Environmental monitoring

IOT CLASS PROJECT 2024-2025,
PROF. GIANCARLO FORTINO
PROF. FRANCESCO PUPO

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UNIVERSITÀ DELLA CALABRIA
DIPARTIMENTO DI INGEGNERIA INFORMATICA, MODELLISTICA, ELETTRONICA E SISTEMISTICA
DIMES

Content

- Goals
- Architecture
- Context-aware
- Challenges
- Features
- Used technologies
- Future development

Goals

Main Goal:

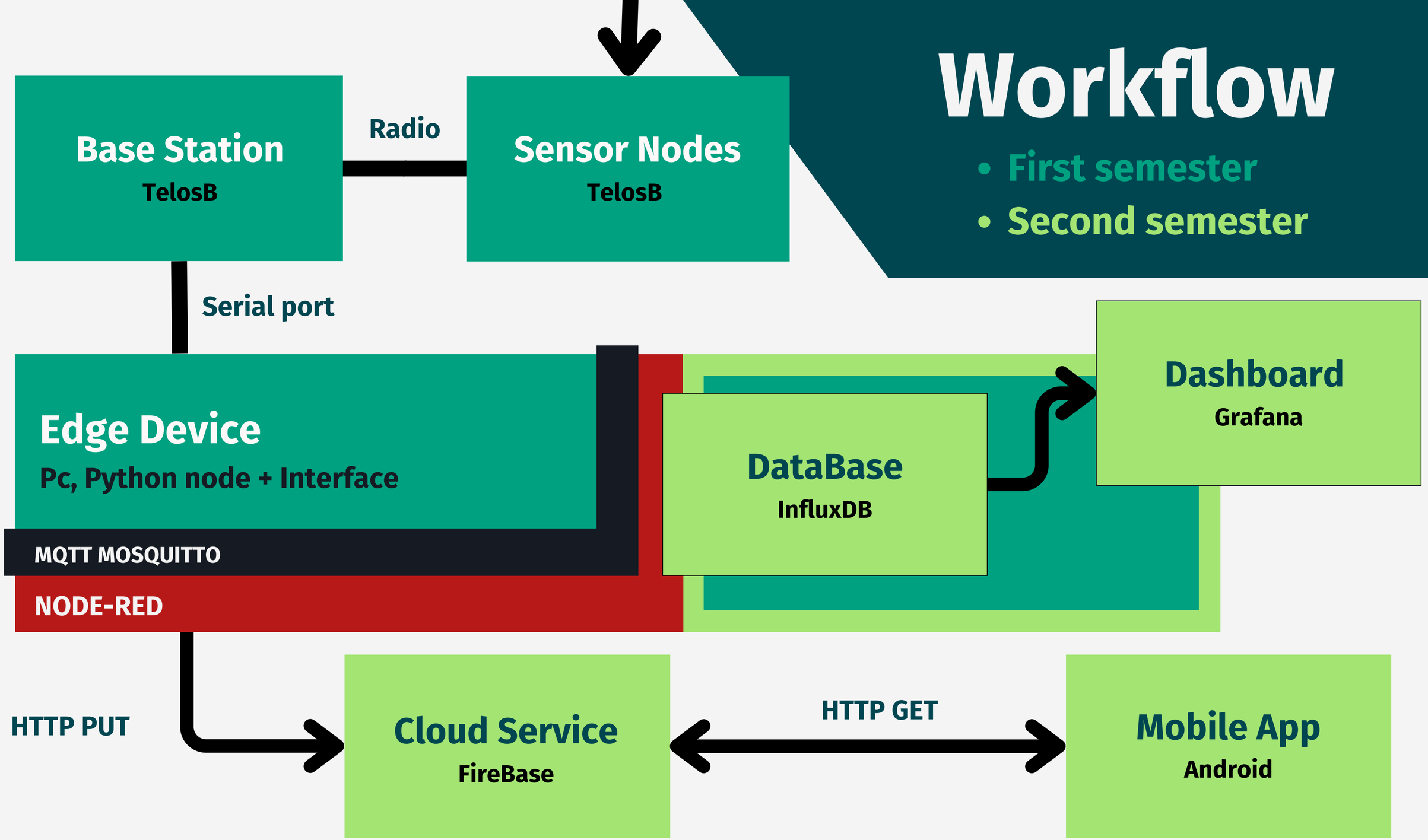
Museum's environment Monitoring Dashboard

Side Goal:

Museum's environment Realtime updating

Workflow

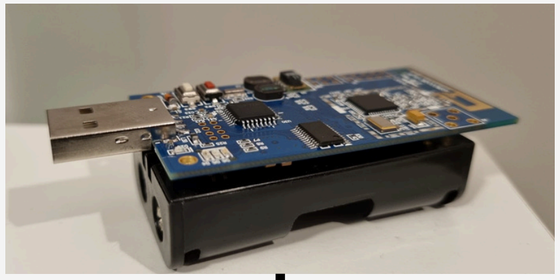
- First semester
- Second semester

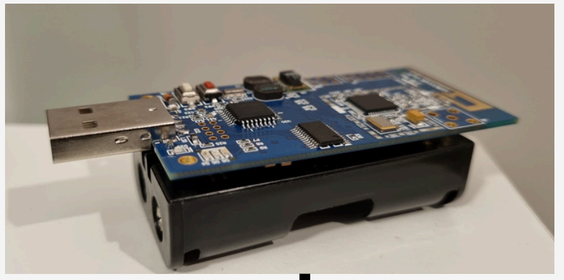


Sensor Nodes
TelosB

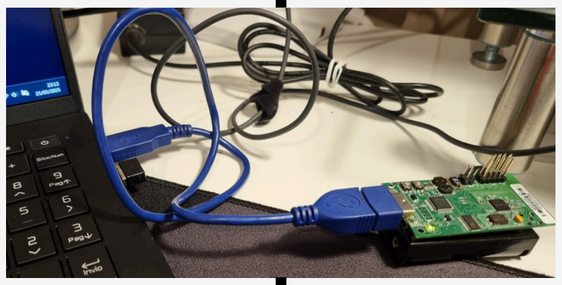
Base Station
TelosB

Edge Device
PC, Python Interface

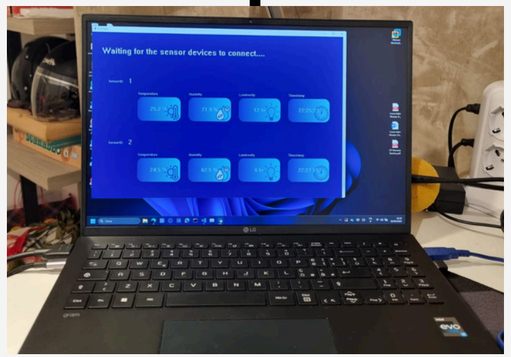




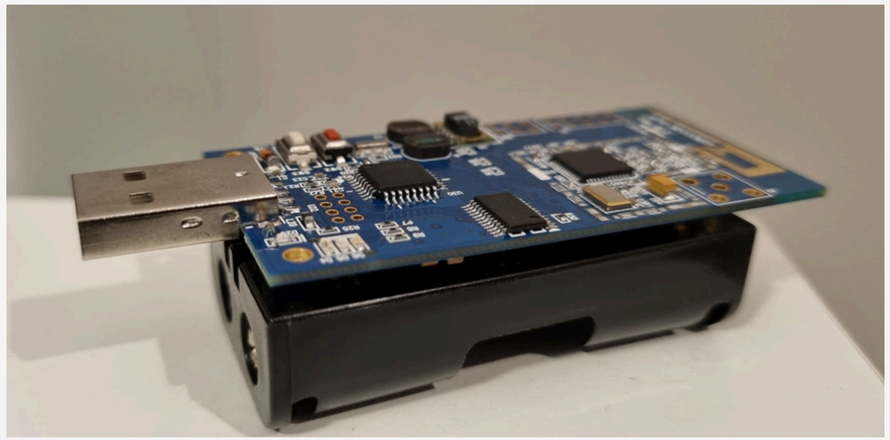
radio



Serial Port



Sensor Nodes



2 TelosB

MAKEFILE

SensingAppC.nc

SensingC.nc

SensorMsg.h

Base Station

1 TelosB

MAKEFILE

