



Bakalářská práce

SENZORICKÉ ŘEŠENÍ CHYTRÉ DOMÁCNOSTI S AUTOMATICKOU DIAGNOSTIKOU KOMUNIKACE

Autor

Patrik NACHTMANN

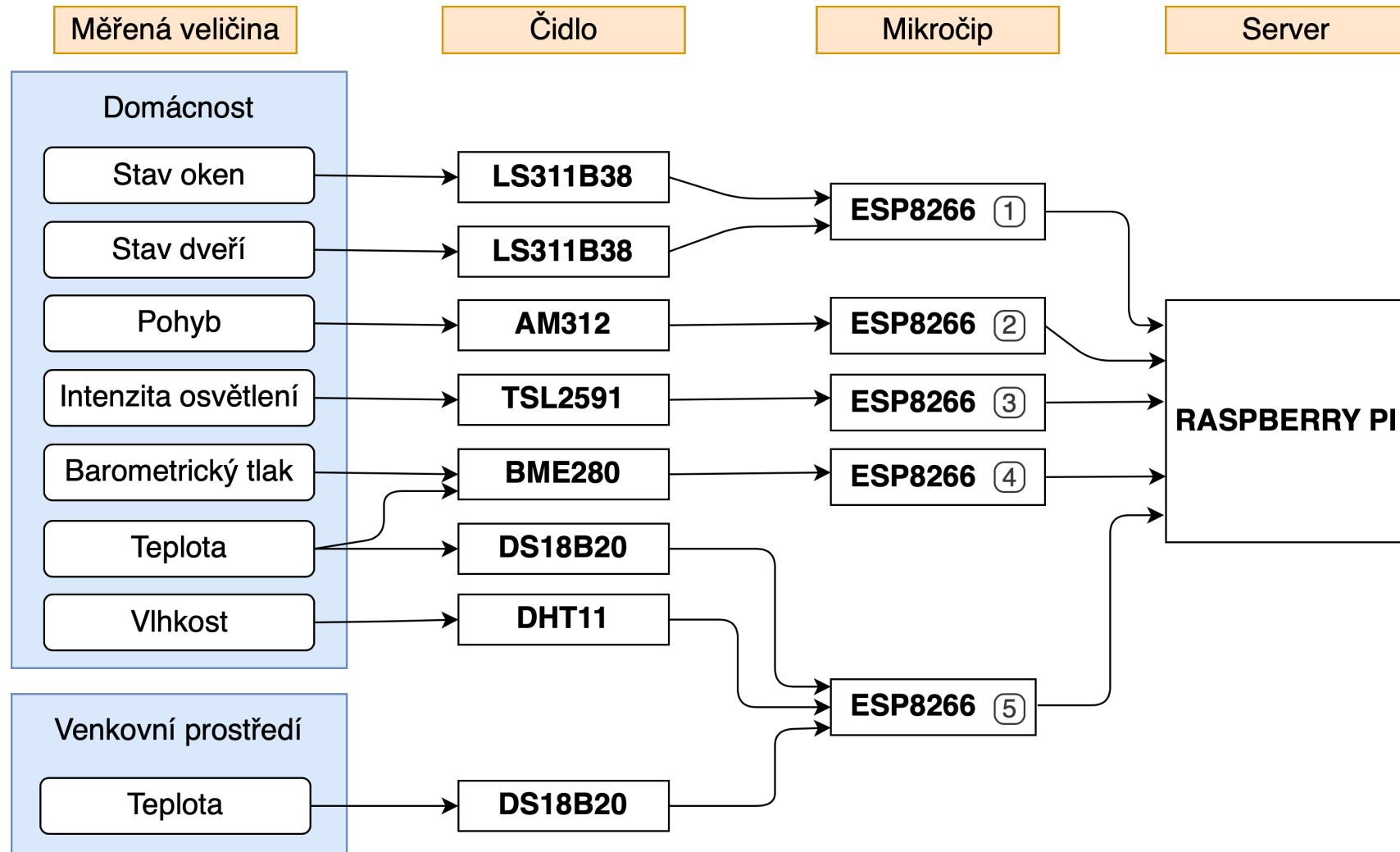
Vedoucí práce

Ing. Martin BULÍN, MSc.

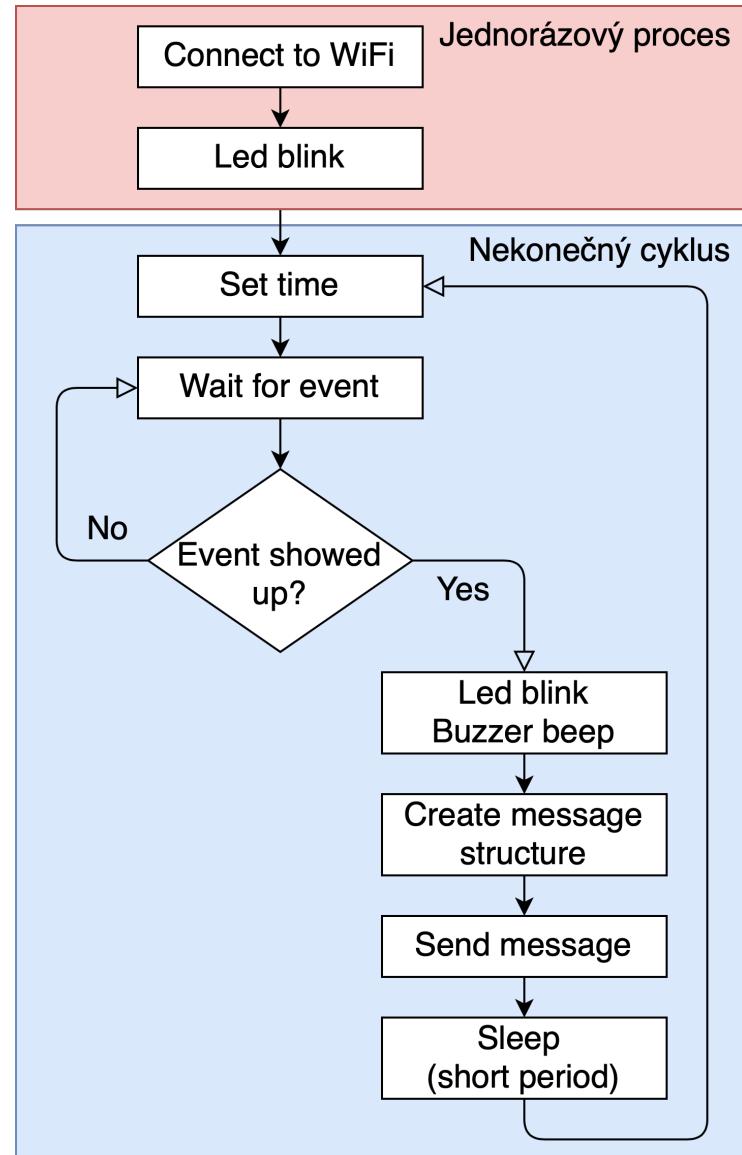
CÍLE PRÁCE

- 1** Otestovat a zkonstruovat vhodné senzory
- 2** Zajistit odesílání dat po síti a ukládání do databáze
- 3** Navrhnout systém automatické diagnostiky komunikace
- 4** Vytvořit interaktivní webové rozhraní

