Projects and laboratory on communication systems

Fissure sensor

FEZ49 GROUP

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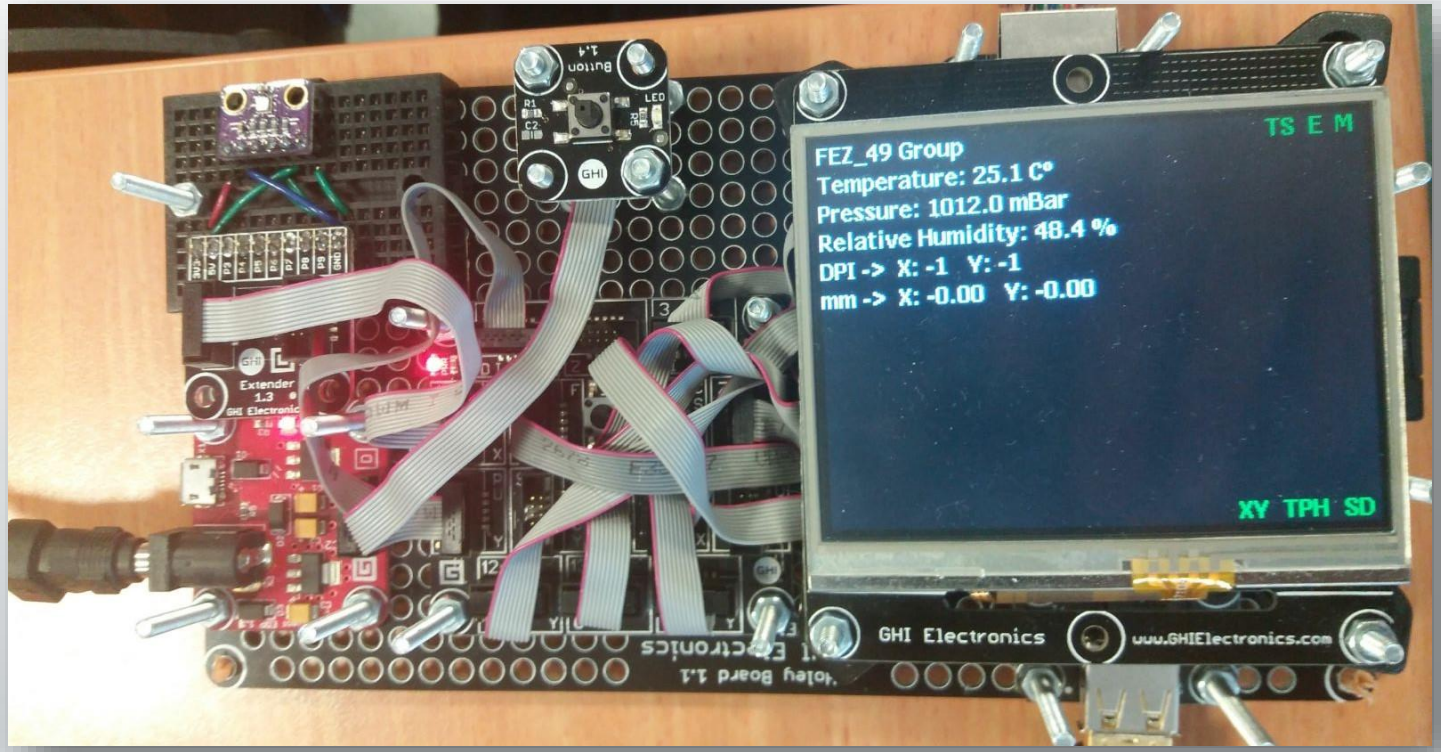
INTRODUCTION

- Our work consists on a board made up by several hardware components, taking these kinds of data from sensors:
  - Fissure size (X and Y axes)
  - Temperature
  - Humidity
  - Pressure
- HARDWARE:
  - FEZ Spider II
  - Sensors:
    - Laser mouse
    - Bosch BME280



FISSURE SENSOR:

Tecknet laser gaming mouse

- High resolution (8200 dpi, 0,003 mm)
- Laser sensor works on almost any surface
- Advantages compared to elastometers:
  - Lower price
  - Double directions measurement
  - Measurements not affected by temperature and other environmental conditions
  - It doesn't need a conditioning circuit
- Advantages compared to a standard mouse:
  - Better responsiveness
  - No standby-problem (power saving mode disabled)