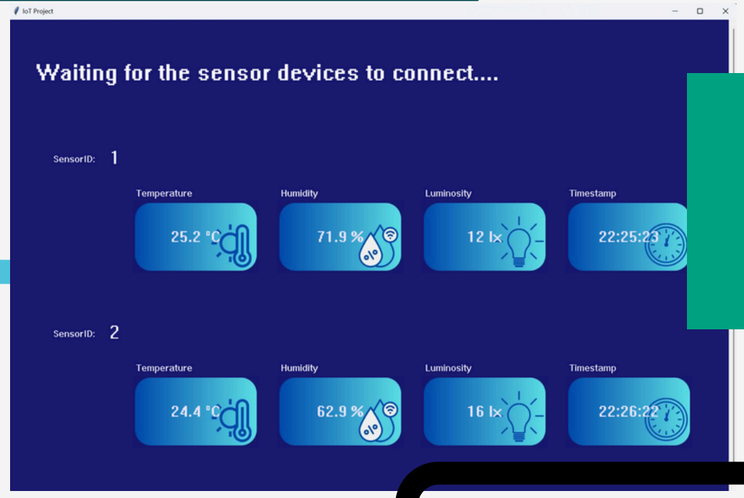
SimpleReceiver AppC.nc

SimpleReceiverC.nc

SensorMsg.h

EDGE device

Side Thread



View

Control

Main Thread

Data from the
Serial Port

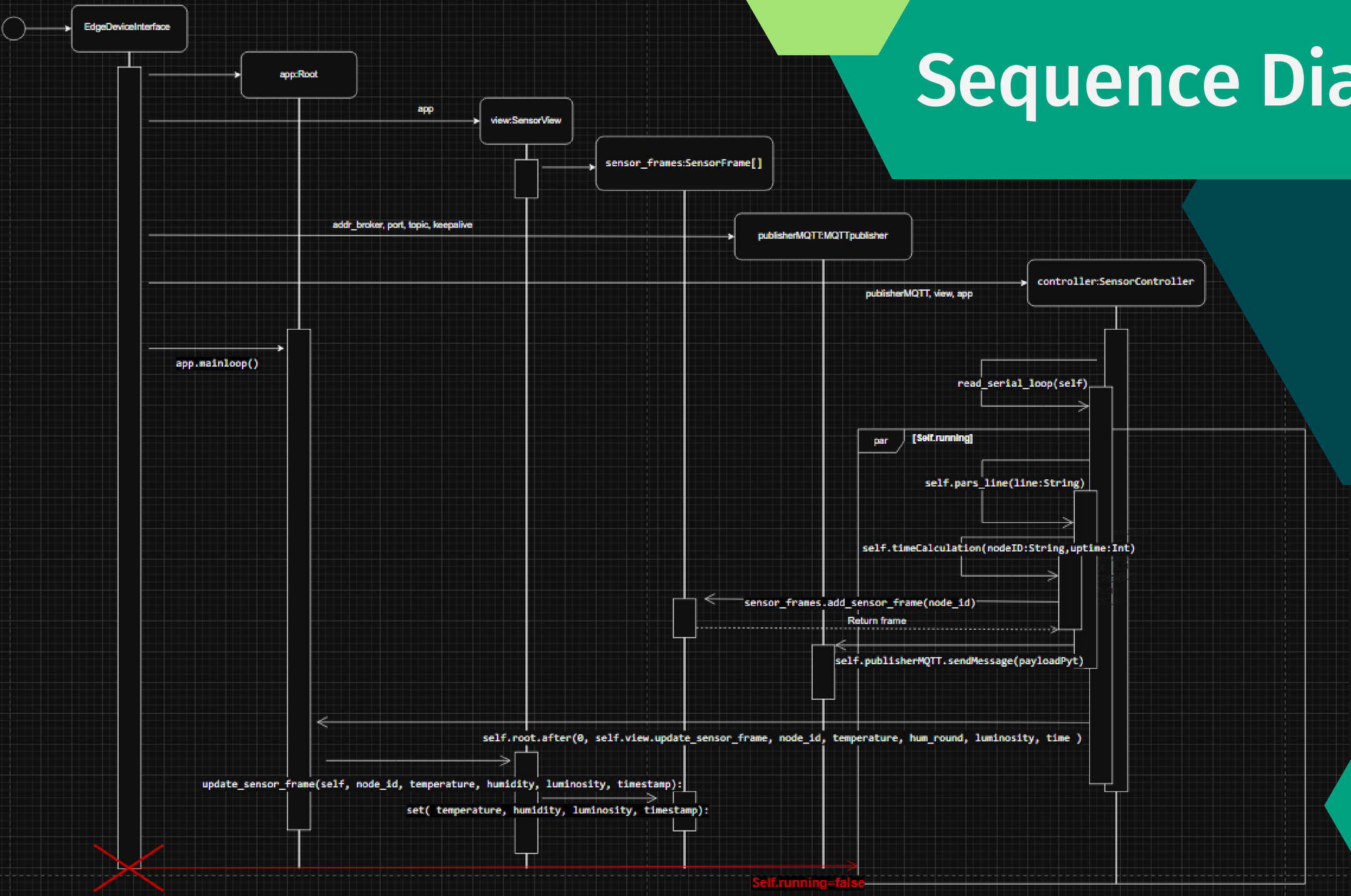
Publisher
Mqtt publisher

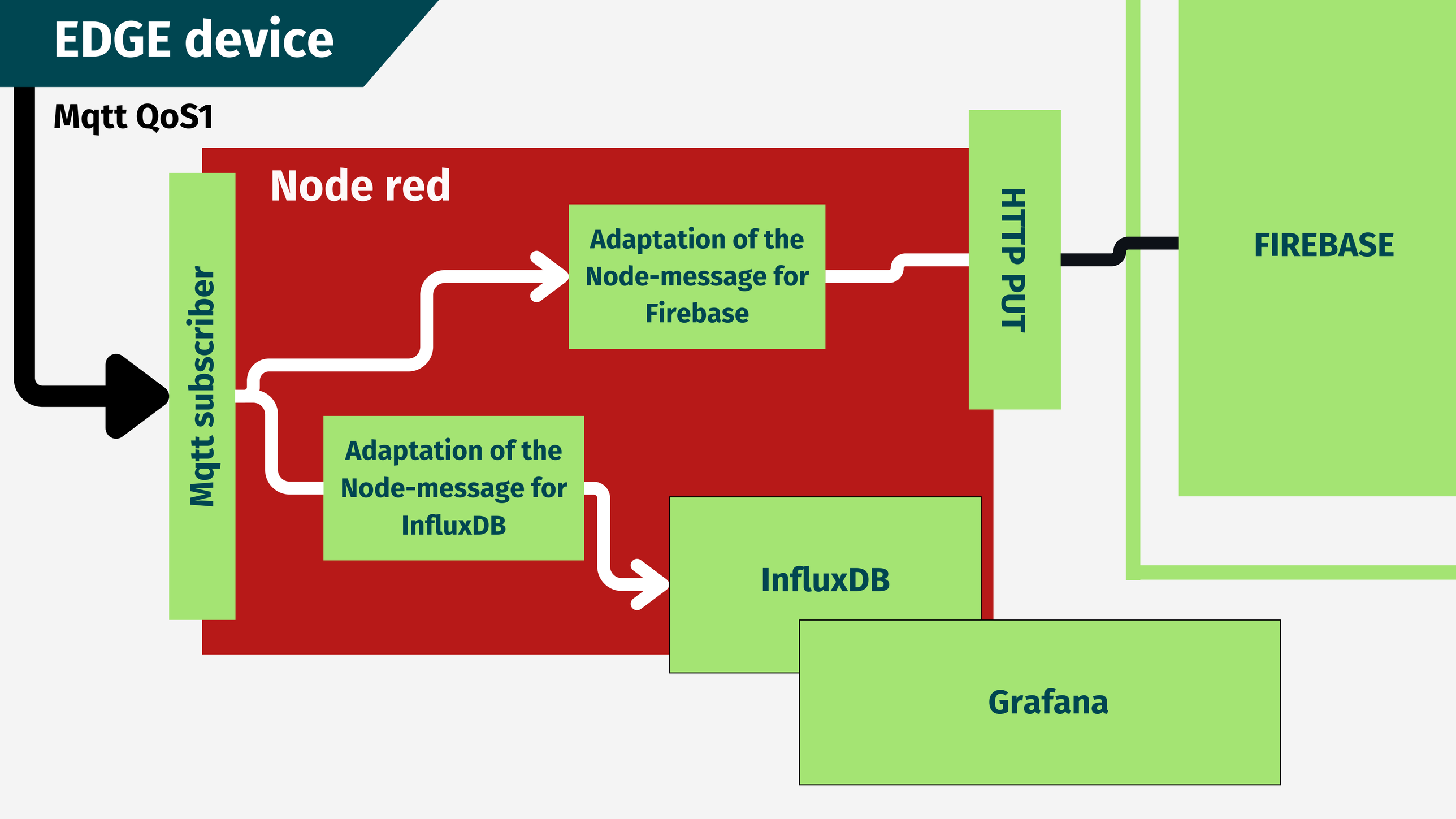
Mqtt Broker
Mosqitto

Mqtt subscriber

Node red

Sequence Diagram




EDGE device
Mqtt QoS1
Node red
Mqtt subscriber
Adaptation of the Node-message for Firebase
Adaptation of the Node-message for InfluxDB
HTTP PUT
