Laboratorio IoT

Prof. Paolo Napoletano

a.a. 2020/2021

Smart Monitoring

Team

- **Gabriele Ferrario 817518**

Materials

Description of the ingredients employed

Components:

- 1x NodeMCU 1.0 (ESP8266)
- 1x 16x2 characters LCD display + PCF8574 I2C converter
- 1x DHT11 temperature and humidity sensor
- 1x Photoresistor
- 1x SW-520D roll ball tilt sensor
- 2x LED
- 2x 10kΩ resistor
- 2x 200Ω resistor

Technologies:

- MQTT
- Flask
- Telegram
- MySQL
- InfluxDB

Other:

- Machine Learning
- Low power consumption

Recap

Description of the previous system

Assignment 1:

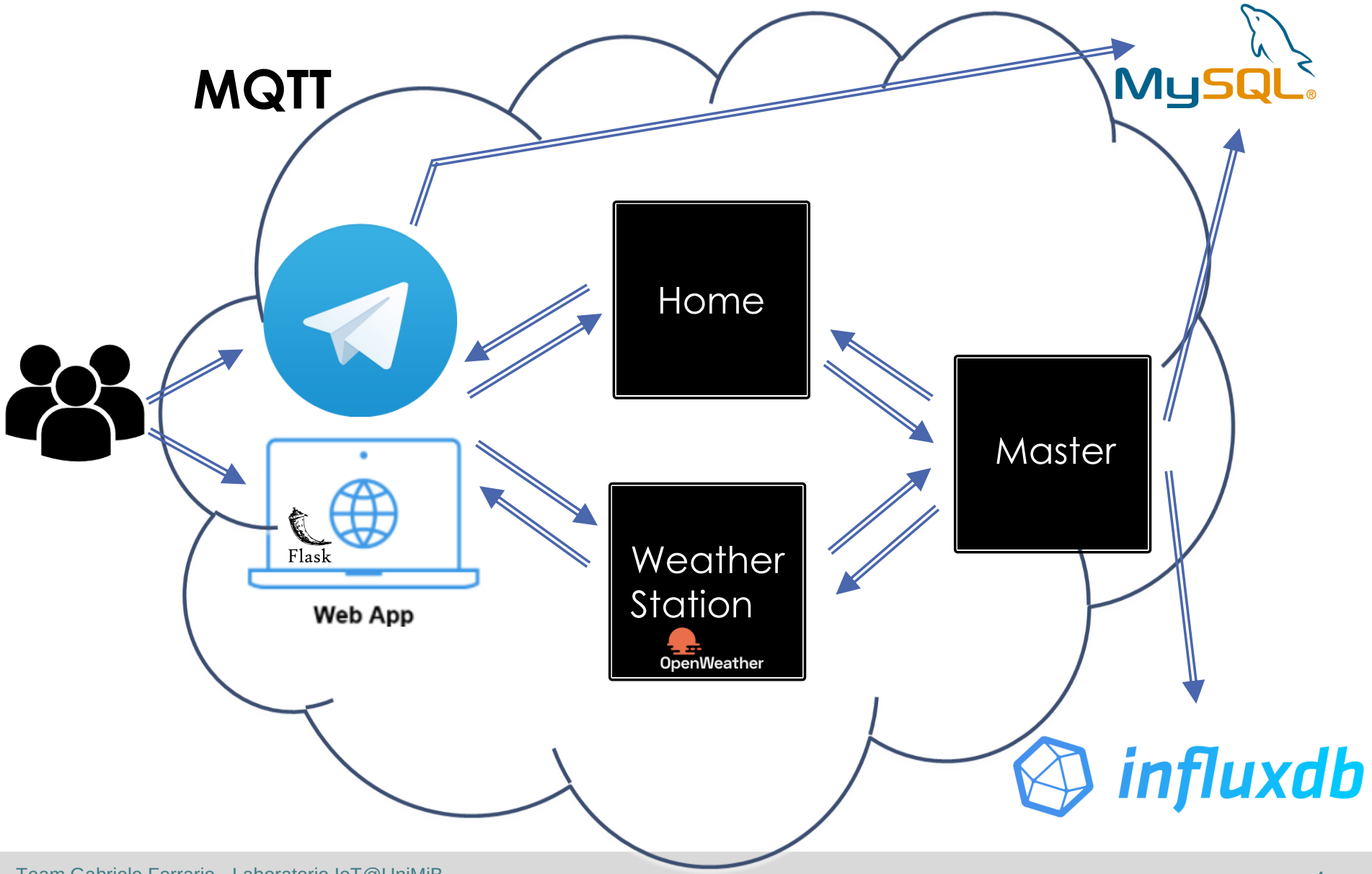
- **Home monitoring** system
- **Detection** of alert events
- **Web Server** on NodeMCU
- Constaint logging on **InfluxDB**
- InfluxDB **Dashboard**