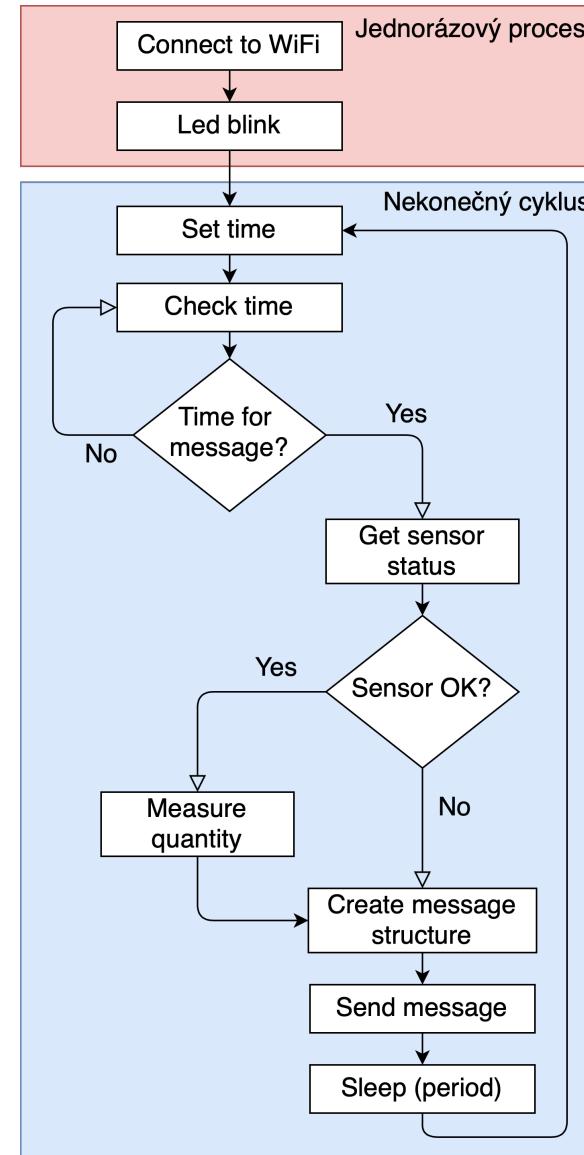
HARDWAROVÉ KOMPONENTY



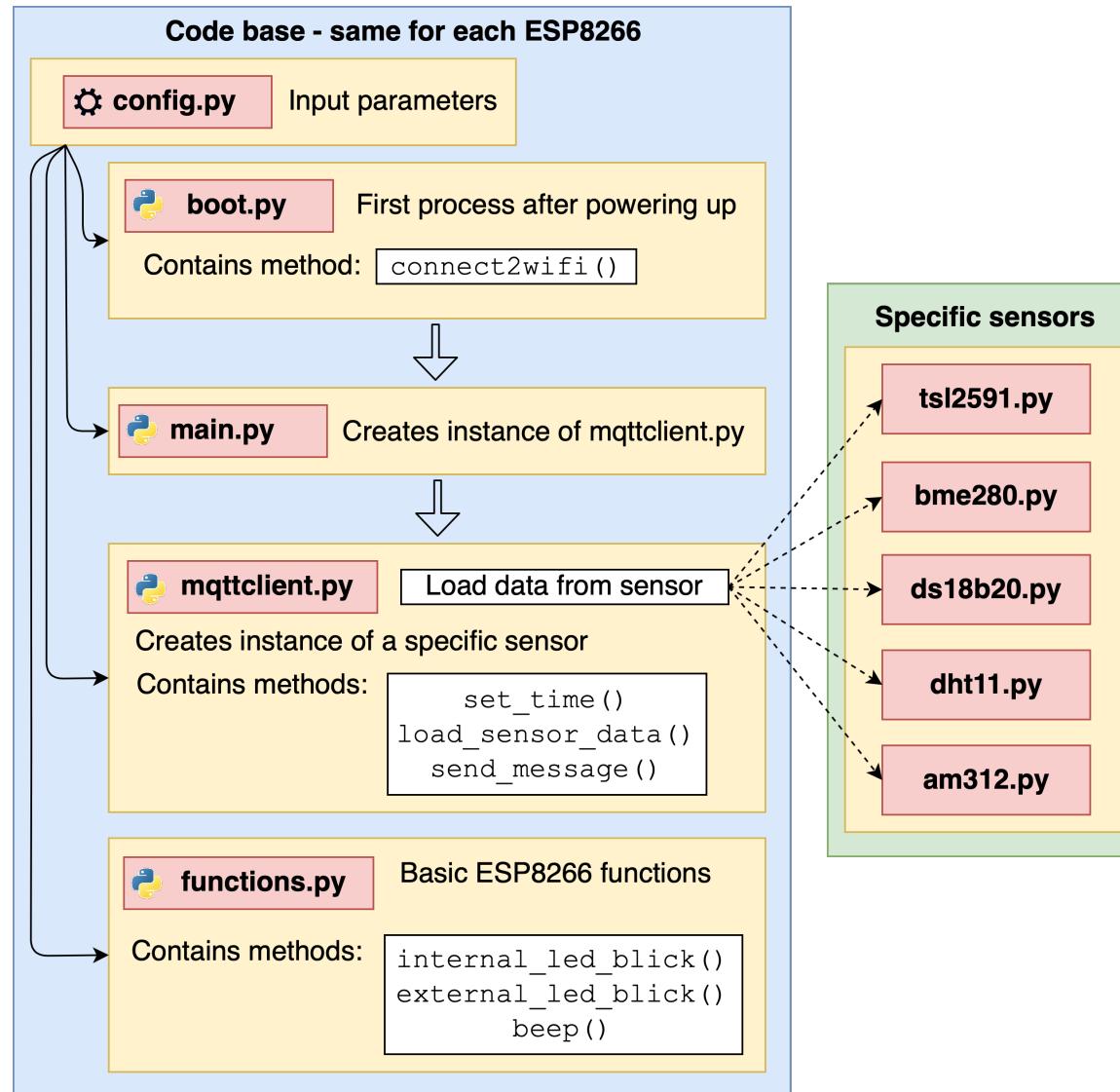
NA ZÁKLADĚ VZNIKU UDÁLOSTI



PERIODICKÉ



ARCHITEKTURA KÓDU NA ESP8266



SÍŤOVÁ KOMUNIKACE A DATABÁZE

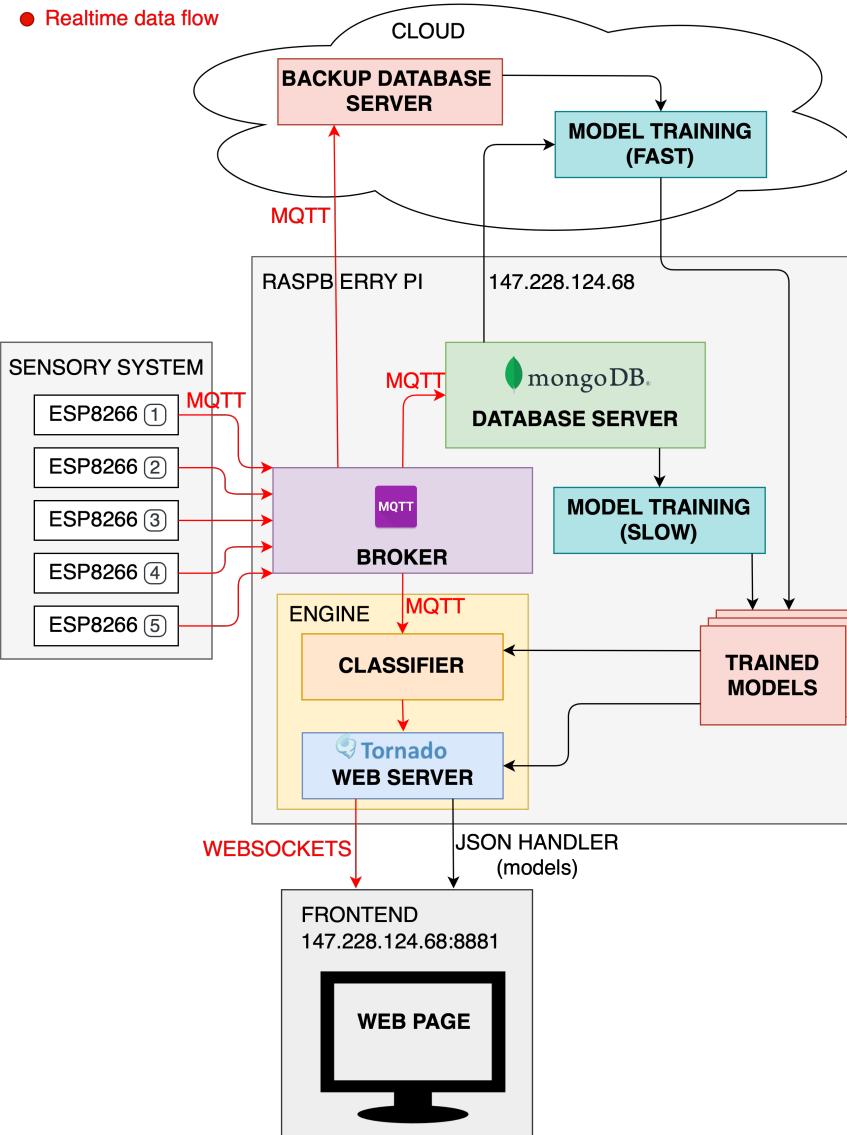
- Principy sítě IoT
- Protokol MQTT
- Websockets
- Databáze MongoDB
- Webserver Tornado

```
{ "sensor_id": "ds18b20_01",  
  "location": "room",  
  "owner": "pn",  
  "status": "ok",  
