Laundromates

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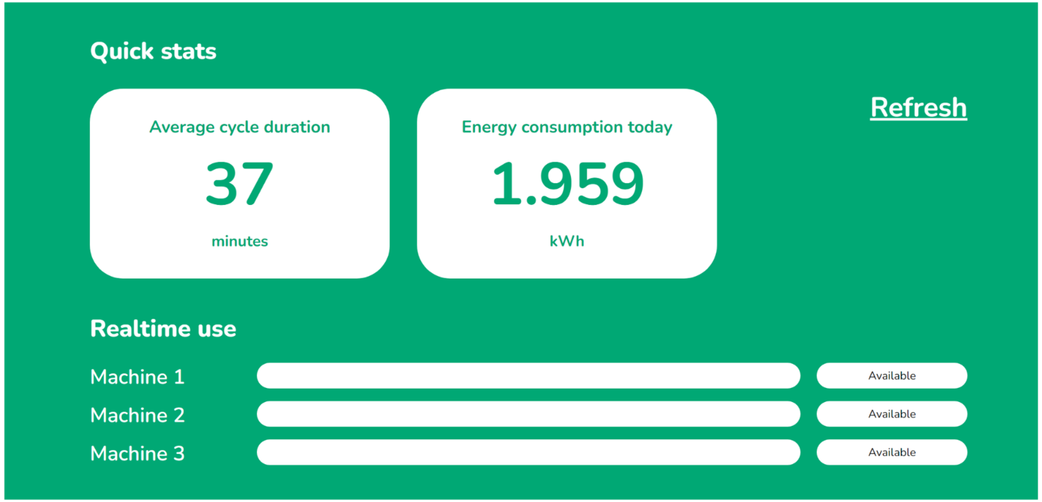
Problem

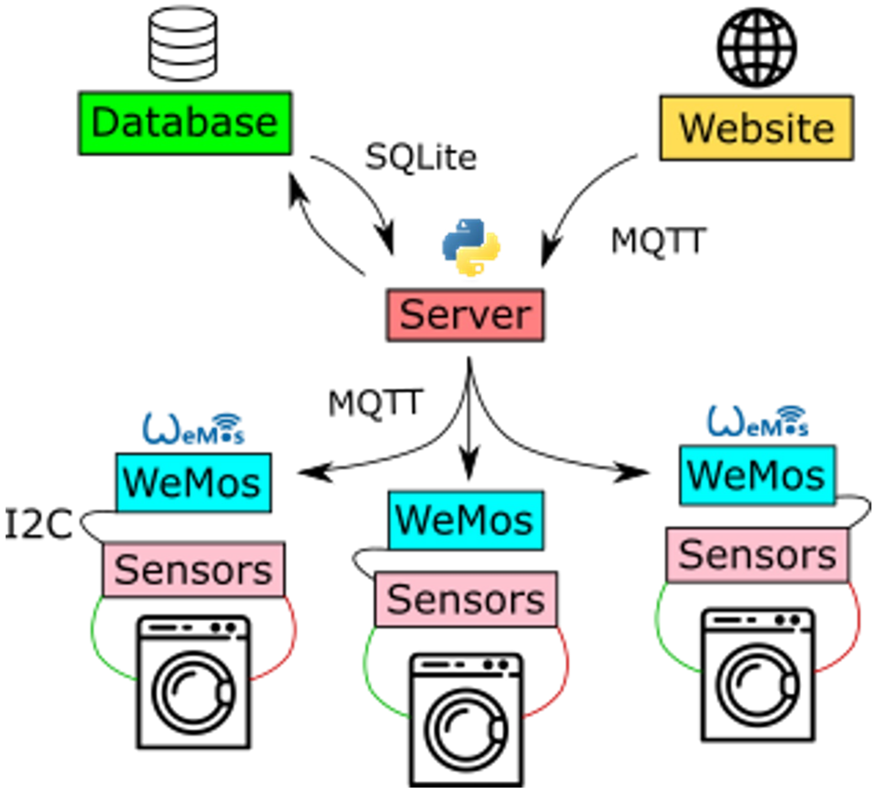
- Laundry machines in halls are a shared resource and incur high contention during peak hours
- There is no efficient way of knowing whether or not a machine is available

