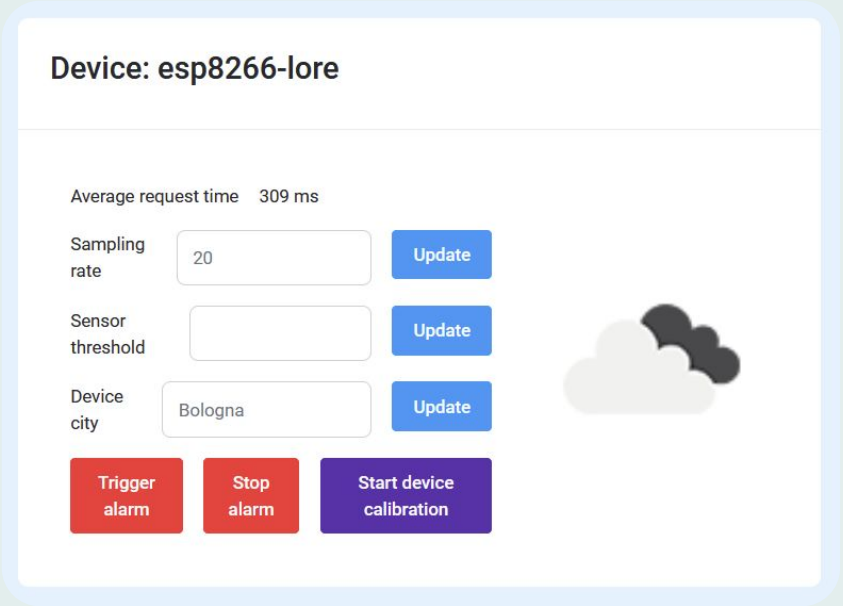
IoT Alarm System with Bed Presence Detection

Presented by:
Luca Torzi & Lorenzo Venerandi

Features

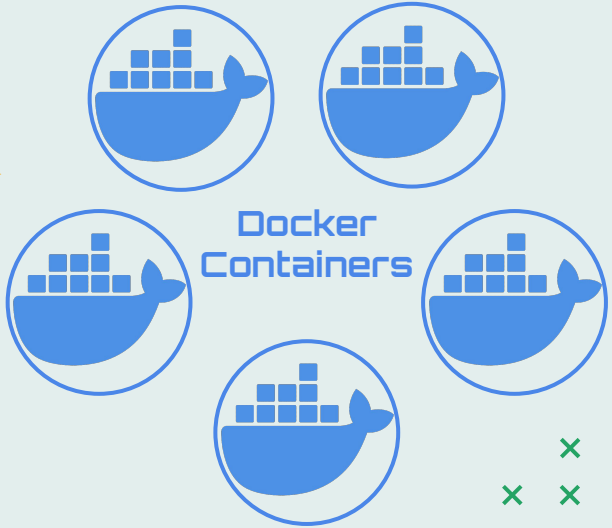
- The alarm is **automatically triggered and stopped**
- Check if the user fall asleep again
- **Web UI**
- **Manage the alarms**
- **Data forecasting**