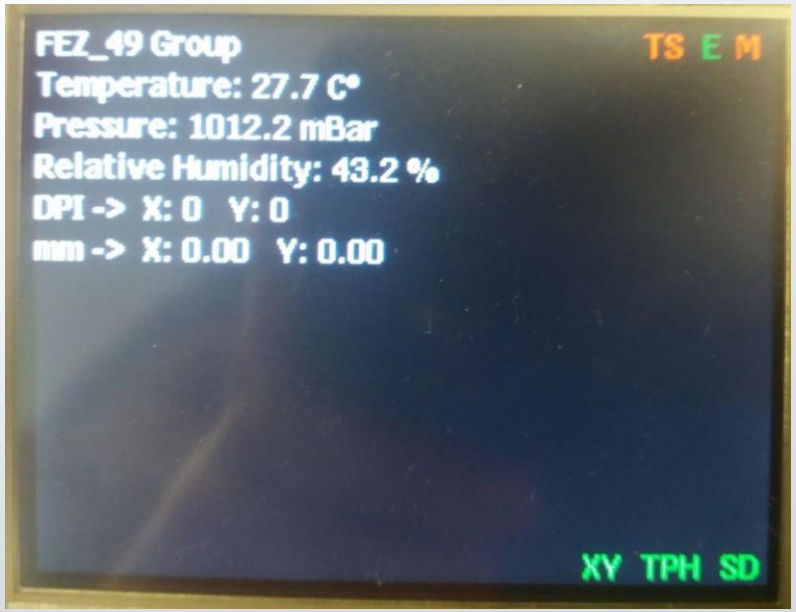
Bosch BME280 SENSOR:

Tempertature, pressure and humidity sensor

- TPH measurements are useful to understand how fissure size is affected by environmental parameters
- I2C interface fully supported by FEZ Spider II
- The sensor was calibrated in Politecnico LED with a Greisinger GFTH95, reference instrument
- Temperature range: -40°C / 85°C

LCD DISPLAY

- Shows real-time measurements
- Provides status icons:
  - TS: Time Sincronized
  - E: Ethernet Connection
  - M: MQTT Connection
  - XY: Mouse Connection
  - TPH: BME280 Connection
  - SD: SD card Connection



Sensor Drivers

Mouse

- Brand-new driver: the already available library didn’t work properly, so we couldn’t take advantage of mouse features
- RawDevice class used to read raw data directly from USB
- Compliant with HID protocol