FIREBASE
InfluxDB
Grafana

EDGE device

Mqtt QoS1

```
let message = msg.payload;
msg.payload = {
    temperature: message.temperature,
    humidity: message.humidity,
    luminosity: message.luminosity,
};

msg.url = "https://iot-environmental-14e42-default-rtdb.europ
    message.idSensor + "/" + message.timestamp+".json";
return msg;
```

Node red

Mqtt subscriber

Adaptation of the Node-message for Firebase

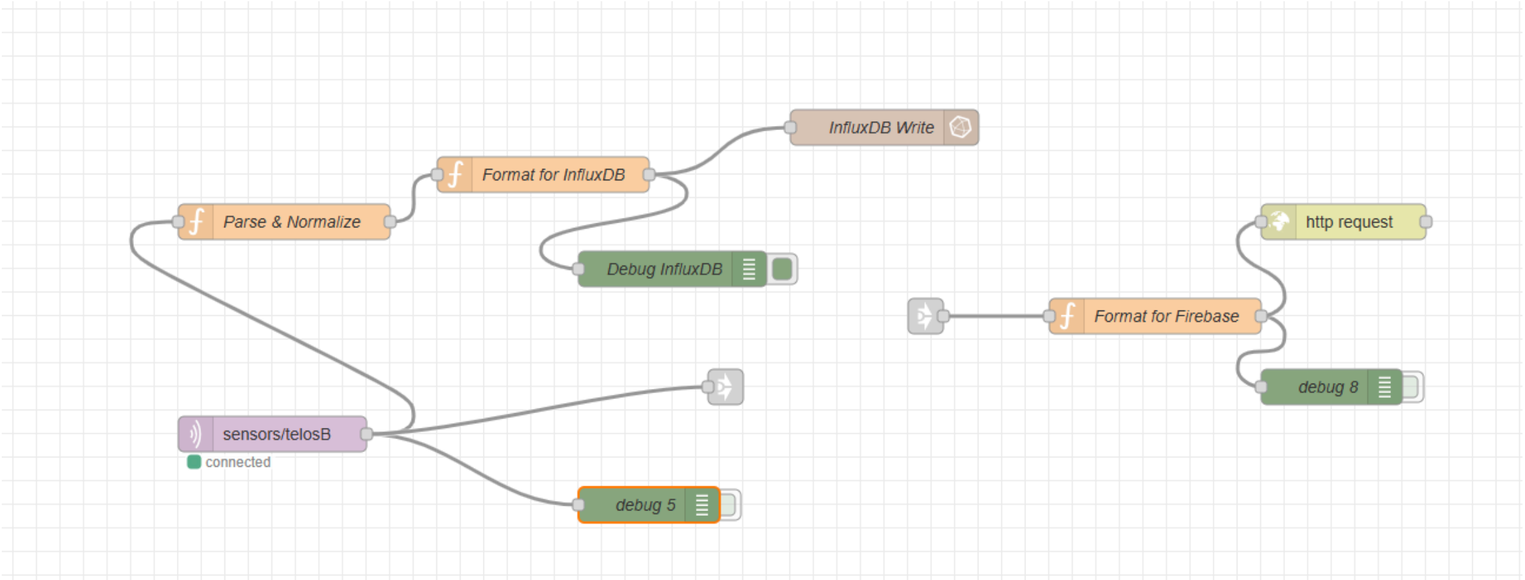
Adaptation of the Node-message for InfluxDB