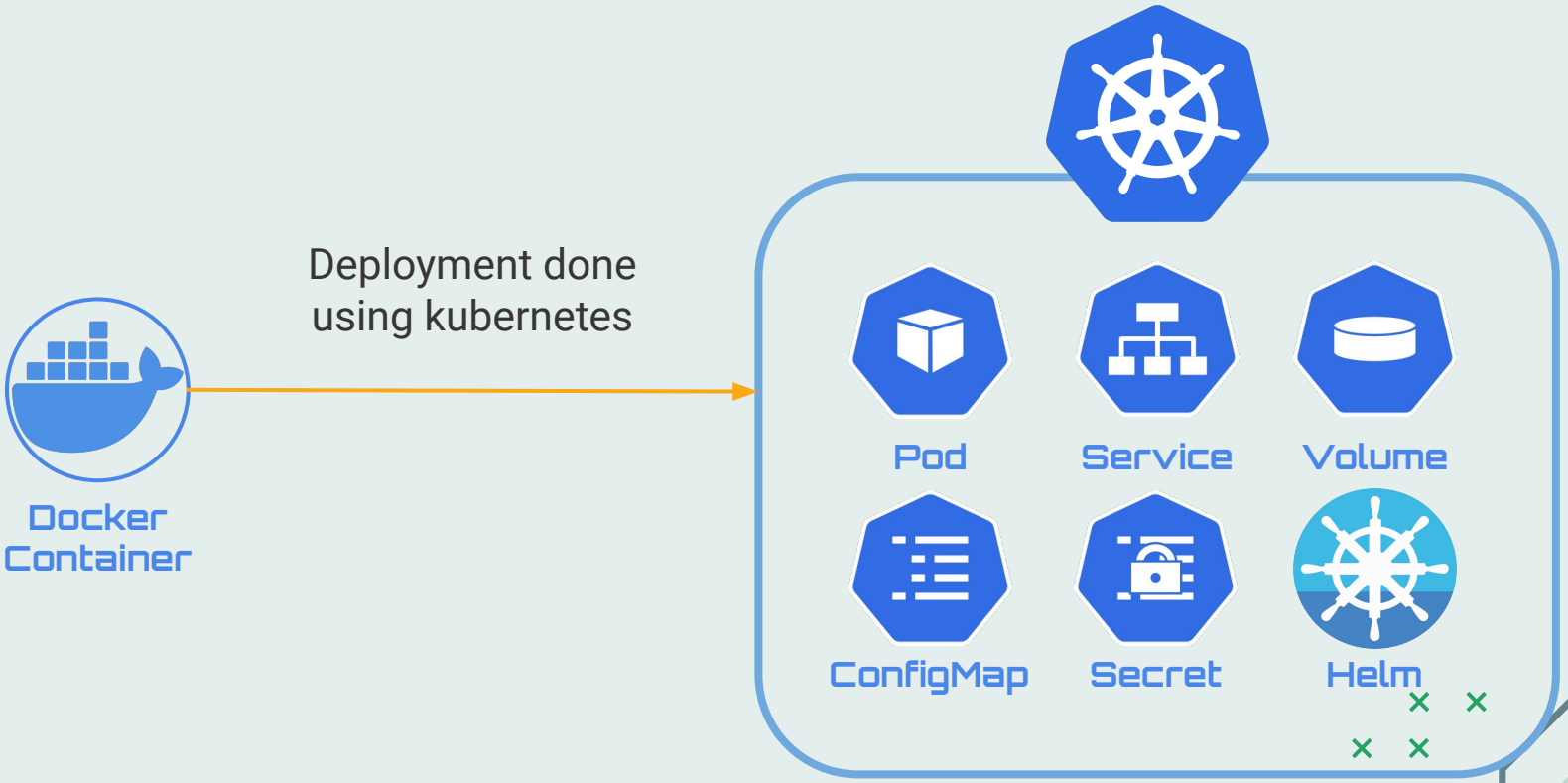
Architecture Components

- Smart alarm device

- MQTT broker
- InfluxDB
- Data Proxy Server
- Data Analysis Server
- Telegram Bot



Kubernetes


Deployment done
using kubernetes
Docker
Container
Pod
Service
Volume
ConfigMap
Secret
Helm