  "quantity": "temperature",  
  "timestamp": "2020-04-09 11:32:30",  
  "value": 24.08 }
```

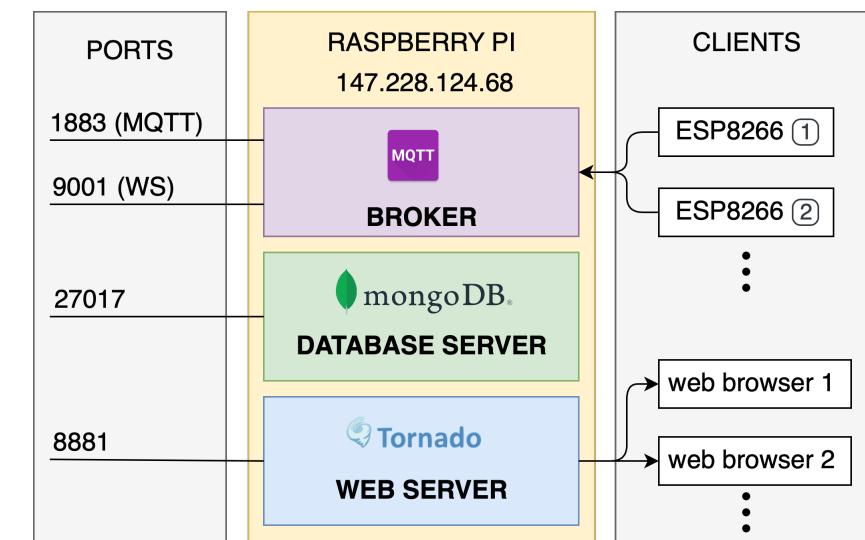
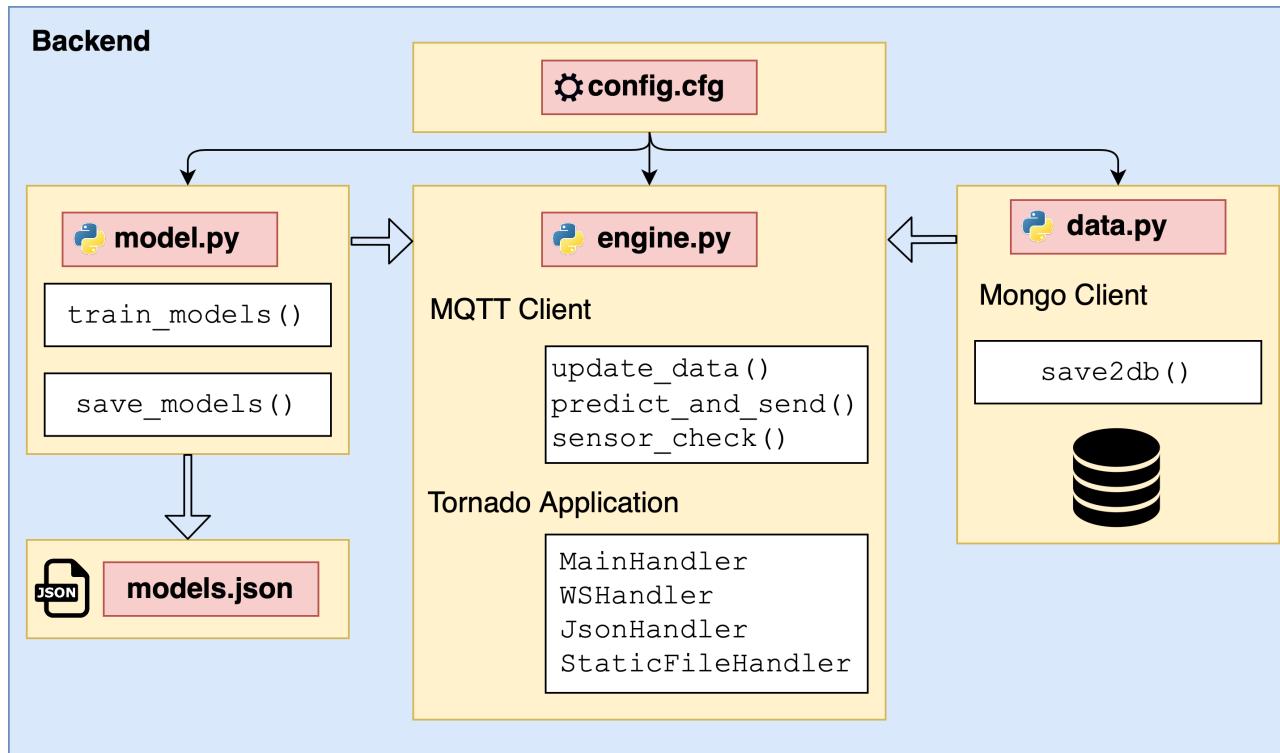
```
smarthome/<location>/<quantity>
```

```
smarthome/room/temperature  
smarthome/outside/temperature  
smarthome/room/humidity  
smarthome/room/illuminance  
smarthome/room/pressure  
smarthome/room/motion  
smarthome/room/door_open  
smarthome/room/window_open
```