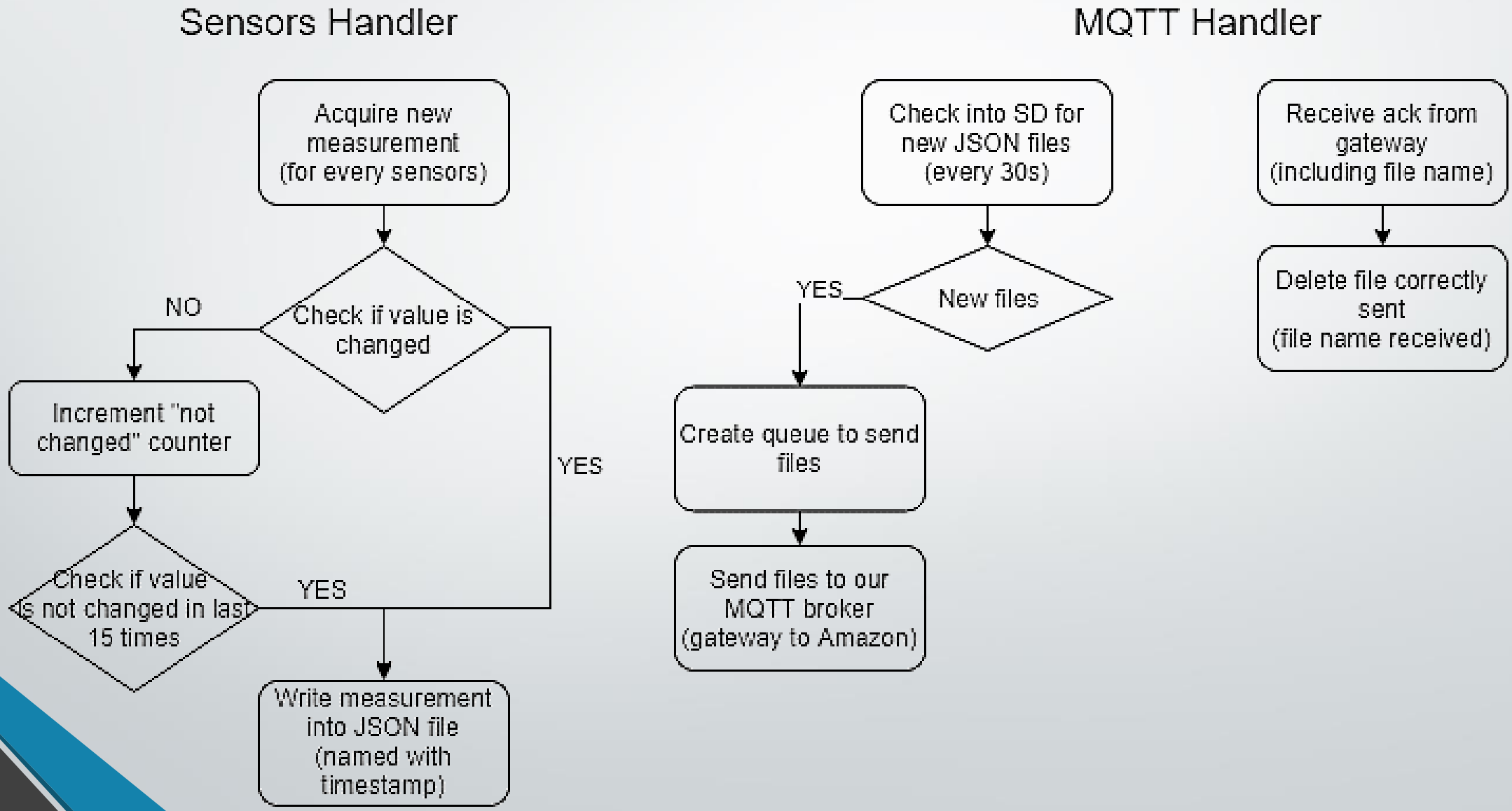
BME280

- Out of range management implemented by us
- Compensation formulas alignment according to the calibration instrument

Data and Time Management

- A Time class is in charge of handle TimeService functionatilies needed to synchronize board clock to a NTP server
  - When SystemTimeChanged event is raised, the Time.SyncTimeOffset variable is set properly, so it can be used later to update unsynchronized timestamps
- System keeps track of time synchronization state and, according to it, adds a suffix (i.e. 20110601T003320_ 1351693418327) to JSON filename useful to:
  - Recognize unsynchronized files
  - Evaluate easily the new synchronized time when the file has to be converted, using the previously exposed variable