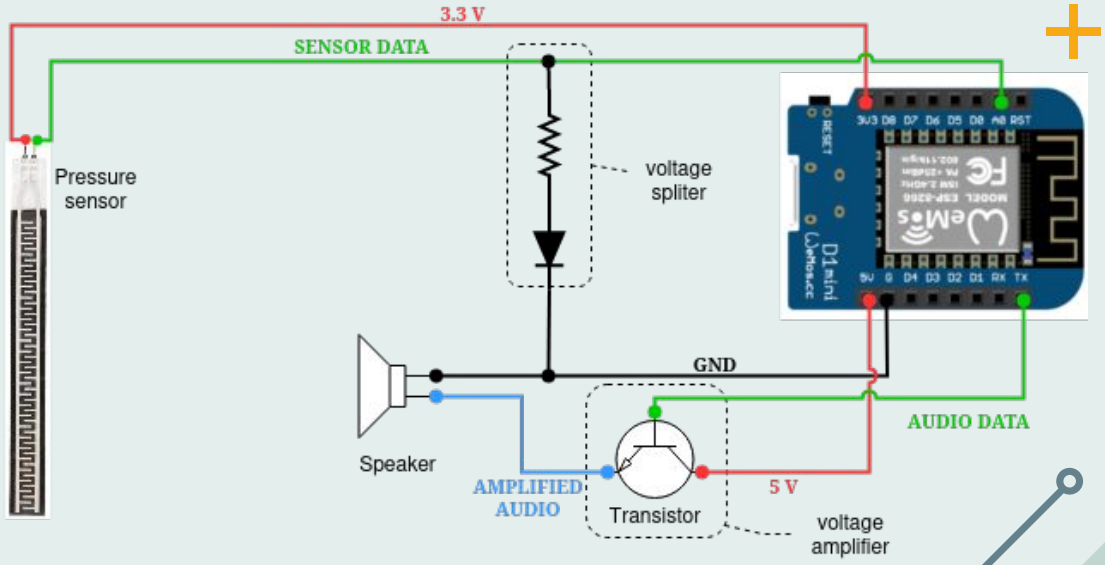
Hardware Components

Main components

- ESP8266
- Pressure mat sensor
- Speaker

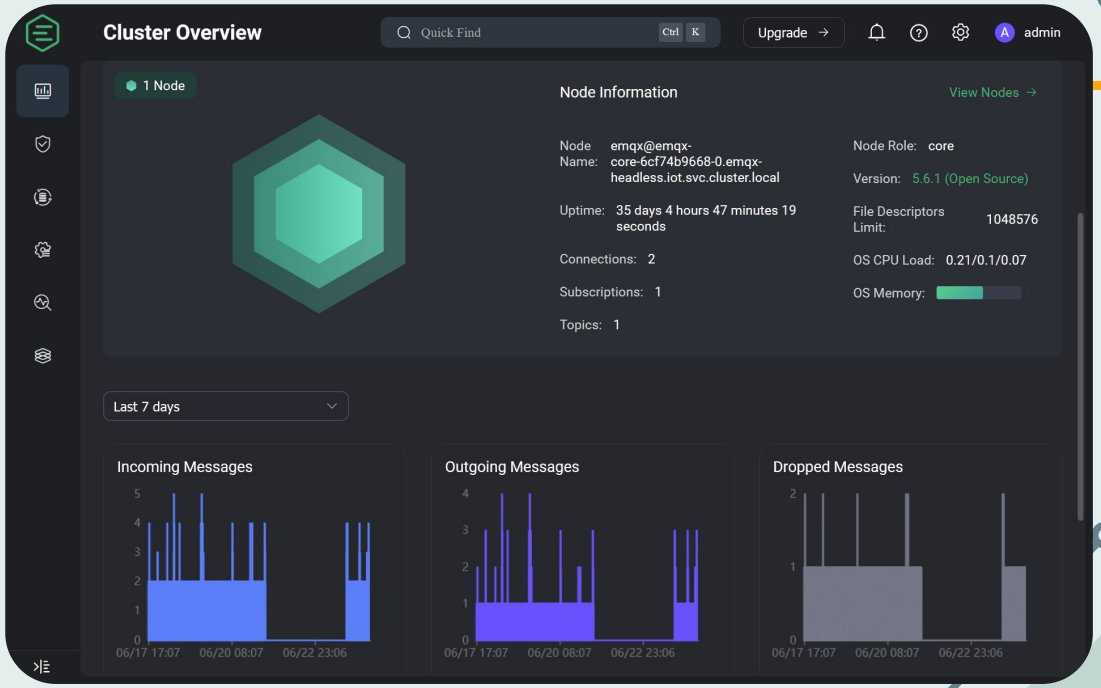
Main libraries used

- `PubSubClient`
- `ESP8266Wifi`
- `ESP8266HttpClient`
- `ESP8266Audio`



MQTT Broker

- **EMQX** is a versatile and extensible platform
- Supports multiple communication protocols
- Guarantees the communication to the actuator