DATOVÉ TOKY

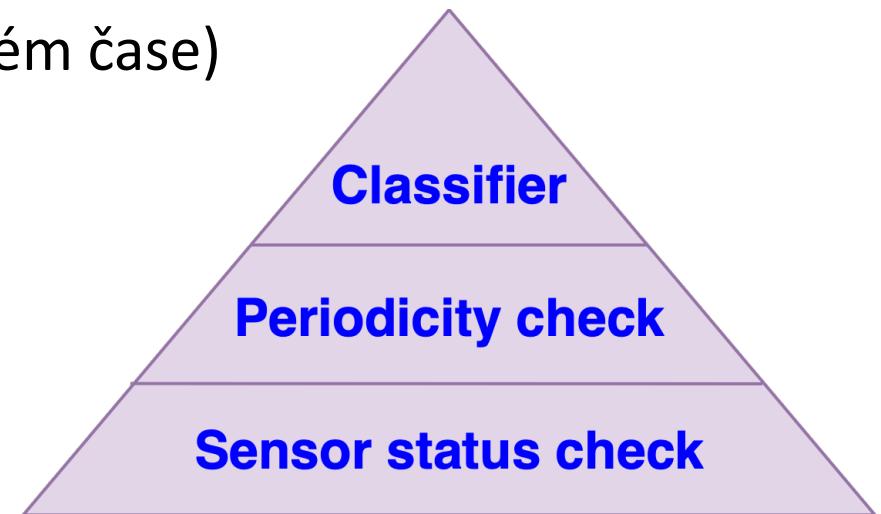
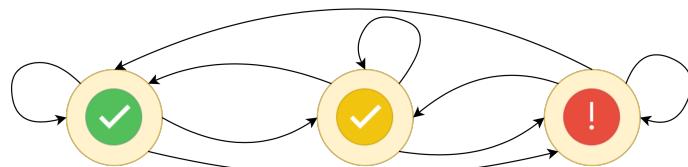


ARCHITEKTURA KÓDU NA RPI



SYSTÉM DIAGNOSTIKY KOMUNIKACE

- Detekce chyb na úrovni ESP8266
- Kontrola periodicity příchozích zpráv na serveru
- Kontrola času a hodnot pomocí klasifikace
 - 1D: **[timestamp]** (kontrola času)
 - 2D: **[timestamp, value]** (kontrola hodnot v daném čase)



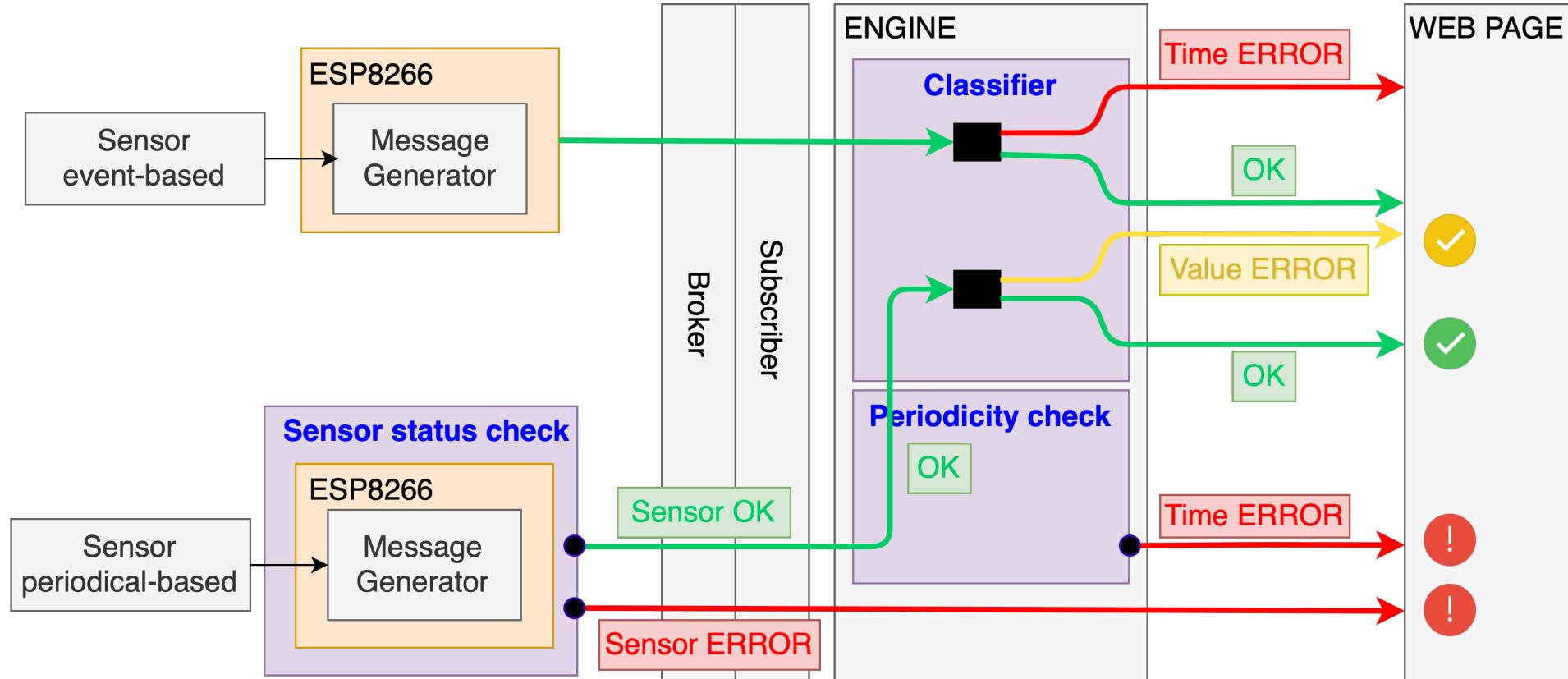
KLASIFIKÁTOR *ISOLATION FOREST*

1. Nízké nároky na výpočetní paměť
2. Zpracování mnohadimenzionálních dat bez další informace
3. V trénovacích datech mohou nebo nemusejí být přítomny anomálie

$$f(x) = \begin{cases} 1 (\textit{sample ok}), & \text{IF } S > 0 \\ 0 (\textit{sample outlier}), & \text{IF } S \leq 0 \end{cases}$$

```
if score of sample > 0 then
    classification := 1
else
    classification := -1
end if
```