Assignment 2:

- **Virtualization** of several **NodeMCU**
- **MQTT**
- **Weather** Monitoring
- Web Server with **Flask**
- **MySQL** for monitoring NodeMCUs
- Dynamic thresholds

Method

Description system: choices, parameters, use cases



Method - Telegram

Description system: choices, parameters, use cases

General:
/registerMe - registers the user to the monitoring system
/removeMe - removes user registration from the monitoring system
/setup sleepTime executionTime - updates the sleep time and the execution time of the ESP8266

Home Monitoring:
/home - activates home monitoring
/stopHome - deactivates home monitoring
/setAlert sensor lowerBound upperBound - sets the thresholds for the indicated sensor

Weather Station:
/weather - activates weather monitoring
/stopWeather - deactivates the weather monitoring
/forecasting city - weather forecasting for the indicated city

Possible value for setAlert:
1) light lowerBound upperBound
2) temperature lowerBound upperBound
3) wifi lowerBound

Method - Telegram

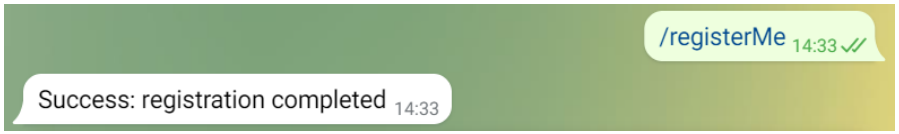
Description system: choices, parameters, use cases

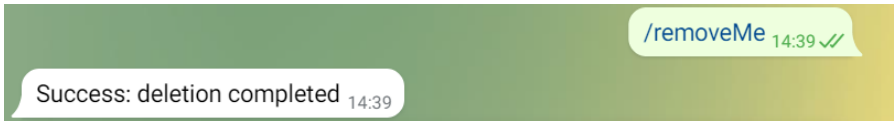
General:
/registerMe - registers the user to the monitoring system
/removeMe - removes user registration from the monitoring system
/setup sleepTime executionTime - updates the sleep time and the execution time of the ESP8266

Home Monitoring:
/home - activates home monitoring
/stopHome - deactivates home monitoring
/setAlert sensor lowerBound upperBound - sets the thresholds for the indicated sensor

Weather Station:
/weather - activates weather monitoring
/stopWeather - deactivates the weather monitoring
/forecasting city - weather forecasting for the indicated city

Possible value for setAlert:
1) light lowerBound upperBound
2) temperature lowerBound upperBound
3) wifi lowerBound