HTTP PUT

FIREBASE

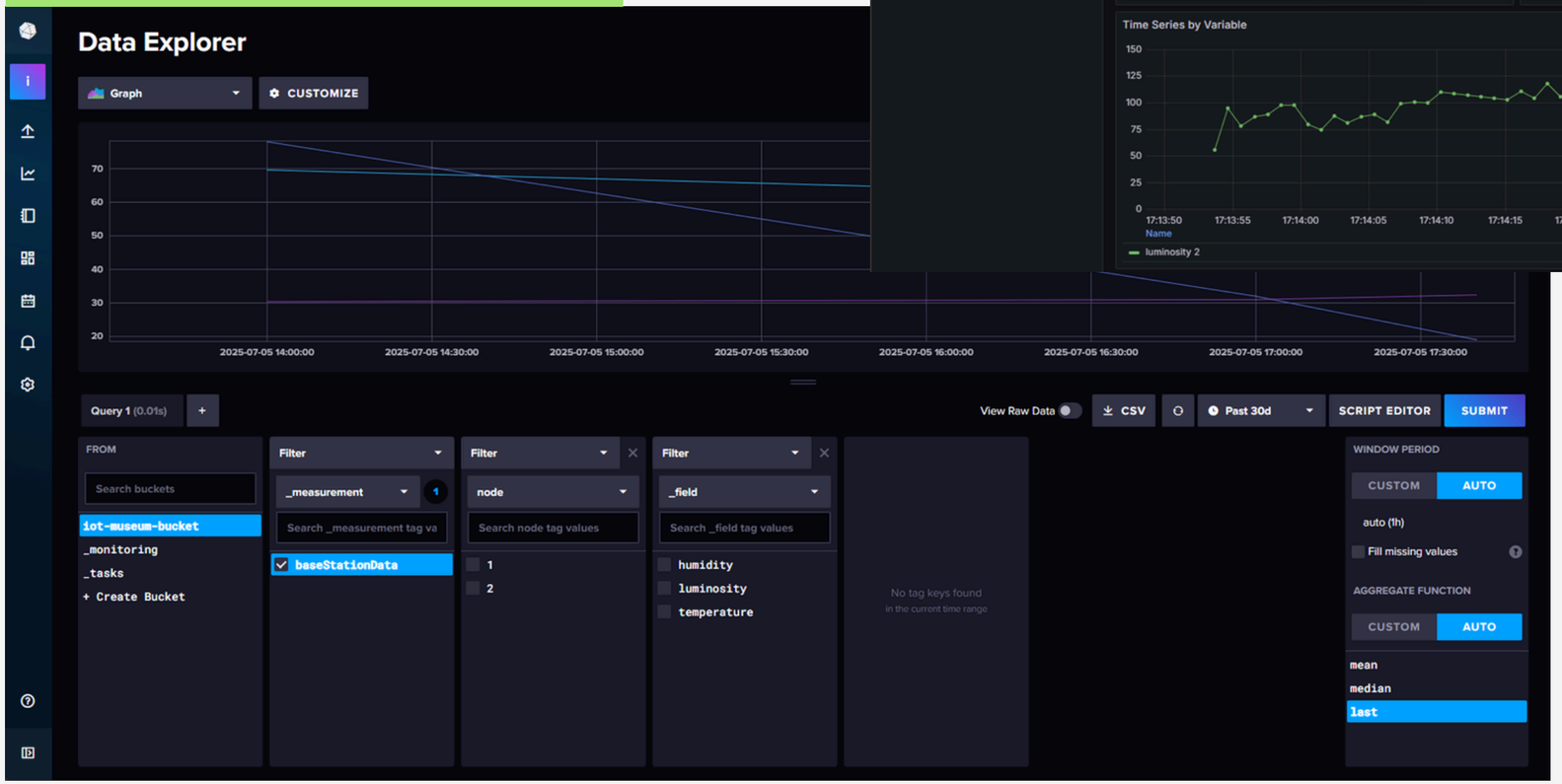
```
msg.payload = [
  {
    temperature: msg.temperature,
    humidity: msg.humidity,
    luminosity: msg.luminosity
  },
  {
    node: msg.sensorId.toString()
  }
];

msg.timestamp=msg.timestamp;
return msg;
```