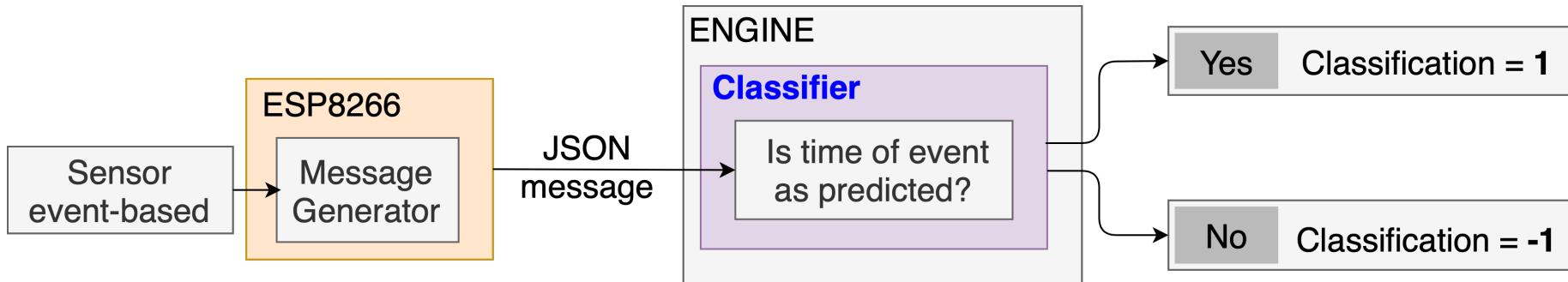
SYSTÉM DIAGNOSTIKY KOMUNIKACE



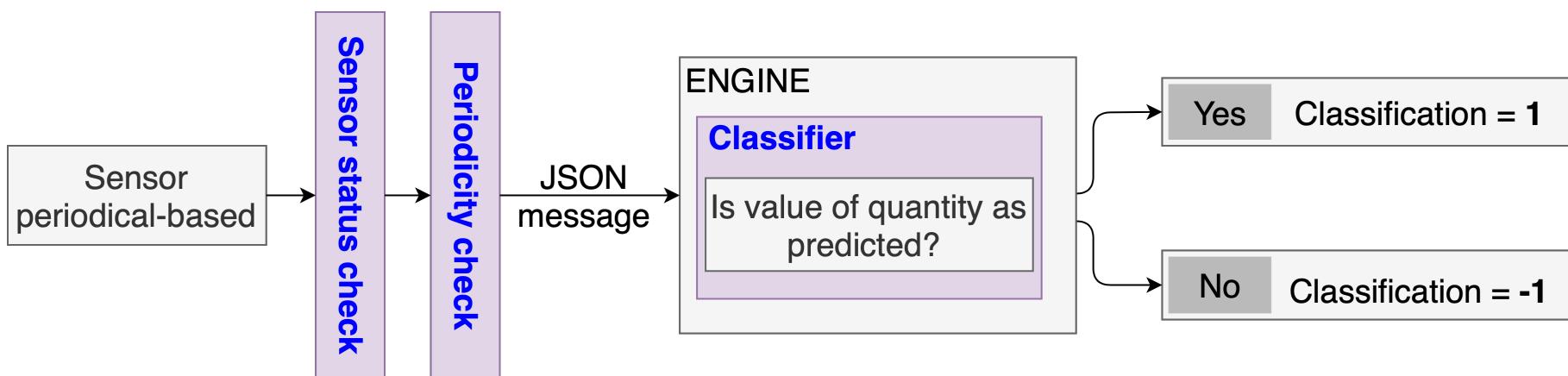
- Status generation
- Status modification (overwrite)

KLASIFIKÁTOR

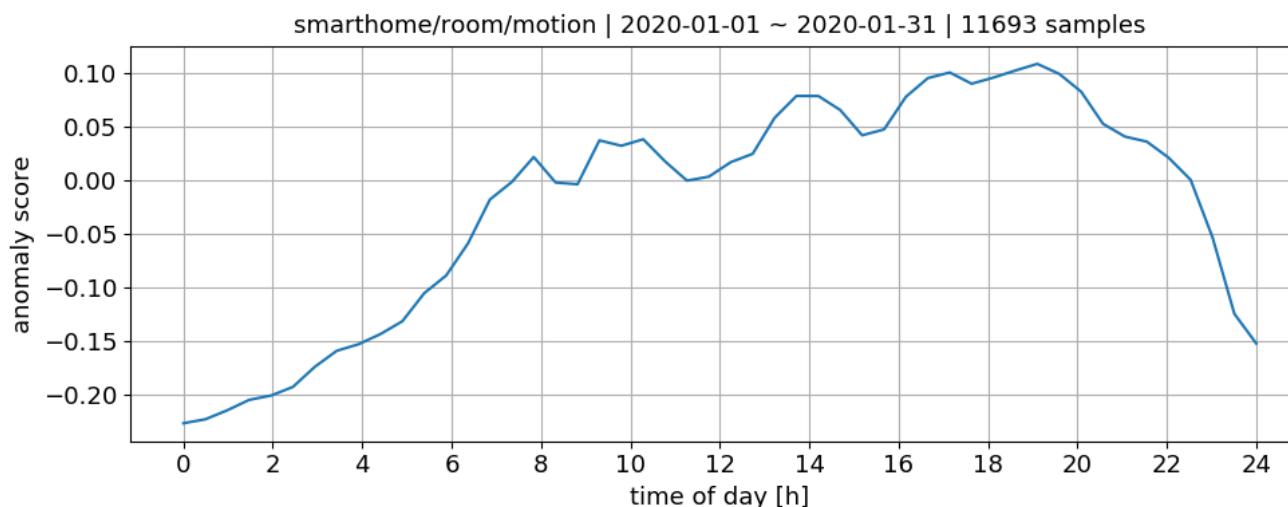
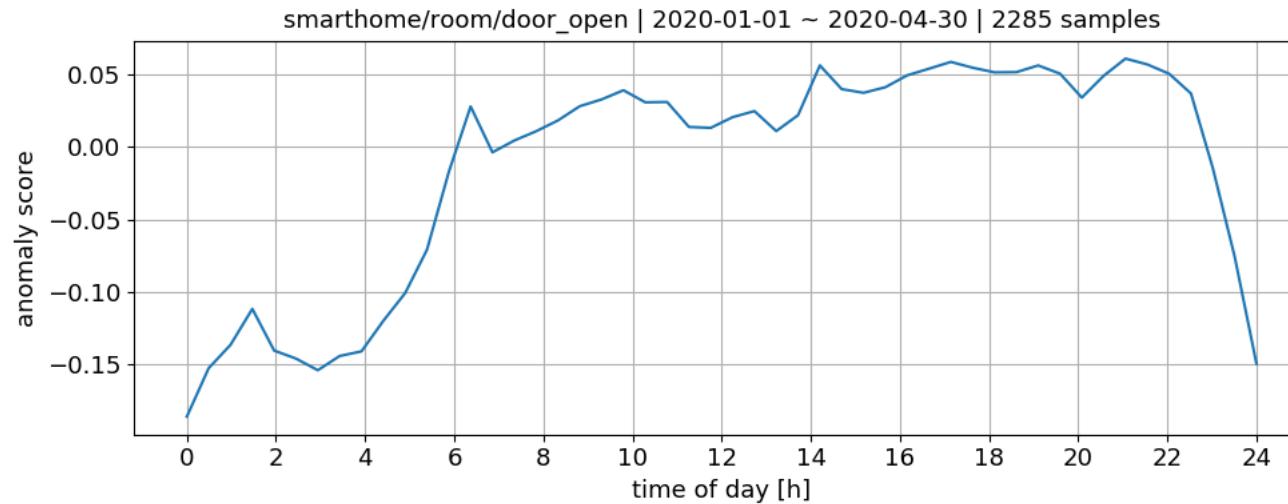
1D