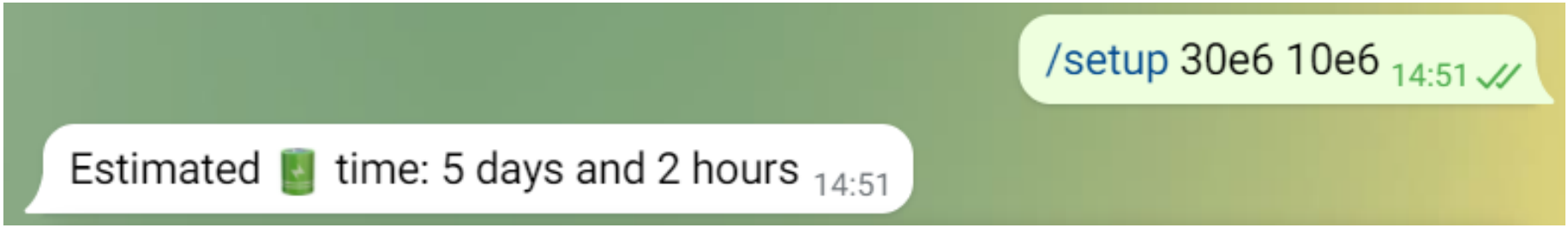




Method – Deep Sleep

Description system: choices, parameters, use cases

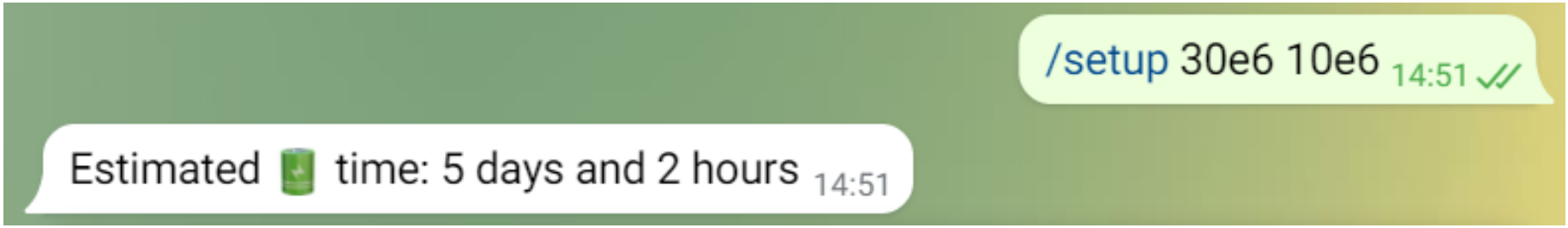
Temporaized Deep Sleep that varies according to measured values



Method – Deep Sleep

Description system: choices, parameters, use cases

Temporaized Deep Sleep that varies according to measured values



$$capacity = 5200\ mAh \qquad awake\ consumption = 170\ mA \qquad sleep\ consumption = 24\ \mu A$$

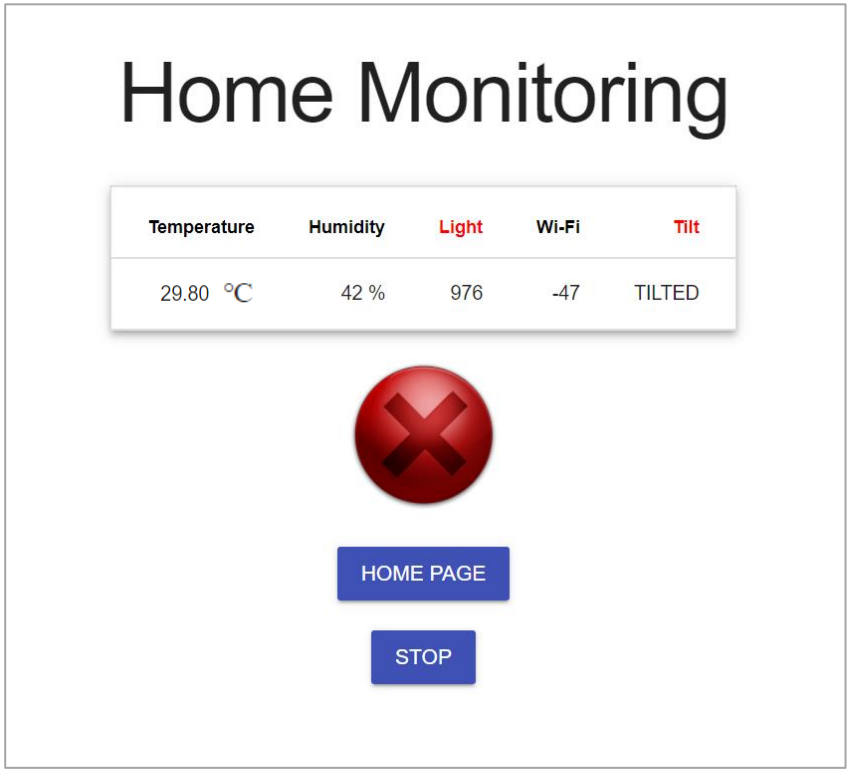
$$lifetime = \frac{capacity}{average\ consumption}$$