Storage and data submission



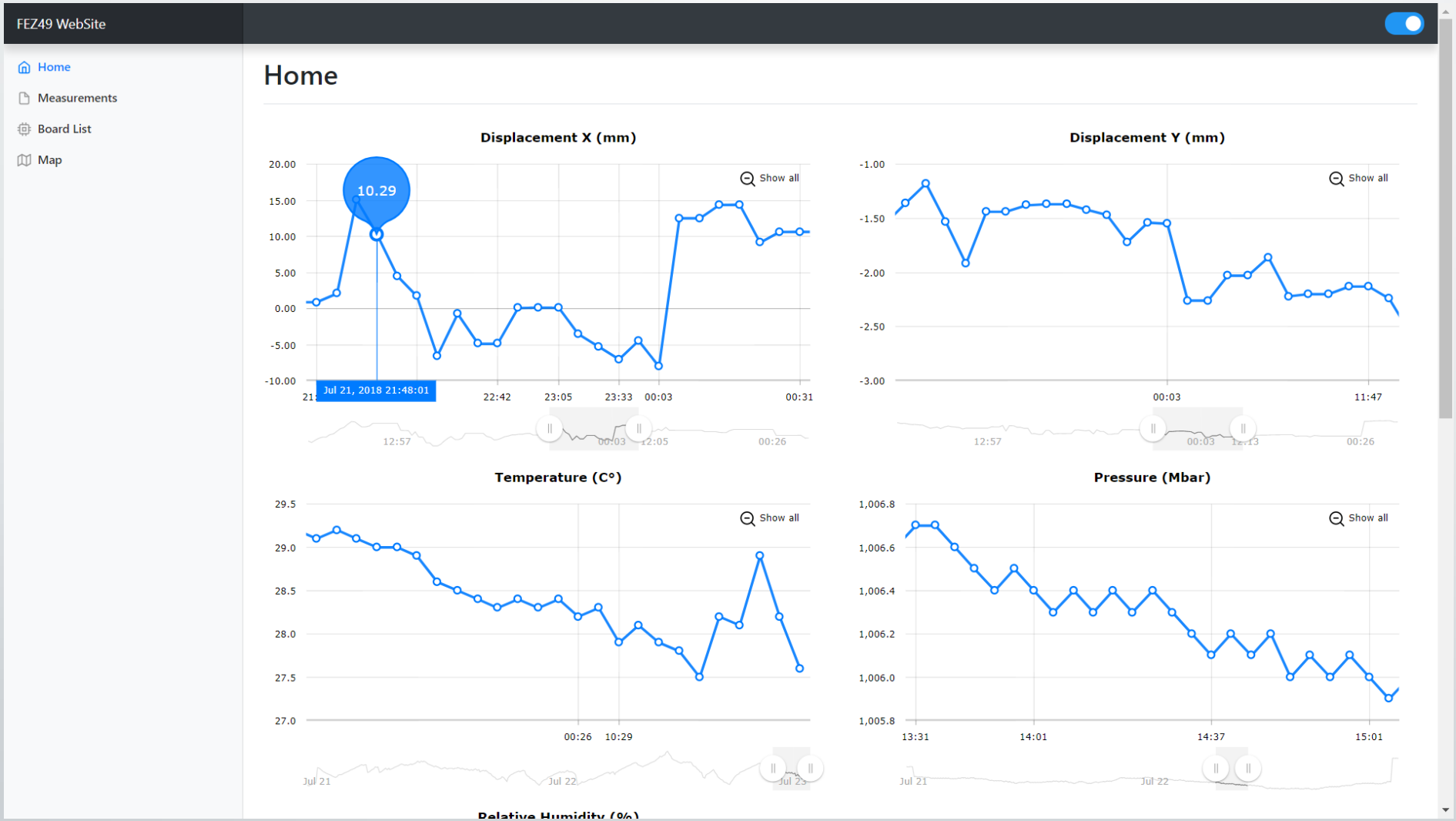
Cloud Connection

MQTT protocol has been used for both communication phases: Fez to GW and GW to Amazon IoT