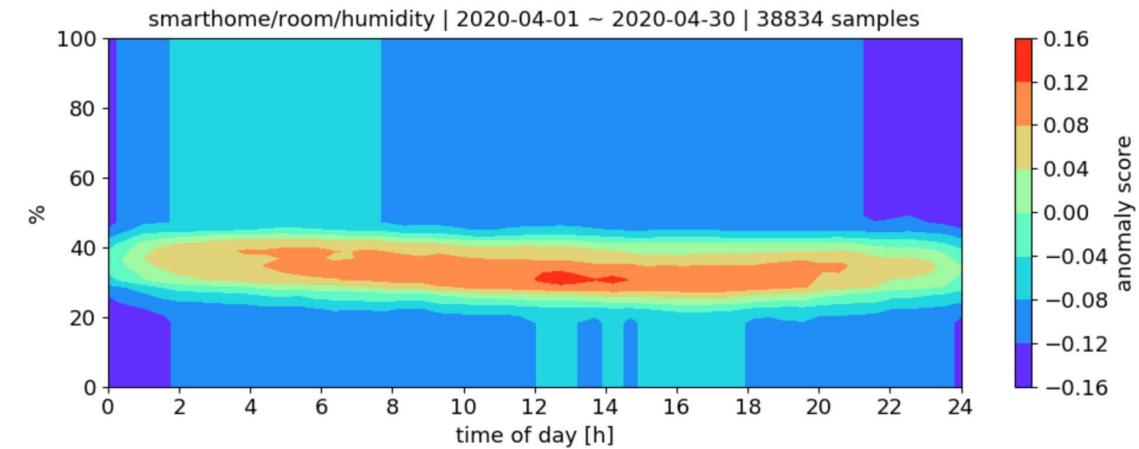
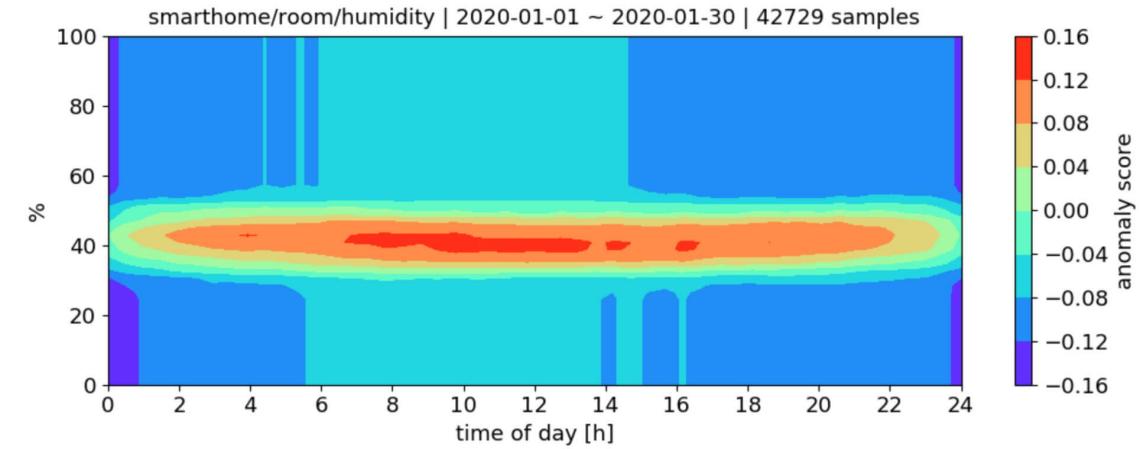
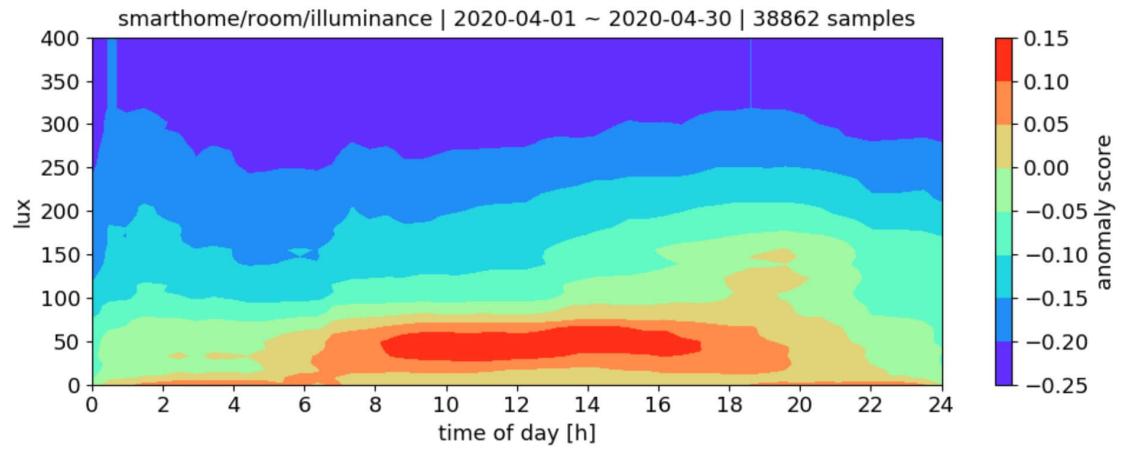
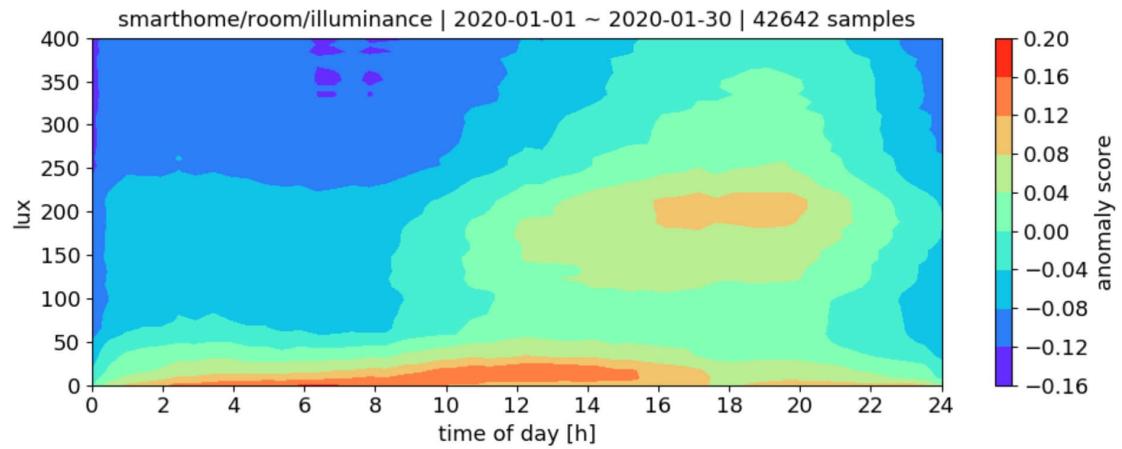
2D



