Elettra Sincrotrone Trieste

COMMERCIAL PROTOTYPE SHIELDS IN ELETTRA

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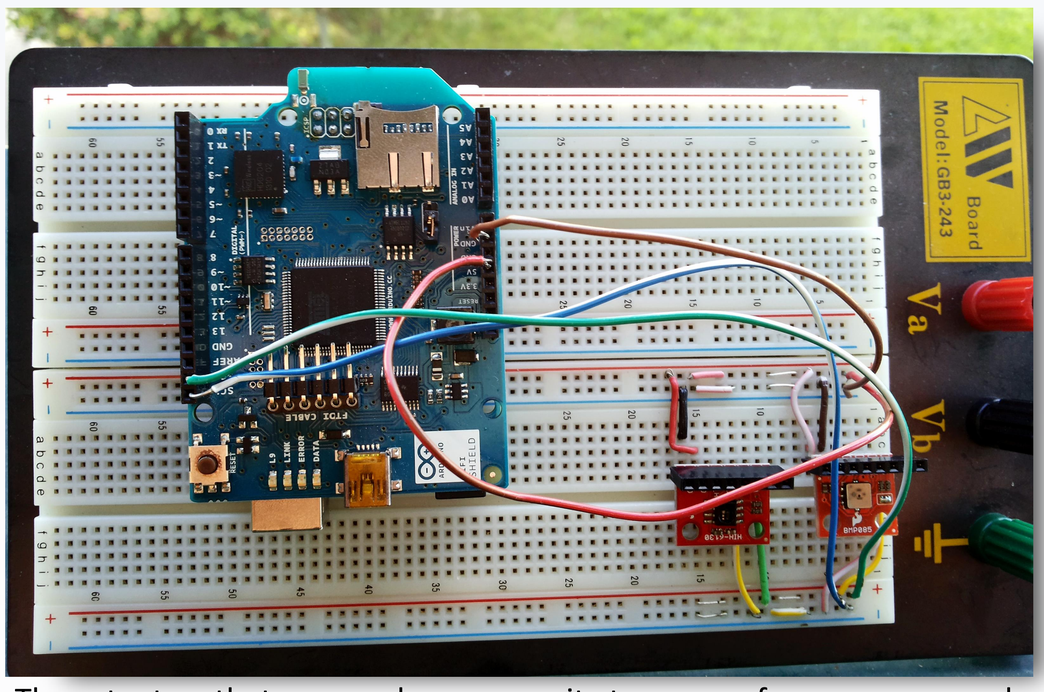
Ambient variables like temperature, humidity, air pressure, vacuum chamber's vibration play an important role conserving the quality and beam stability.

Using the open source platform Arduino it is possible to have a inexpensive and simply single board for all of these measurements and to have all the datas integrated in the control system.

Arduino



Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible.

The model we use is the Arduino Mega 2560. We preferred this model considering the high I/O capabilities and the possibility to connect multiple sensors or actuators using the PWM output.

It is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Our goal is to have a versatile instrument that allows us to connect to a multiple kind of sensors, placed in environments like synchrotron or FEL tunnels. We need to have the possibility to monitor some important parameters that could affect the machine performances. We started to monitor the common variables like:

- Air Temperature, Absolute humidity and atmospheric pressure
- Vibrations on machine components
- Ambient noise to prevent systems malfunctions

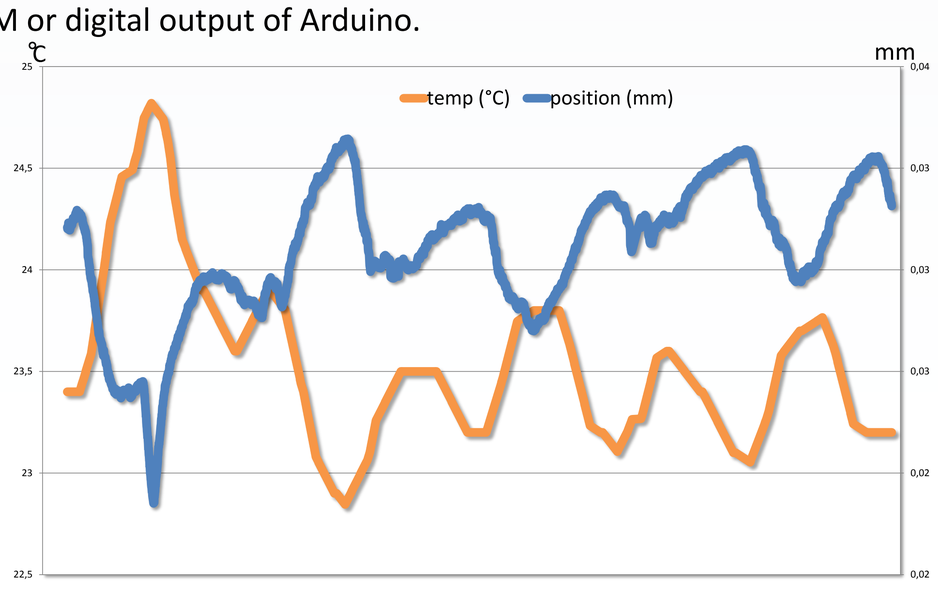
The actuators that we may have necessity to use are fans, pumps or valves controller exploiting the PWM or digital output of Arduino.