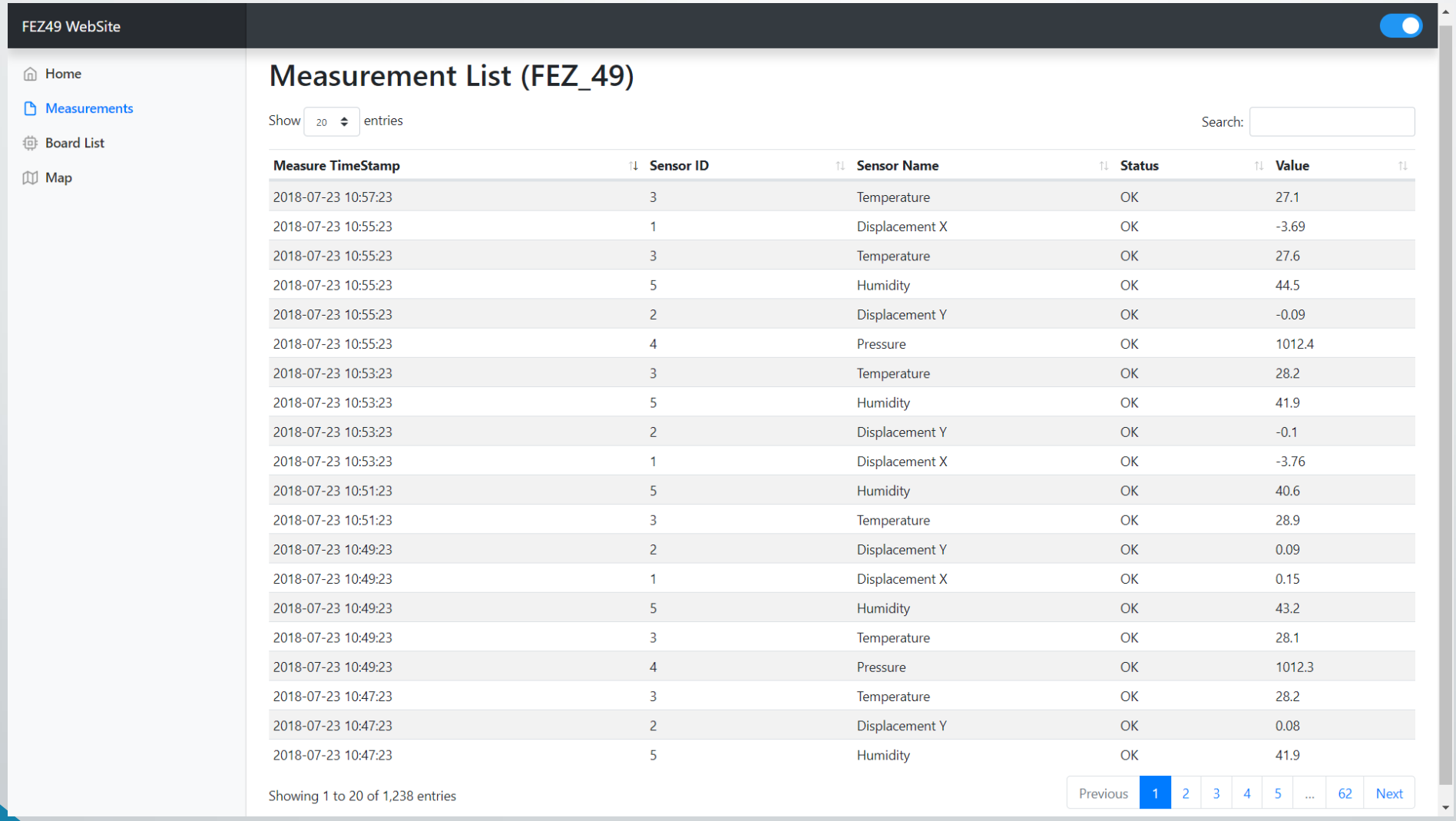
Transmission algorithm:

1. JSON file is transmitted from FEZ to GW
2. GW sends an Ack toward FEZ to notify that JSON file was taken in charge.
3. GW, that has a "JSON file to be sent" queue, transmits measurements acquired to Amazon IoT.
4. Amazon IoT sends an Ack toward GW to notify that the JSON file was correctly received and measurements correctly processed.
5. GW builds an Ack containing the filename of correctly sent JSON and send it to FEZ.
6. FEZ process incoming Ack and delete corresponding file from SDcard.