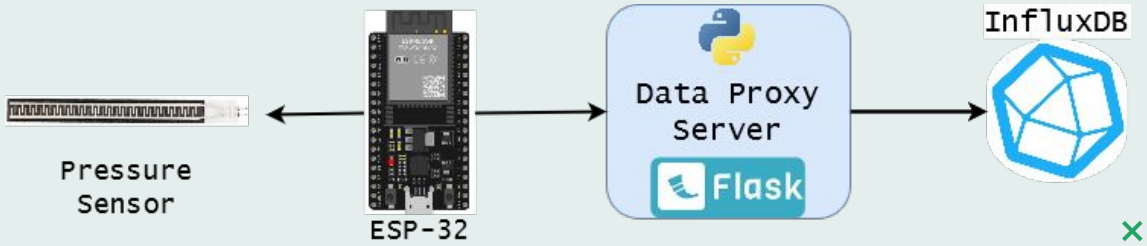


Data Proxy Server

- Manage the devices via HTTP requests
  - `/api/devices`
  - `/api/sampling_rate`
  - `/api/city`
- Manage the alarms via HTTP requests
  - `/api/alarms`
  - `/api/add_alarm`
  - `/api/remove_alarm`
  - `/api/trigger_alarm`
  - `/api/stop_alarm`

Data Proxy Server

- manage the devices via MQTT messages to `/devices/device_id`
  - `sampling_rate [value]`
  - `trigger_alarm [int]`
  - `stop_alarm`
- Receive data from the device via HTTP requests
  - `/api/sensor_data`



Data collection pipeline

InfluxDB

- Open-source time-series database
- Optimized for managing large volumes of data

Grafana

- Dashboard to visualize the pressure sensor data stored in InfluxDB

Data Analysis Server

Calibration of the device

- `/analyze/calibration`
- `/analyze/get_weights`
- `/analyze/set_threshold`

PROPHET

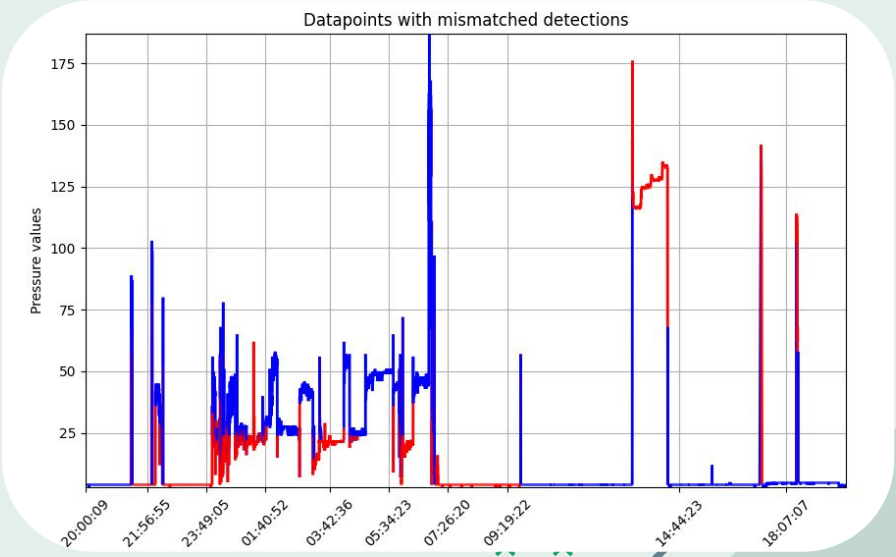
FastAPI

Data Analysis Server

Analyze the data collected

- `/analyze/compute_sleep_time_for_day`
- `/analyze/sleeping`
- `/analyze/check_sleep`

Day	Accuracy	Precision	Recall	F1-Score
Day 1	0.59	0.99	0.36	0.53
Day 2	0.89	1.0	0.53	0.96
Day 3	0.57	0.87	0.39	0.54
Day 4	0.63	0.63	0.59	0.61

