the sensor by clicking on it (while the simulation is running).
   A small popup window will open. Now adjust the reading written on the "Editing Ultrasonic Distance" Sensor". By changing the readings, it must be visible on the serial monitor. (A deviation of 5-12 cm is viable). An LED should glow at a certain distance, as decided by the group.

Task 2:

Given the short duration of the project, we have collected a dataset that consists of humidity and temperature values along with the time stamps. You have access to a dataset containing temperature and humidity values, each associated with timestamps. Your objective is to categorize each day based on predefined criteria:

- Hot (temperature > 30°C and humidity ≤ 70%)
- Hot and Humid (temperature > 30°C and humidity > 70%)
- Cold (temperature ≤ 30°C and humidity > 30%)

- Cold and dry (temperature ≤ 30°C and humidity ≤ 30%).

Your task involves accurately classifying a given date according to these predefined categories and their respective thresholds.

You also have to examine the dataset using graphs or plots to analyze the changes in weather patterns over the years.

Dataset: https://drive.google.com/file/d/1wtGzFLtIW80mAPi-Pij8MQJN3Me6823v/view

Deliverables: -

1. Submit a report in **PDF** format mentioning how you have built the smart monitoring system with the sensors used. Also, provide the link to your simulated project in the report (You can generate the link for your project from the simulator by signing in and saving the project).
   Note: Please mention the names and email IDs of each group member and the percentage of contribution in the report.

2. Download the zip file of the simulation from the simulator. It should contain sketch.ino and diagram.json files.
3. Submit the code for the Machine learning task (Task 2) in a .**ipynb file**. Please write comments within the code that describe various functions.
4. The solution for the assignment should be submitted as a zip file. **Please submit a single file per group**. The zip file must contain the above-mentioned Report, Simulators zip file, and .ipynb file.

Evaluation Scheme for Assignment:

1. Building the Circuit in the Simulator (15 Marks)
2. The functionality of the smart monitoring system is based on the specifications given above and other expected deliverables. (30 Marks)
3. Implementation of the ML model along with evaluation metrics. (30 Marks)
4. Writing Report for the experiment setup and implementation. (25 Marks)