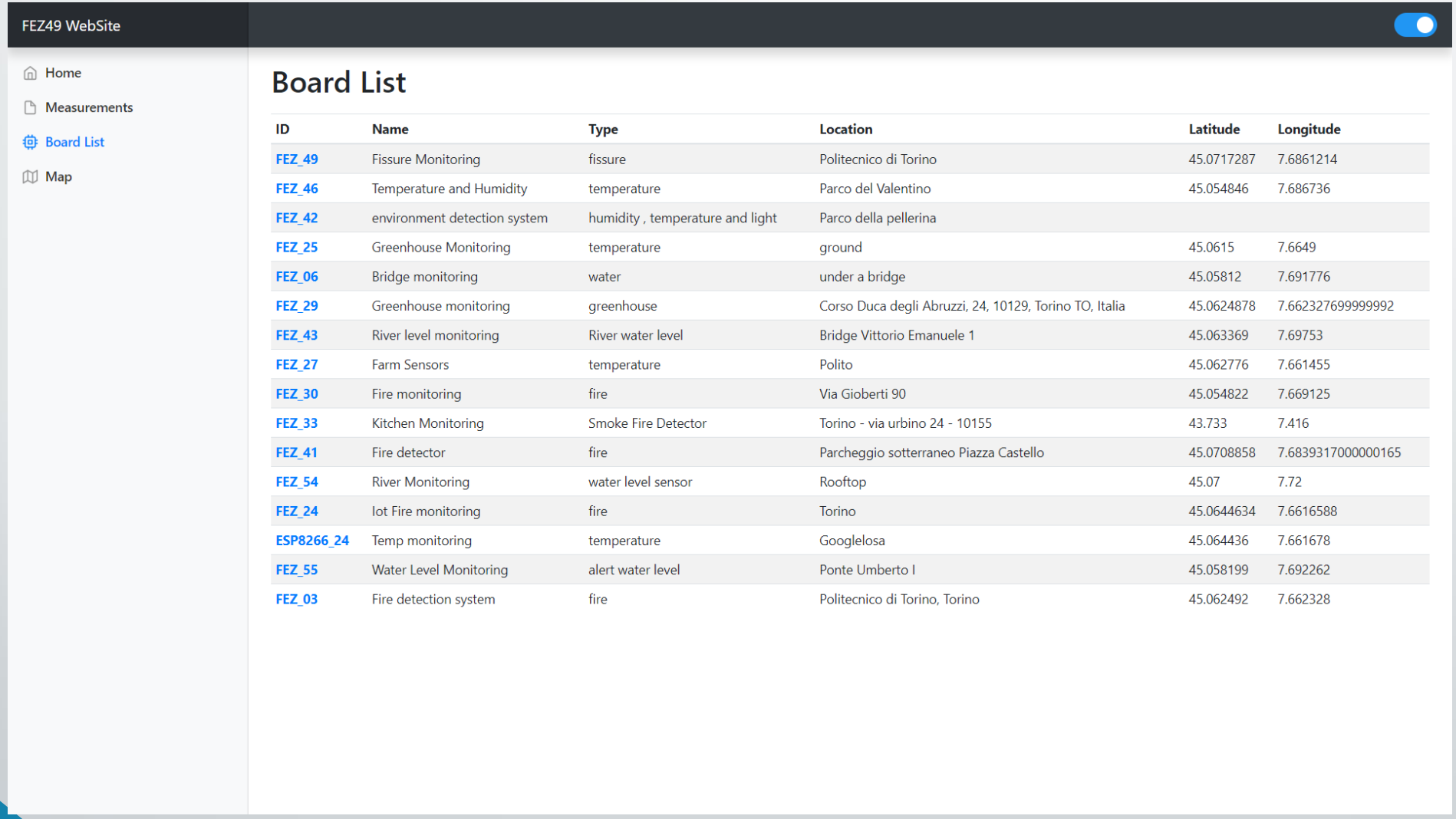
Website – Home page



Website – Measurements page



Website – Board List page



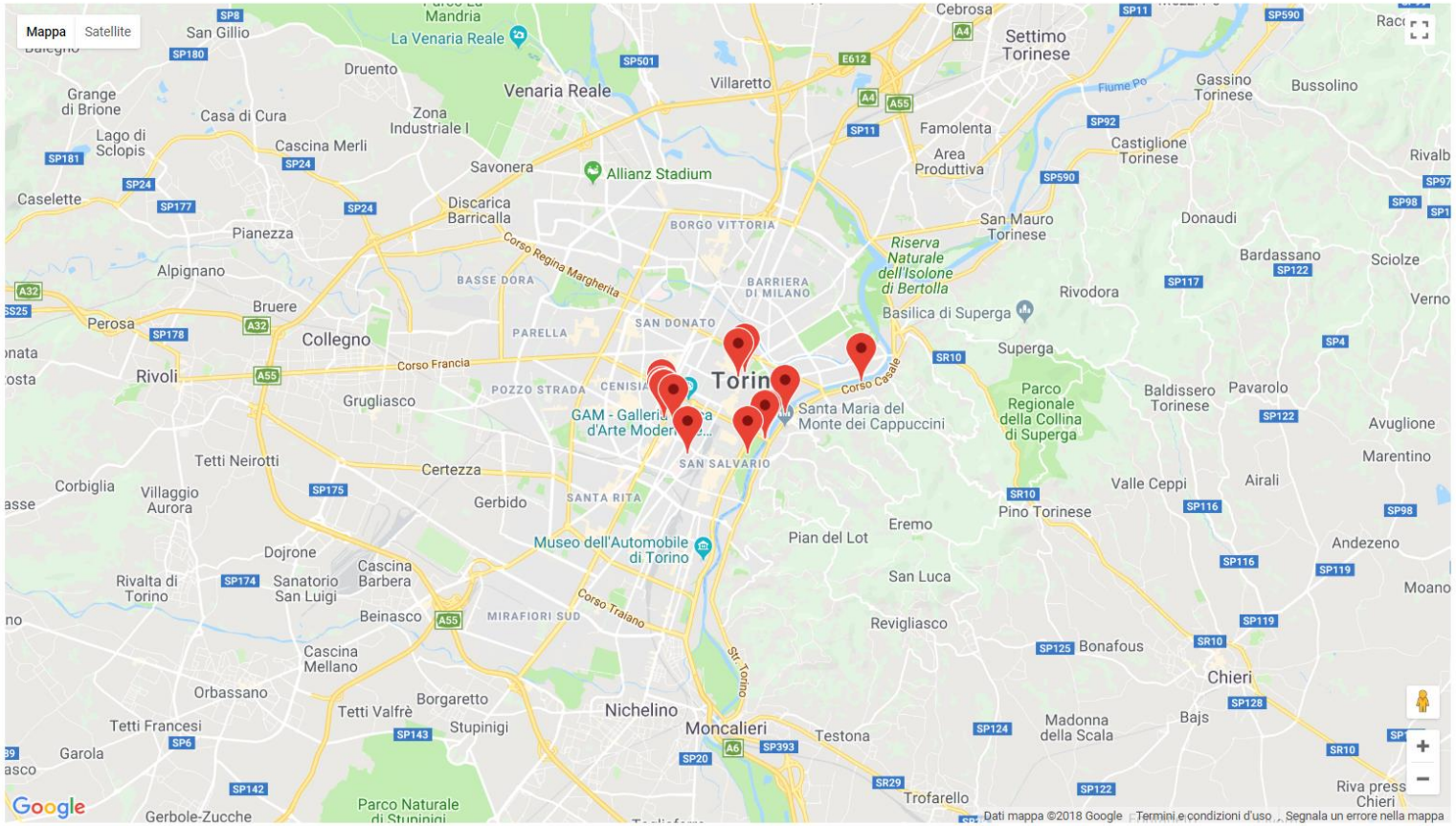
ID	Name	Type	Location	Latitude	Longitude
FEZ_49	Fissure Monitoring	fissure	Politecnico di Torino	45.0717287	7.6861214
FEZ_46	Temperature and Humidity	temperature	Parco del Valentino	45.054846	7.686736
FEZ_42	environment detection system	humidity , temperature and light	Parco della pellerina		
FEZ_25	Greenhouse Monitoring	temperature	ground	45.0615	7.6649
FEZ_06	Bridge monitoring	water	under a bridge	45.05812	7.691776
FEZ_29	Greenhouse monitoring	greenhouse	Corso Duca degli Abruzzi, 24, 10129, Torino TO, Italia	45.0624878	7.662327699999992
FEZ_43	River level monitoring	River water level	Bridge Vittorio Emanuele 1	45.063369	7.69753
FEZ_27	Farm Sensors	temperature	Polito	45.062776	7.661455
FEZ_30	Fire monitoring	fire	Via Gioberti 90	45.054822	7.669125
FEZ_33	Kitchen Monitoring	Smoke Fire Detector	Torino - via urbino 24 - 10155	43.733	7.416
FEZ_41	Fire detector	fire	Parcheggio sotterraneo Piazza Castello	45.0708858	7.6839317000000165
FEZ_54	River Monitoring	water level sensor	Rooftop	45.07	7.72
FEZ_24	Iot Fire monitoring	fire	Torino	45.0644634	7.6616588
ESP8266_24	Temp monitoring	temperature	Googlelosa	45.064436	7.661678
FEZ_55	Water Level Monitoring	alert water level	Ponte Umberto I	45.058199	7.692262
FEZ_03	Fire detection system	fire	Politecnico di Torino, Torino	45.062492	7.662328