Flow



EDGE device

http://localhost:8086

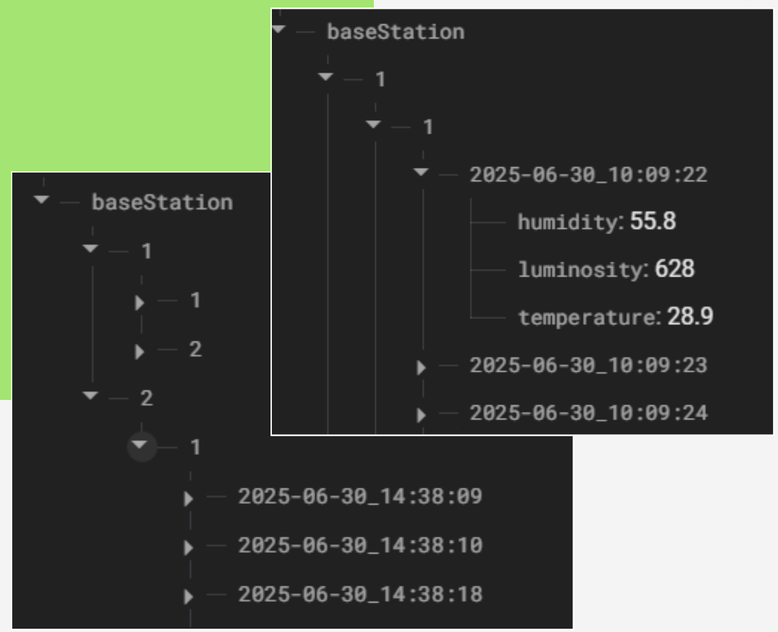


http://localhost:3000

Firebase + Android

JetPack Compose

FIREBASE



Data

Data Representation

SensorReading
NodeData
BaseStationData

MAIN ACTIVITY

Nav

AppFragmentNavigator

View

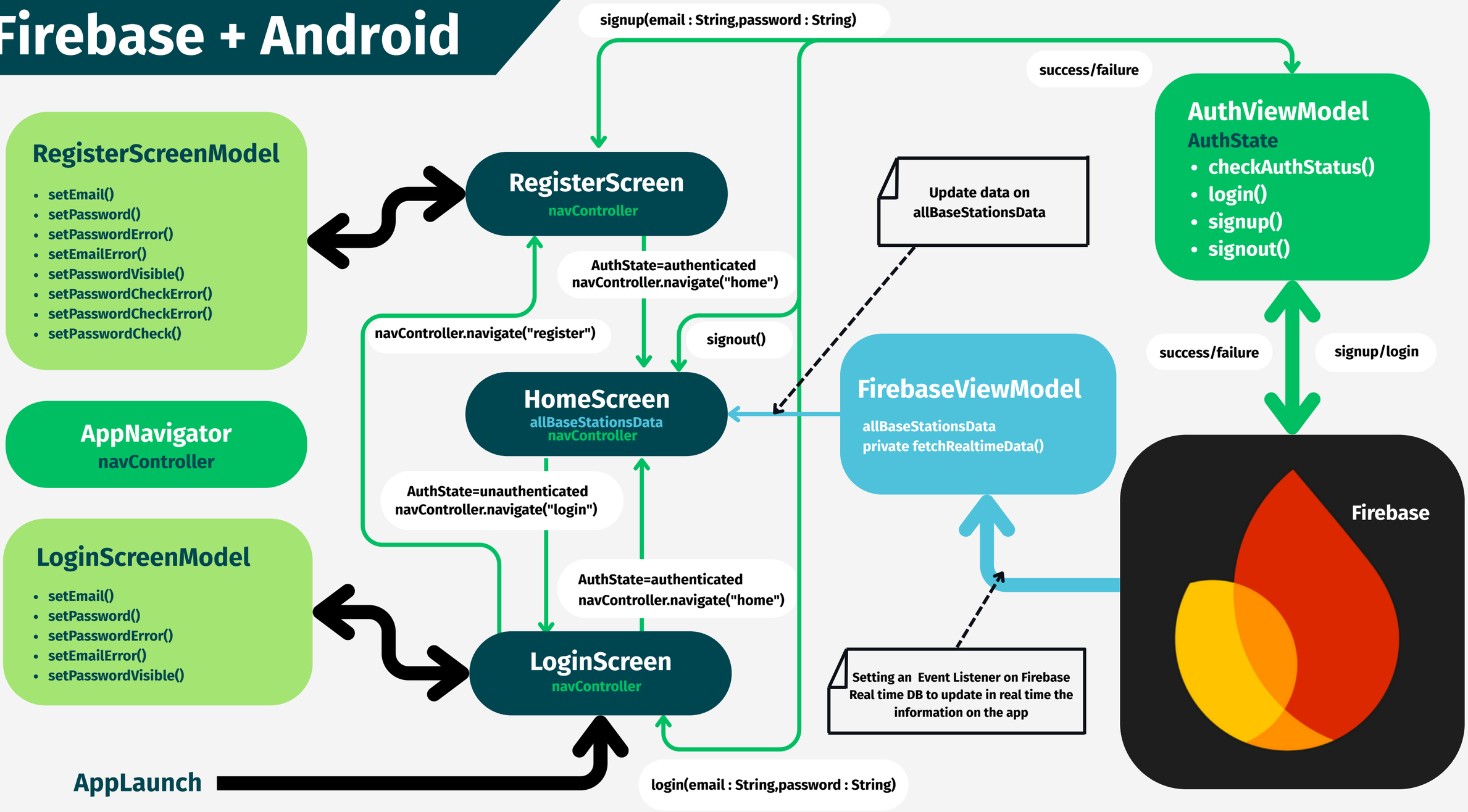
Screen

HomeScreen
LoginScreen
RegisterScreen

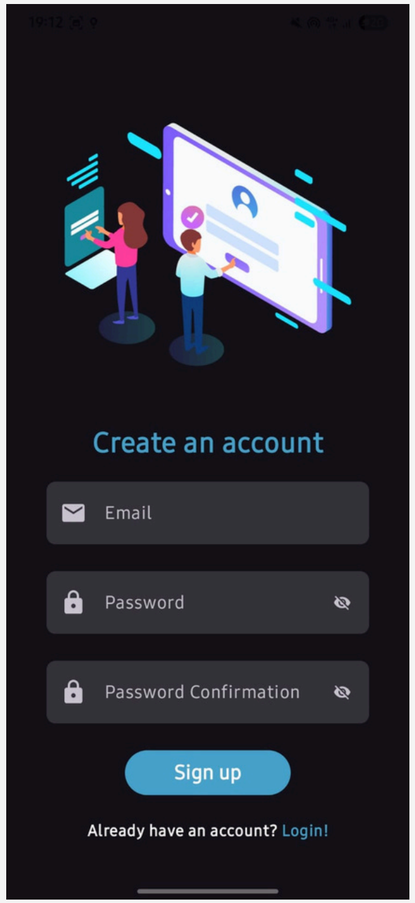
Model

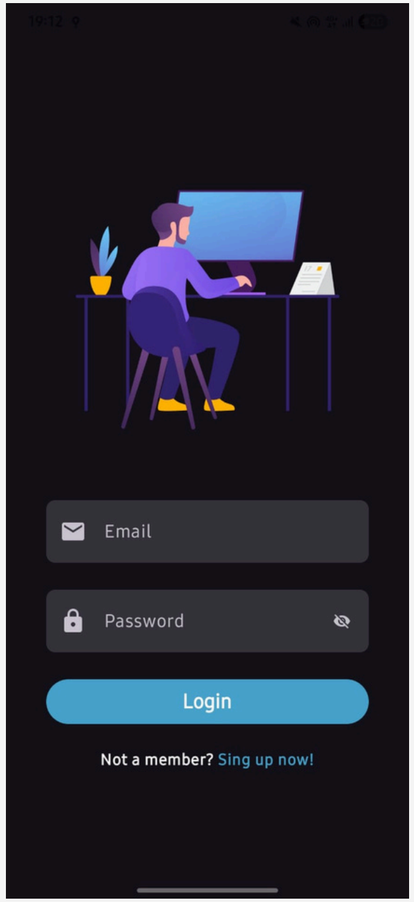
AuthViewModel
FirebaseViewModel
LogicViewModel
RegisterViewModel