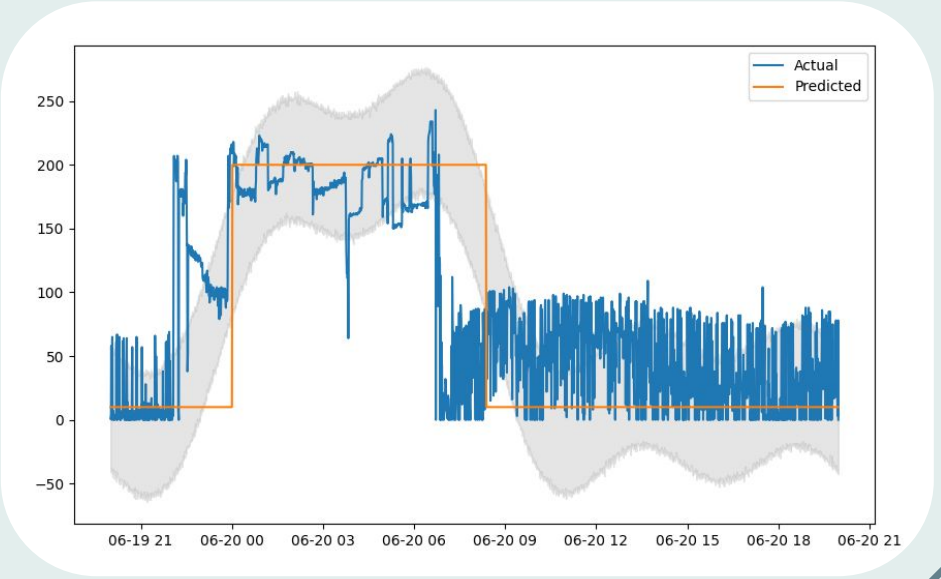


Data Analysis Server

Forecasting

- `/analyze/forecast`

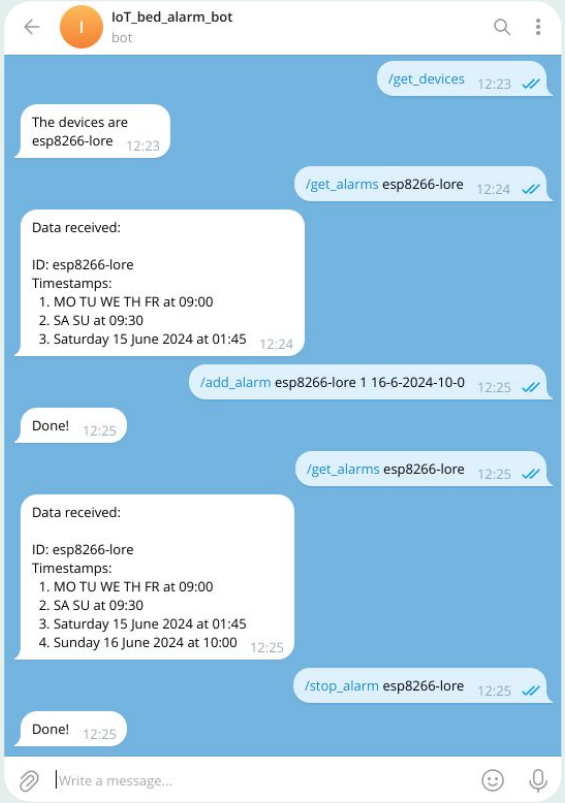
Trained using the values of the 4 previous days, augmented by 10 times.