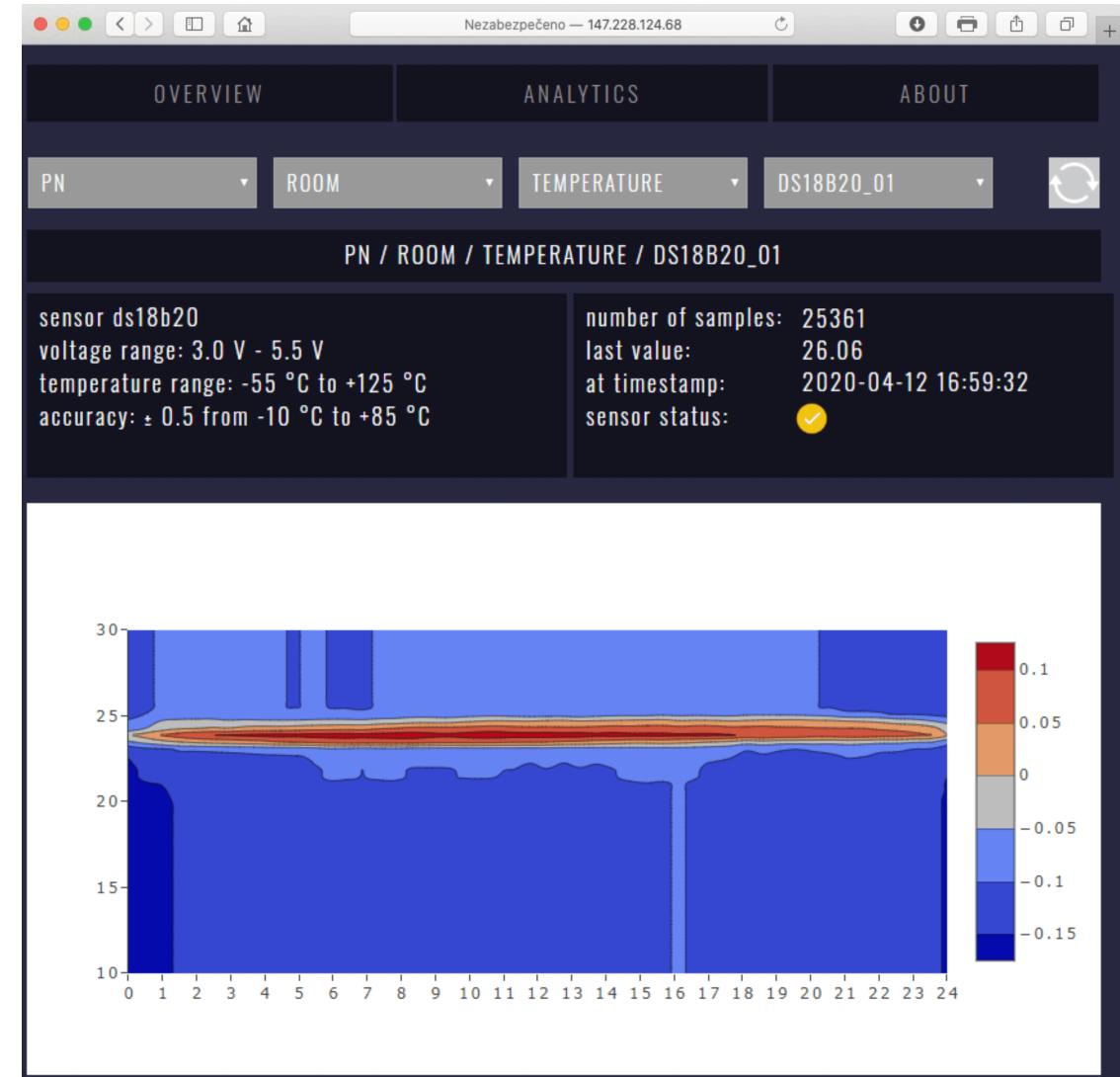
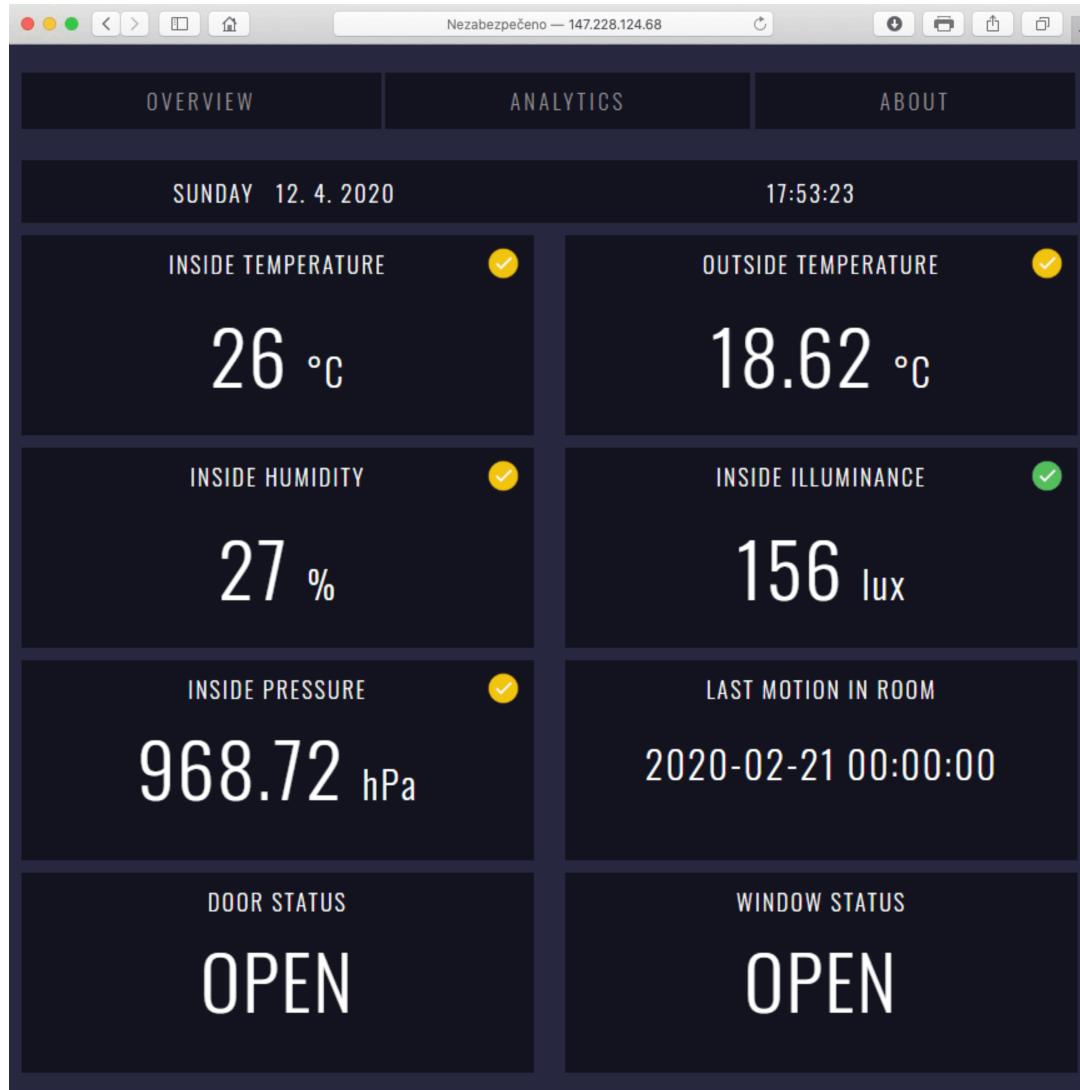
KLASIFIKACE ČASU NEPERIODICKÝCH ZPRÁV