Solution

- A universal IoT system which reports laundry machine availability to a website

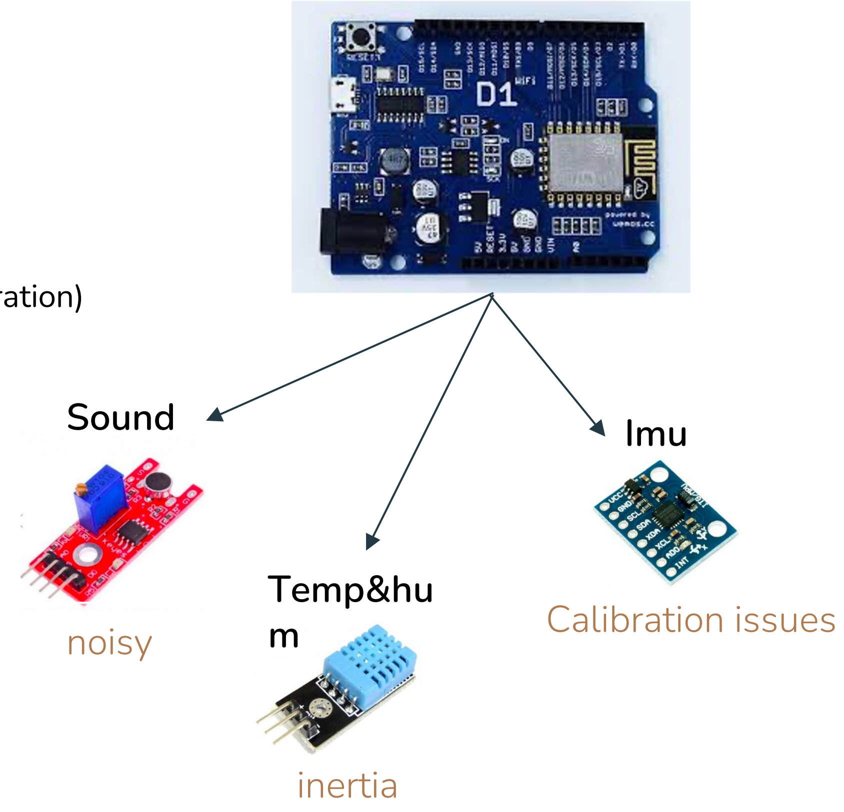


General Structure



Hardware

- 1 wemos per machine & 3 machines in total
- Sensors: Humidity+temperature, Sound, Imu (acceleration)
- Data is sent every 60s to the server in JSON
- Communication with server with MQTT
- One ID per machines



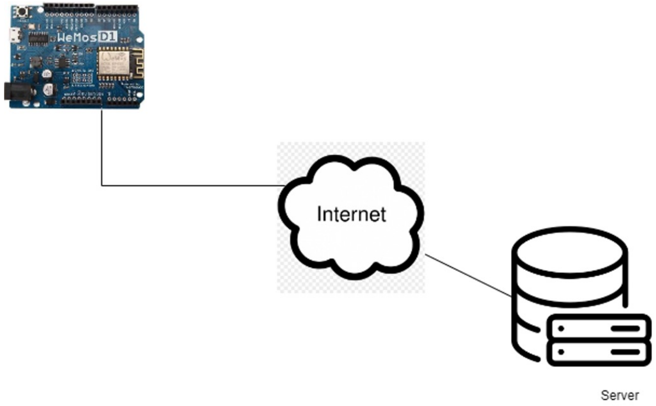
MQTT

Server

Machine Learning Model

- Model produced from supervised data - Classification to {‘On’, ‘Off’}
  - Input from csv file
  - Noise added to data to increase data size
  - Data is scaled using MinMaxScaler
- Neural network and Decision Tree Classifier
  - Similar precision (~97%)
  - Neural network - reliability if malfunctioning sensor, slightly faster detection of transitions
- Neural network parameters
  - 2 layers, (‘relu’, ‘softmax’)
  - SGD optimizer - 0.2 learning rate
  - 100 epochs

Server



- Sets up 2 different connections through MQTT:

1. With the WeMOS: It receives the data polled by the sensors every 60s and using the ML model, it comes up with a prediction.
2. With the Website: It receives a request for updated data, sets up the data that will be displayed on the the website and sends it using JSON format.

- Both connections are on different channels, each of the WeMOS and the Website connect to their respective channel.
- When a cycle of laundry is terminated, the server stores the information in the database.

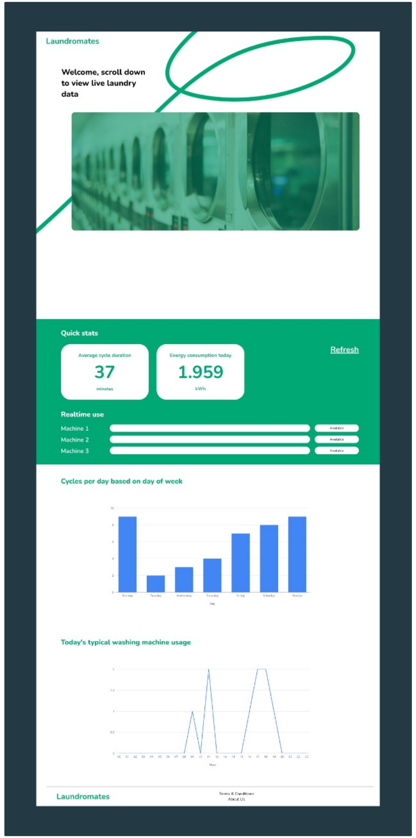
Database

- Used SQLite to set up a relational database which fitted our needs.
- Every time a washing cycle is completed, we store a new tuple.
- The attributes are:
    1. Machine’s ID
    2. Cycle duration
    3. Start timestamp
    4. Hour of the cycle
    5. Day of the cycle
- DBMS is useful as it allows the management of a lot of data and is scalable + allows to query and obtain useful results when needed.

Website

- Fetches data from MQTT broker through MQTT via websockets
- Reports:
    - Availability of specific machines and estimated time remaining of a wash cycle
    - Average cycle duration
    - Power consumed by machines on a given day
    - History of cycles per day based on day of week
    - Historical usage times for current day of week

Repo: https://github.com/davhao/CS3237Website



Power Consumption

- Light-sleep cycles: ~1mA
- Poling every minute
  - Sufficent accuracy
- Poling consumption: ~70mA for around 6.5s (Wi-fi, MQTT, sensors)
- Sensor consumptions:
  - Sound: Almost null (input pin)
  - IMU: 9.3µA
  - Temp and humidity: 0.3mA active, 60µA standby
- Power supply can simply be a plug, since the system is static

Live Demo

Video + live simulation demo

Possible Improvements

- Personalized feature - Face/login recognition and use of personal data
    - Personal notifications when laundry finished/interrupted
- More esthetic design
- Collection of more data for supervised learning - increased precision
- Centralisation of multiple sensors onto one WeMos board with ADC converters - Cost reduction

Questions