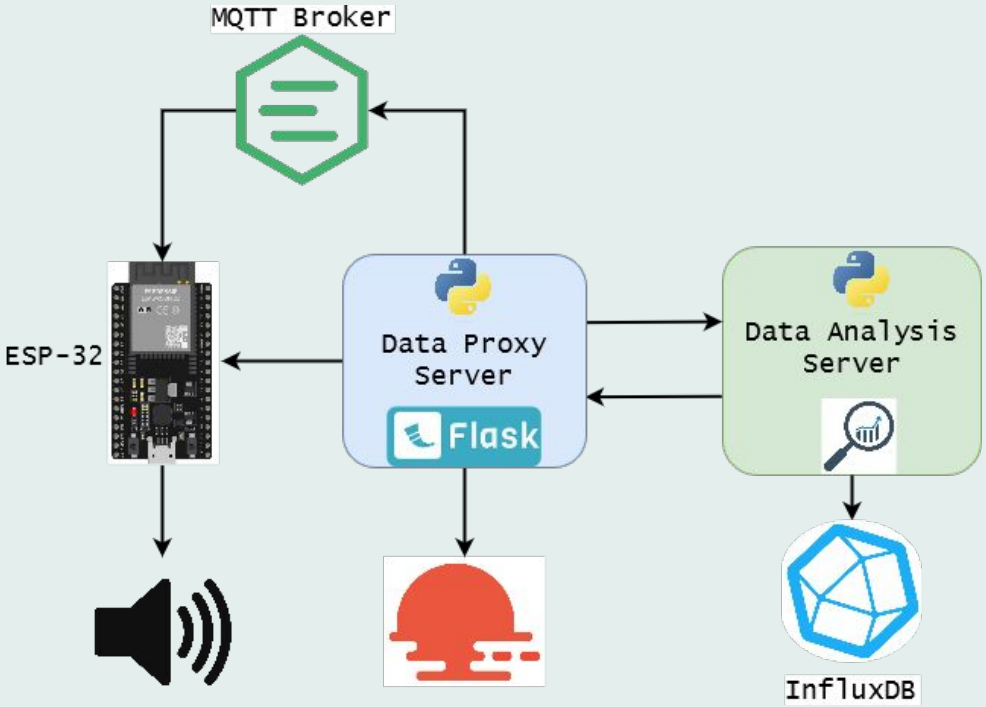
Telegram Bot

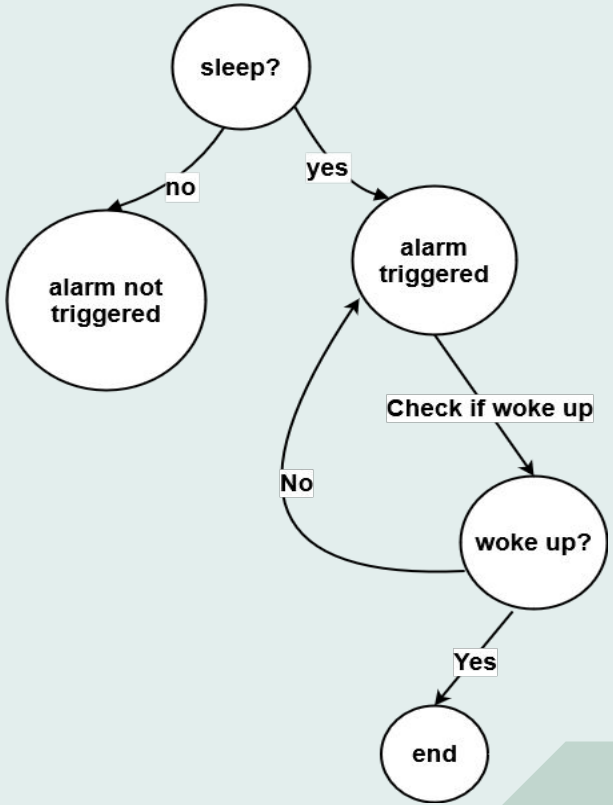
Commands

- /help
- /get_devices
- /get_alarms
- /add_alarm
- /remove_alarm
- /update_alarm
- /trigger_alarm
- /stop_alarm