$$average\ consumption = \frac{(sleep\ consumption\ \cdot\ sleep\ time\ +\ awake\ consumption \cdot awake\ time)}{(wake\ time + sleep\ time)}$$

Method – Home Monitoring

Description system: choices, parameters, use cases

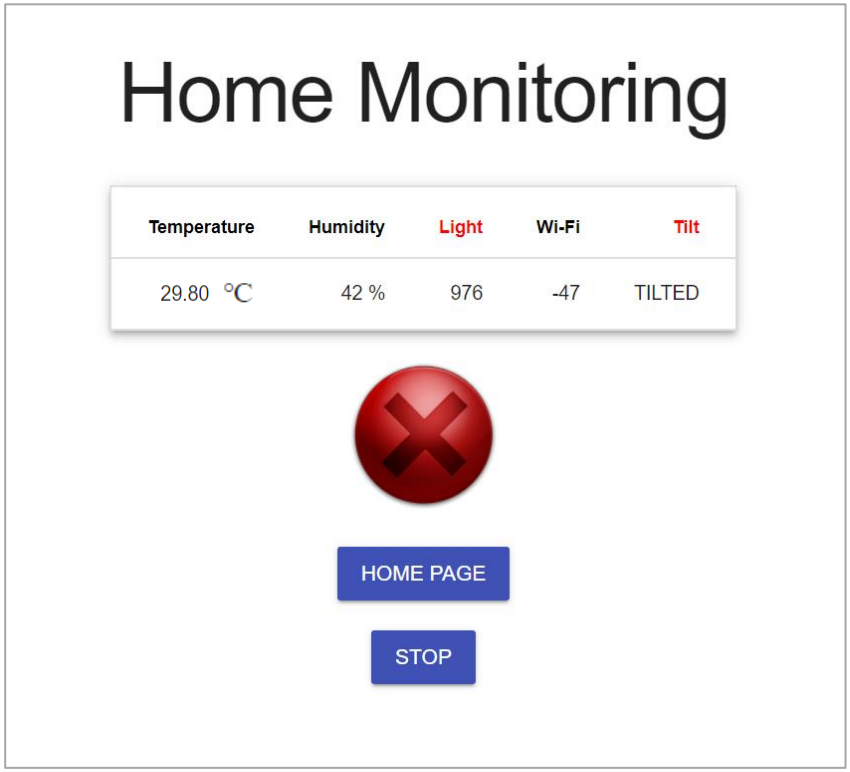
Web App



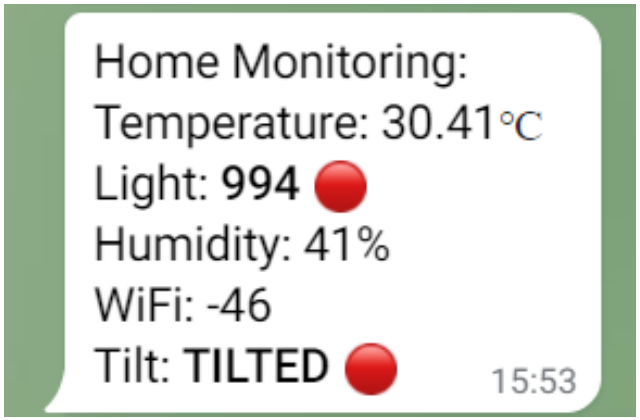
Method – Home Monitoring

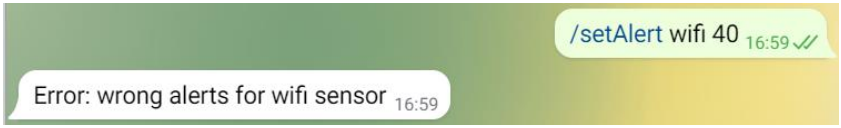
Description system: choices, parameters, use cases