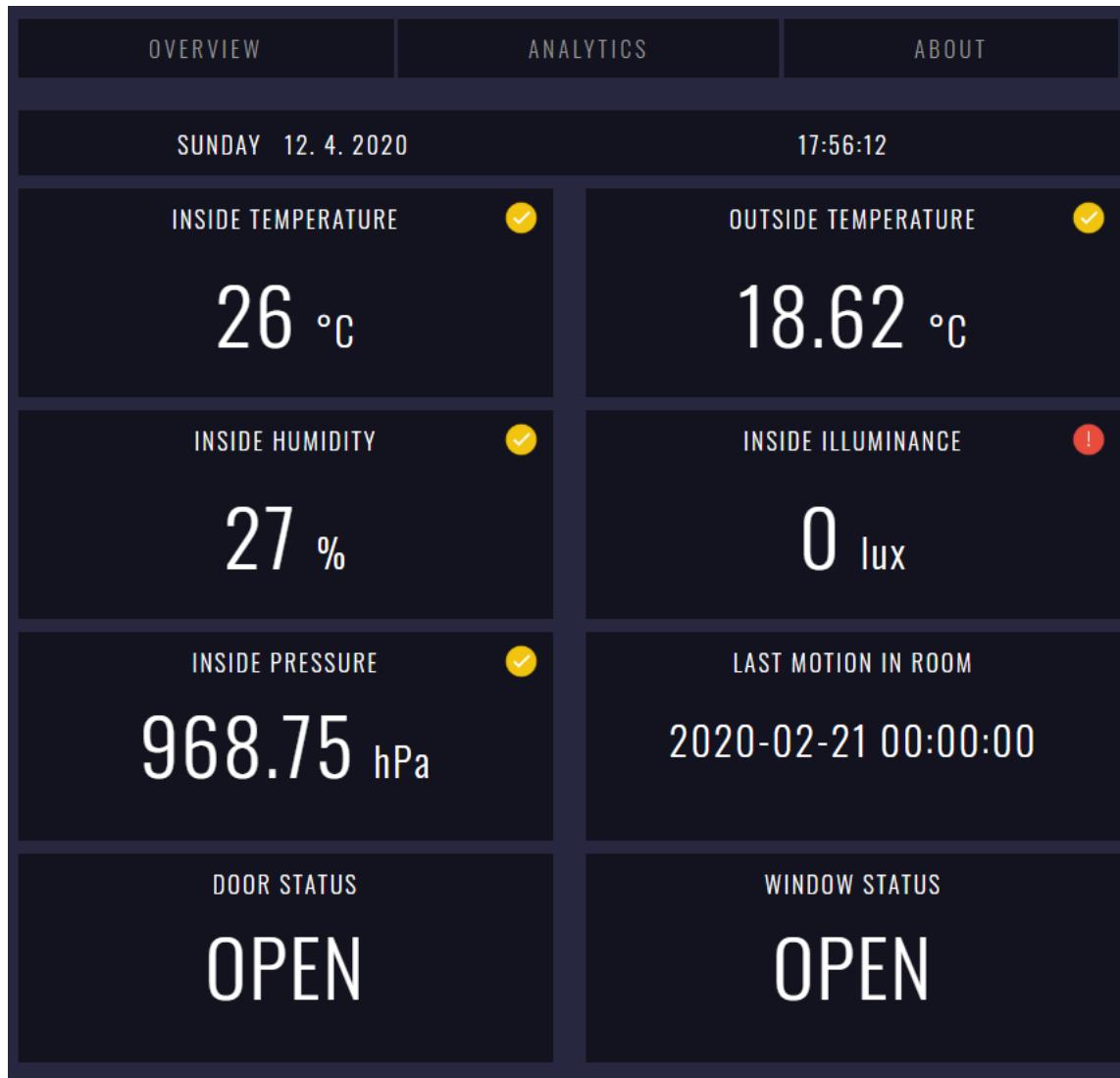
KLASIFIKACE HODNOT V DANÉM ČASE



WEBOVÁ VIZUALIZACE



WEBOVÁ VIZUALIZACE



OVERVIEW **ANALYTICS** **ABOUT**

SMART HOME SENSORY SYSTEM WITH AN AUTOMATIC COMMUNICATION DIAGNOSTICS

This project is a bachelor work at Faculty of Applied Sciences, Department of Cybernetics at University of West Bohemia.

Aim of this student work is to design and built several smart home Wi-Fi sensors, programm the communication between individual sensors and broker via MQTT standard and design an automatic communication diagnostic system in order to catch anomaly and possible failure of the sensors.

These sensors are based on ESP8266 platform and the data transfer is performed wireless over Wi-Fi.

- OK**: When everything works fine. Both ESP8266 and sensor is **OK**, data transfer is OK. Range of measured value is in the predicted area - Classification is **1**.
- Warning!**: When almost everything works fine. Data transfer is OK but the value is not as expected. This can be caused by the lack of trained data or the sensor might be down. Range of measured value is **not** in the predicted area - Classification is **-1**.
- Error!**: When some **error** occurred. ESP8266 did not send data several times or the sensor is broken. This can be cause by no internet connection or broken sensor.

FACULTY OF APPLIED SCIENCES UNIVERSITY OF WEST BOHEMIA

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2020

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