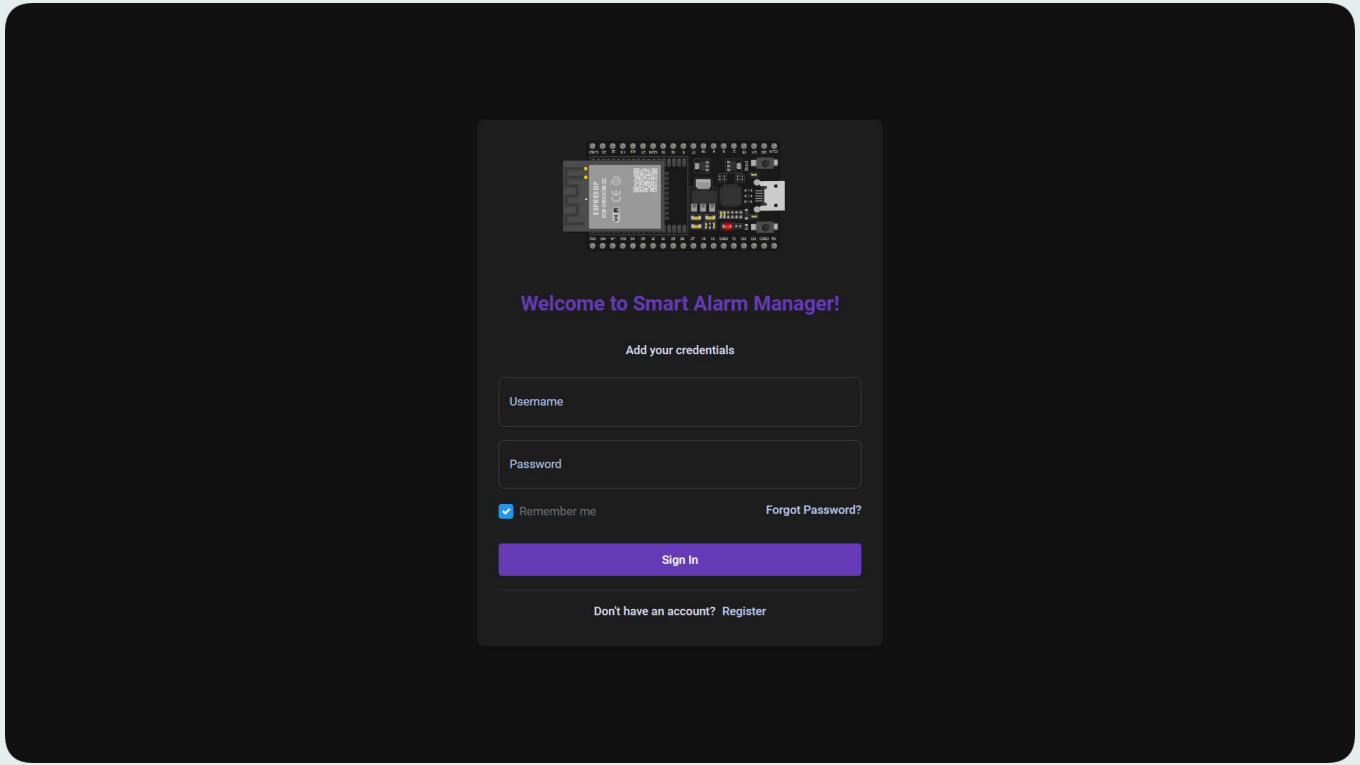


Use Case: Trigger Alarm

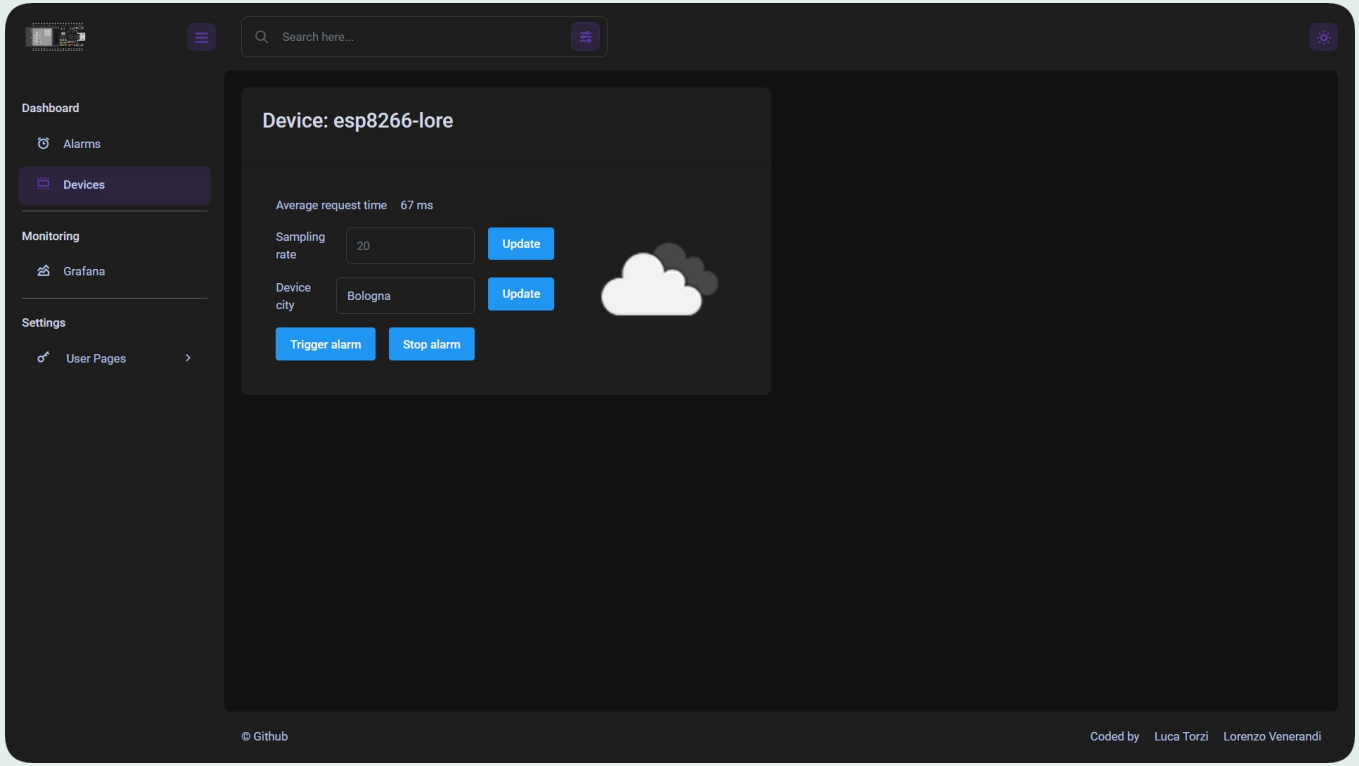




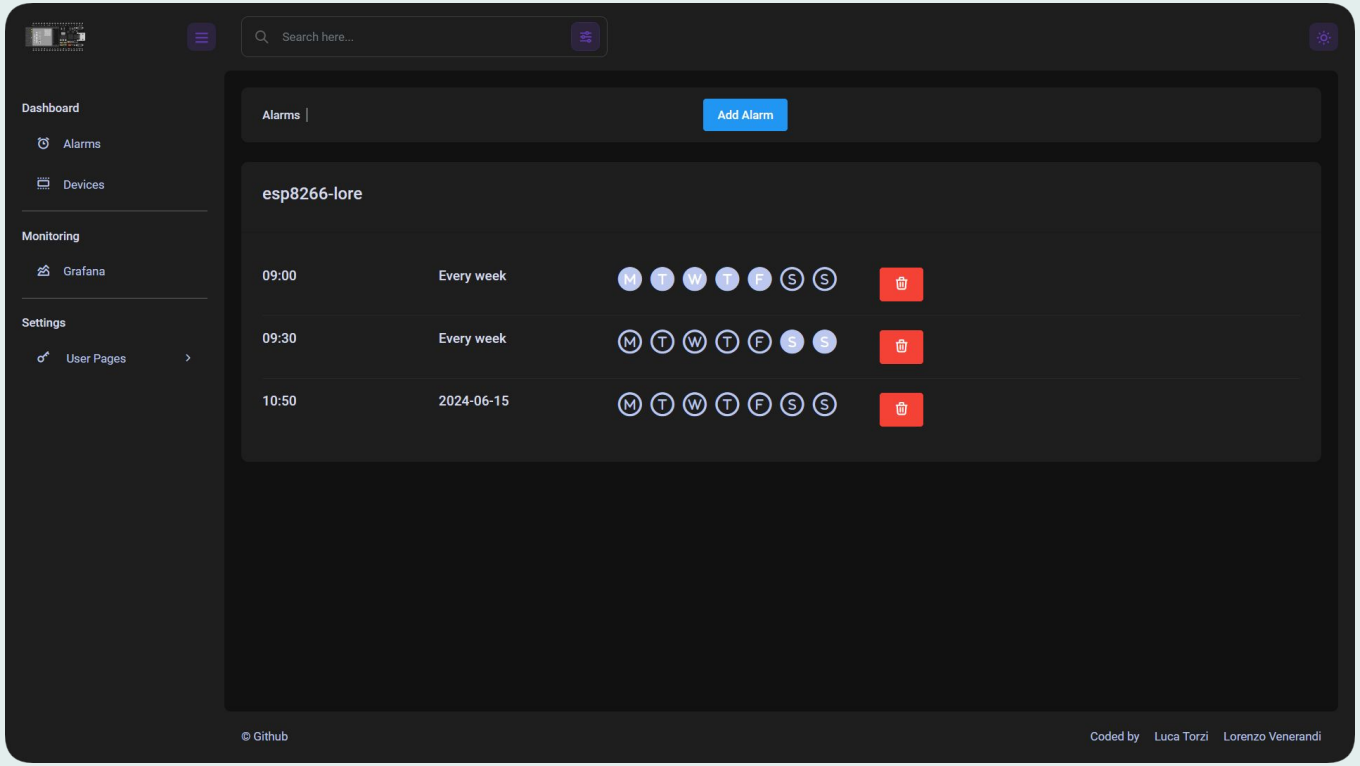
Web Application - Login



Web Application - Devices



Web Application - Alarms



Web Application - Alarms

THANKS FOR THE ATTENTION