Web App



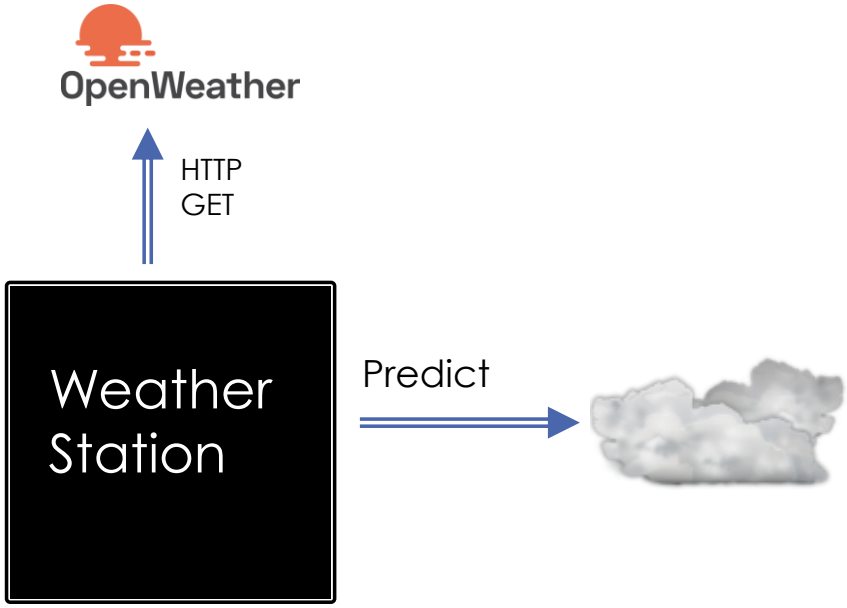
Telegram Bot





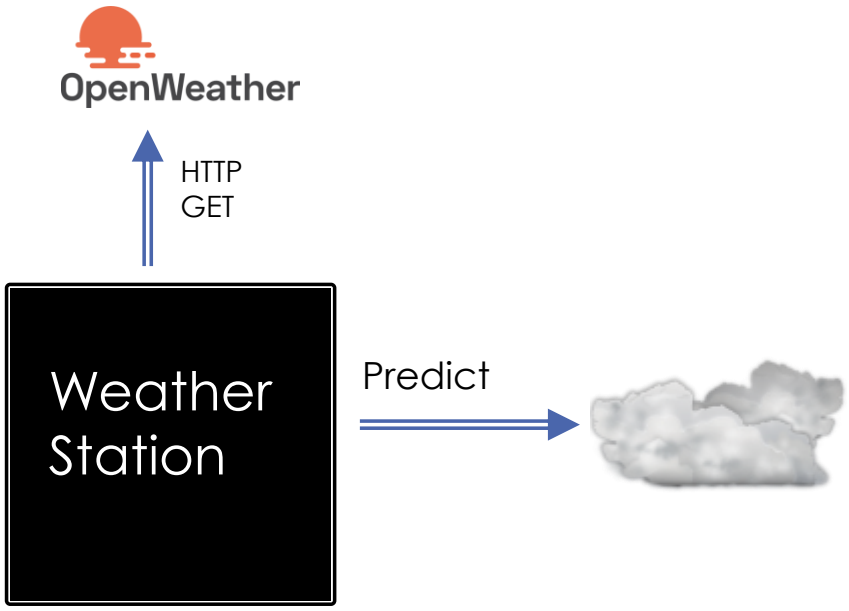
Method – Weather Station

Description system: choices, parameters, use cases



Method – Weather Station

Description system: choices, parameters, use cases



Machine Learning:

- **Weather prediction** (sun, cloudy, rain)
- Unbalanced Dataset

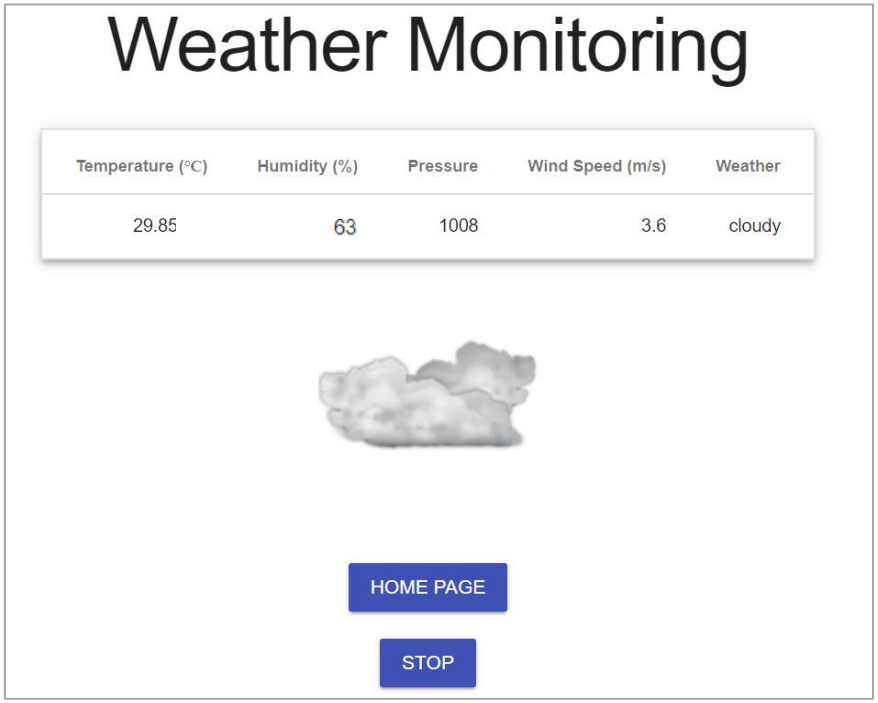
  ↓

  Oversampling (SMOTE)
- **SVM** (temperature, humdity, wind, pressure)
- **Hyperparameter optimization** (Grid Search)
- Accuracy ≈ 0.82
- **Conversion** to Optimized C code (MicroML)