For better portability we configured the Arduino main board with a Wi-Fi shield obtaining the perfect solution for the portability. Using a Wi-Fi connection it's possible to initiate a measure only connecting the board to a source power and the software will manage the Wi-Fi connection and the acquiring data. The Arduino Ethernet Shield will be used if we will measure some parameters in a fixed place for a long time.

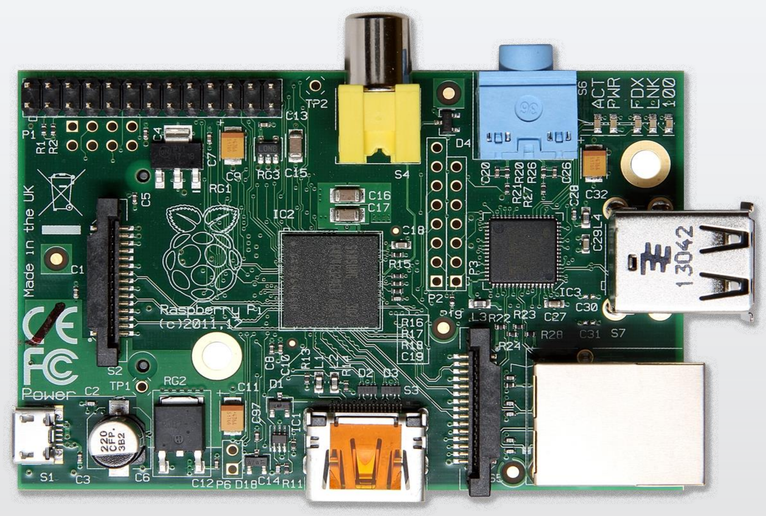
The Arduino board is integrated in the Tango environment, so all the parameters are immediately saved in the HDB archiver and reachable trough Tango instruments.

We installed the first prototype inside the LIBERA BPM cabinet. After the data analysis, important correlations were found between temperature inside the cabinet and the LIBERA output. From the graph it's easy to note that a delta temperature of 1° C correspond to a drift of 5 µm at 1 BPM. From the PBPM of the following beamline, the drift is increases of 50 µm.

After these measures we are planning to install a water cooled cabinet, in order to improve the temperature stability of the Libera rack and consequently the long term orbit stability.



Raspberry



The Raspberry Pi is a low cost, credit-card sized computer. It is a capable little device that enables people to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

The operators in charge in control room must operate two accelerators: Elettra and Fermi, so they have to communicate with more than 30 beamlines, and it's easy to understand how this task is a fundamental goal of the operators. But at the same time in control room there are present only two operators.

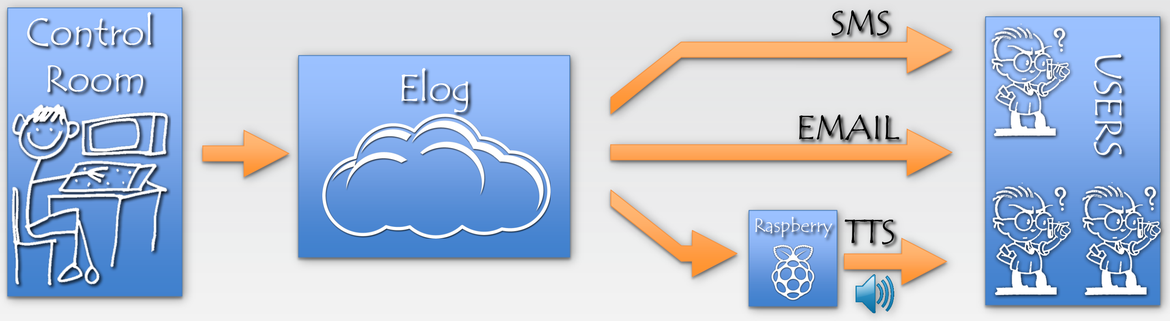
Customers satisfaction cannot be only measured by machine parameters like uptime or beam quality, in fact it's influenced by the communication between who works to improve machine performance and who uses the beam. Without an effective means to communicate will not be possible to create a timely and accurate information flow between control room and experiments who become isolated from the machine status. The importance of communication is crucial to the success in our business, if the right message does not get to the right person, in the right format, then this could create dissatisfaction.

We mainly use two communication systems: sms alert and speaker installed in the experimental hall.

After 25 years of operation, the speaker system installed in experimental hall needs to be improved due to low sound quality, so we decided to use a local speaker system to have the possibility to communicate with a single or multiple beamlines at the same time.

A raspberry PI well adapts to our requirements and moreover is very cheap, so we developed a complete speech synthesis system, that is composed by one raspberry PI (€50) and one HDMI TV 22'' (€150) for a total cost of only €200.

We are planning to install one complete system for each beamline, so the operators will be able to send text messages, that the TTS will convert to a vocal message. Moreover each beamline will have displayed on the TV the general machine parameters and also information about their own beamline.



The system capability are:

- the message is sent to a single or multiple beamlines
- the message is delivered by sms, email and speaker system
- the message is computed by the raspberry and the text is converted in audio using a TTS translator
- multiple TTS language selectable by the operator, in order to well adapt with the foreign users

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