Website – Map page

FEZ49 WebSite

- Home
- Measurements
- Board List
- Map

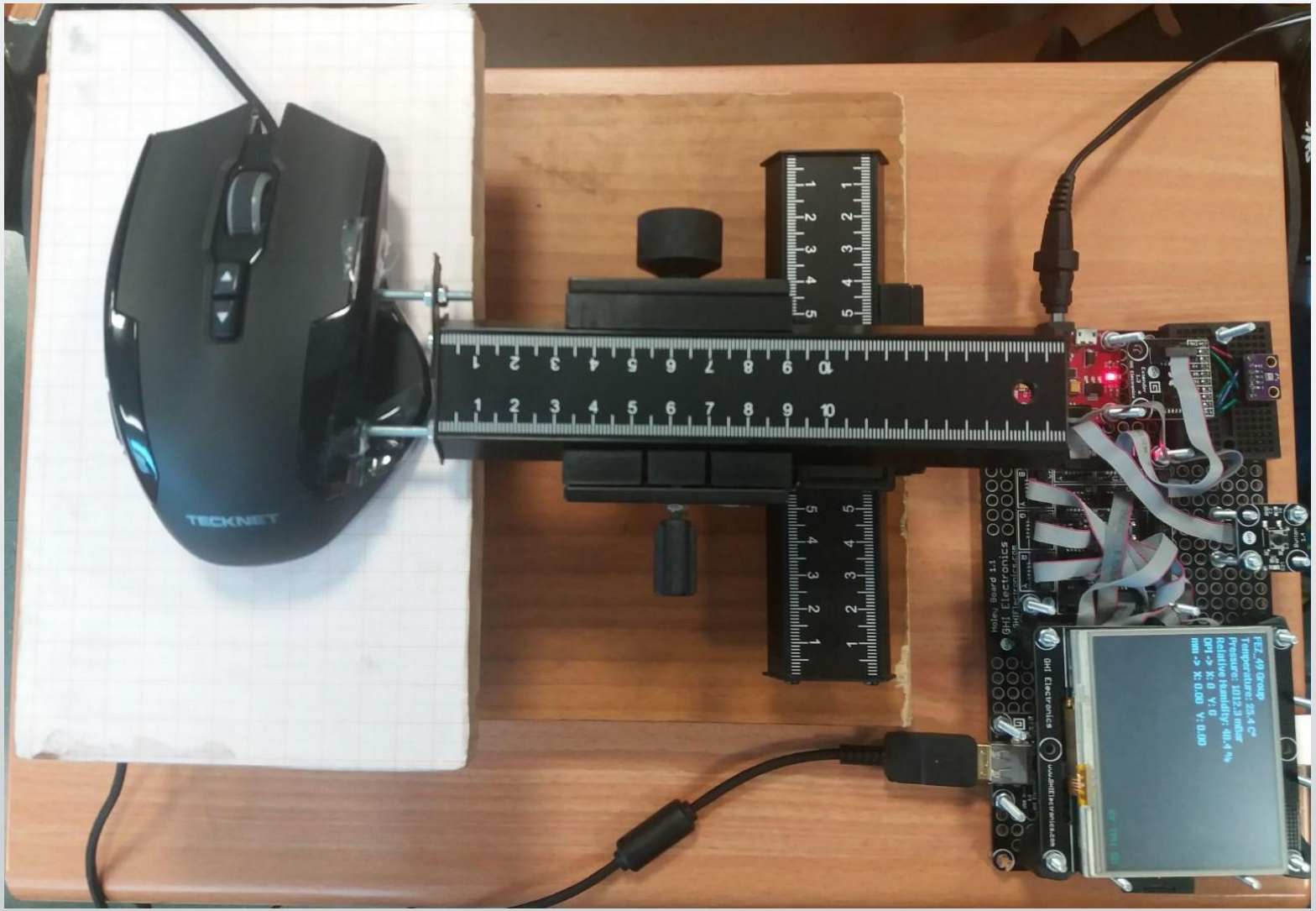
Map



Test and Simulation

- Mechanical Fissure Simulator, realized with X and Y micrometer slides
- Push button to reset fissure displacements, useful during debug and installation phases

Mechanical Fissure Simulator



Thanks for your attention!