Firebase + Android

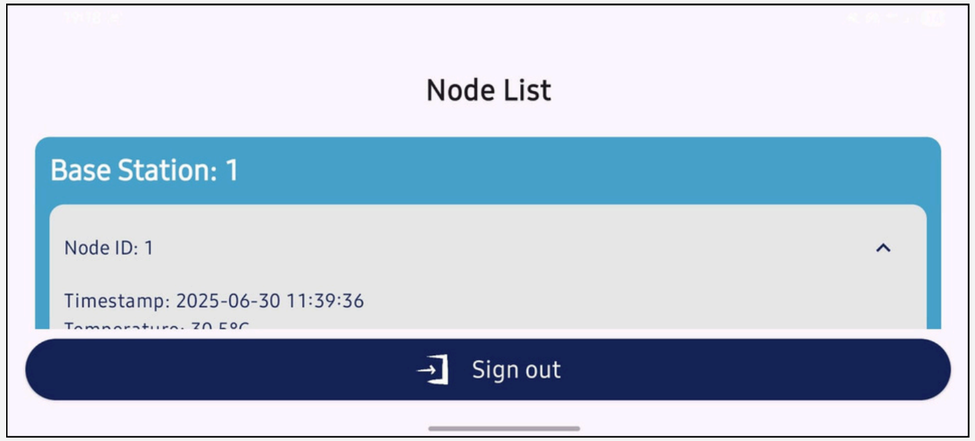


Android UI


Create an account
Email
Password
Password Confirmation
Sign up
Already have an account? Login!


Email
Password
Login
Not a member? Sing up now!


Node List
Base Station: 1
Node ID: 1
Timestamp: 2025-06-30 11:39:36
Temperature: 30.5°C
Humidity: 53.2%
Luminosity: 179lx
Node ID: 2
Base Station: 2
Node ID: 1
Node ID: 2
Sign out


Node List
Base Station: 1
Node ID: 1
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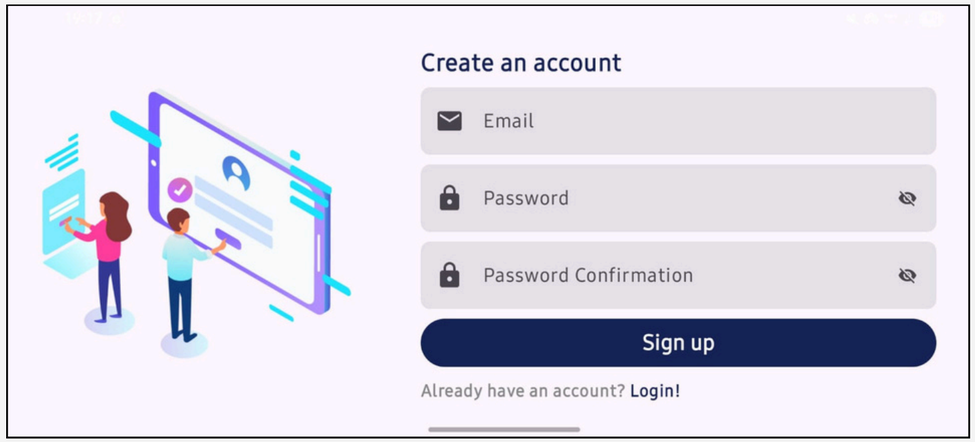
Sign out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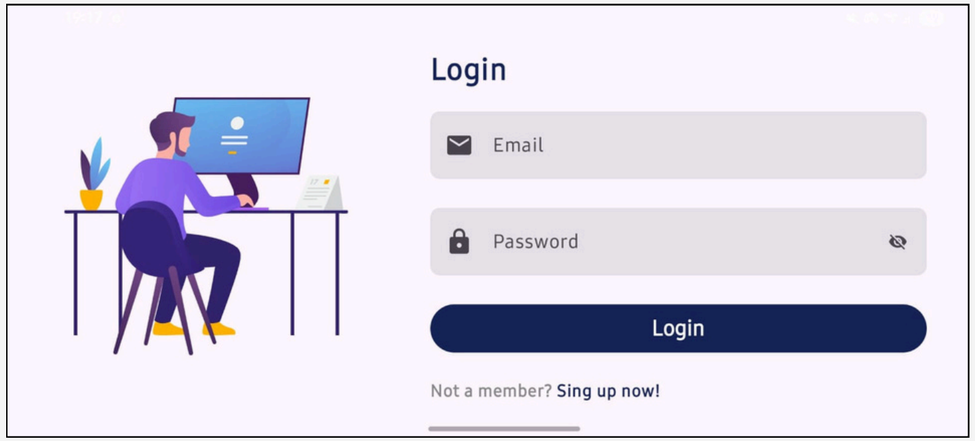
Login
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Password
Login
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Context-aware

*Scalable

2* ~ TelosB sensors to monitor temperature, humidity and luminosity

1* ~ TelosB base station

1* ~ PC that act EdgeDevice

1* ~ Android mobile Device

Challenges

- Measurement Frequency
- Radio communication fails between TelosB
- Sensors Placement
- Uncertainty

Challenges

- **MQTT implementation with QoS=1 to balance RealTime constraints & Reliability**
- **Flow management**