https://github.com/eloquentarduino/micromlgen

Method – Weather Station

Description system: choices, parameters, use cases

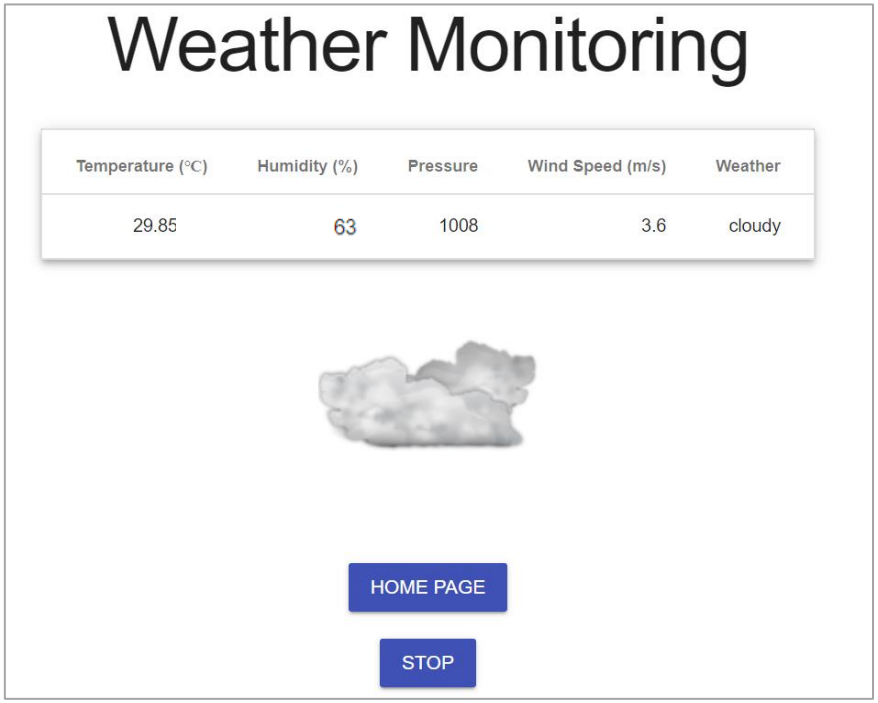


Web App

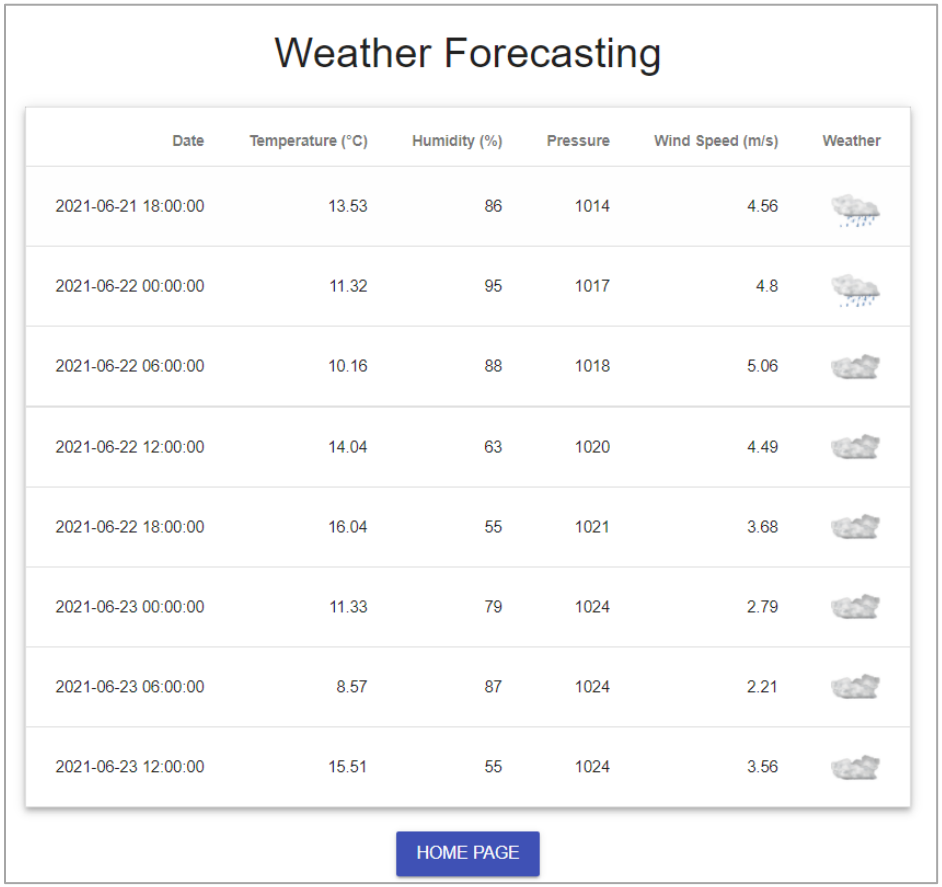
Telegram Bot

Method – Weather Station

Description system: choices, parameters, use cases



Web App



Telegram Bot

Final remarks

Results, Discussion, conclusion

The system allows to:

- monitor the house and notify the users in real time
- set different alarms
- monitor the weather in real time via a Weather Station
- weather forecasting

Observation:

- simultaneous running of home monitoring and weather station can cause RAM problems

Future works:

- insert new sensor for house monitoring and replace Openweather with sensors
- predict more weather conditions
- weather forecasting via Machine Learning