Challenges

- Integration of Node-red and InfluxDB
- Integration of InfluxDB and Grafana

Challenges

- Design following the JetPackCompose Paradigm
- Real time syncronization with the sensors datas on Firebase

Features

Dashboard that provides real-time visualization of the sensors datas	Real time synchronization with Android mobile devices
Cloud integration to store and share data	Easy scalable system

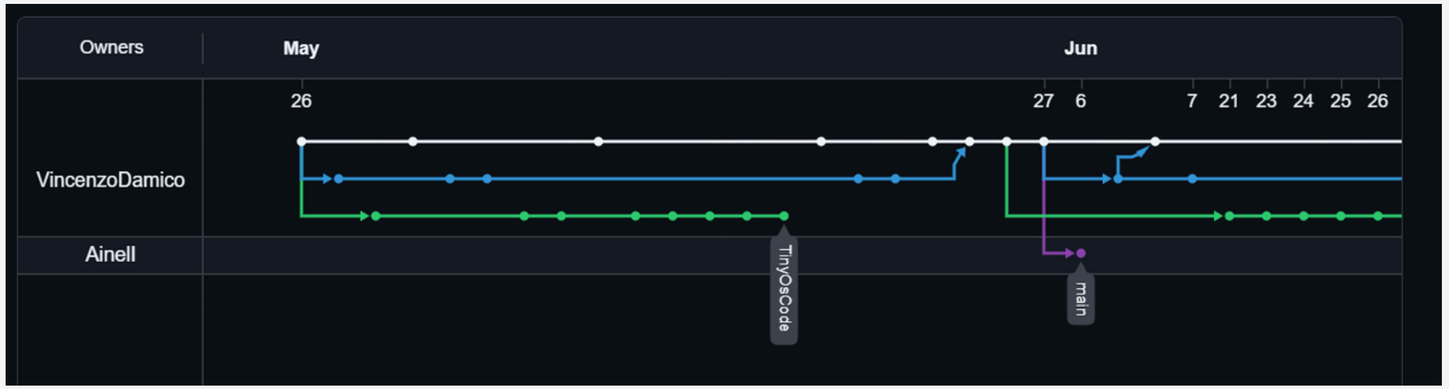
What did we use?

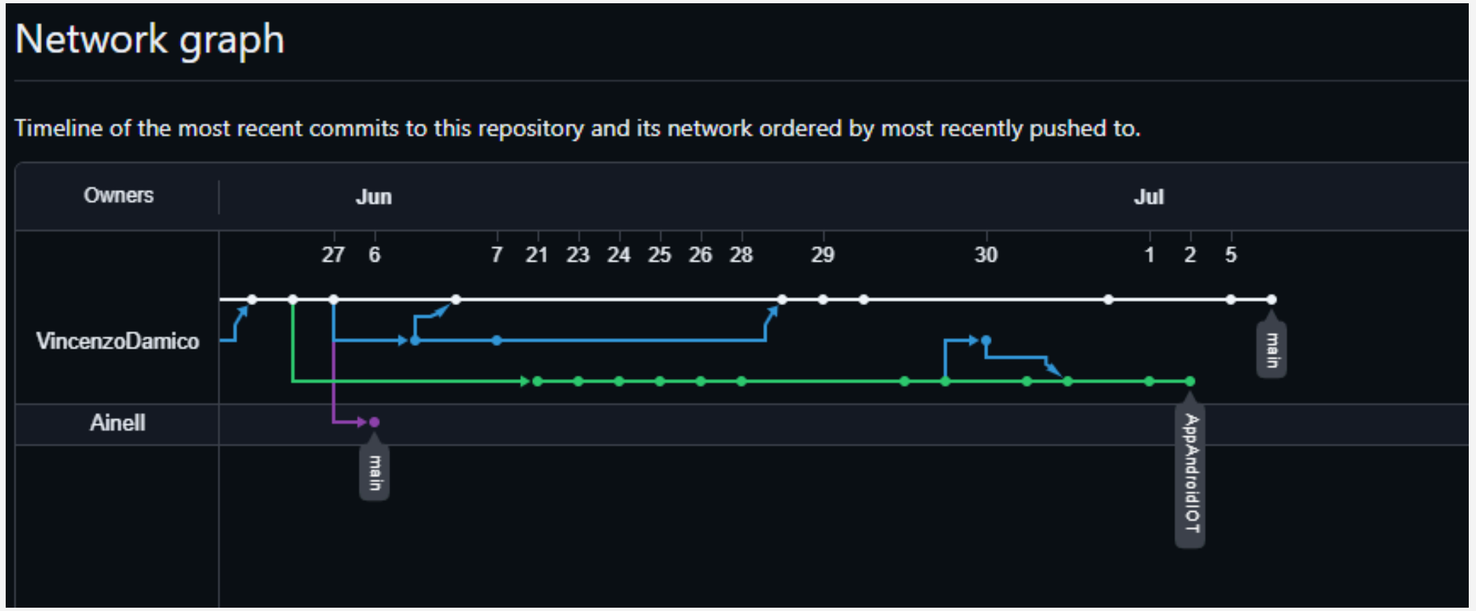
TinyOS (.nc)	Python
Firebase	MQTT (Nodered+ Mosqitto)
Grafana	Android

Future development

Implementation of actuation to change temp, hum, lum	Reinforced learning model for auto-regulation of the actuators
Implementation of area data inference model	Advise deployment AI System for better positioning of the sensors

Git-Hub





https://github.com/VincenzoDamico/IOT_TinyOs

Thank you

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