Multipurpose IoT network watchdog device with the capability of add on sensors for multi instrument field stations

EGU General Assembly 2020

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ABSTRACT

Several stations (seismological, geodetical, etc.) suffer from communications problems, such problems create data gaps in real-time data transmission, also excess humidity and temperatures further than manufacturer limits, usually make components and circuitry, of expensive instruments, failure, and results to unaffordable service or unrepairable damage.
We create a low-cost opensource device that will raise the reliability of the stations and secure the instruments from severe damage, such a device installed as a prototype at UOA (University of Athens) seismological station KARY (Karistos Greece) for a year and the reliability of the station raised tremendously, since then the device upgraded to provide wireless connection and IoT GUI (mobile app). A local server was built to serve all the devices uninterrupted and provide a secure network.
The software is fully customizable and multiple inputs can provide addon sensors capability, for example, gas sensor, humidity sensor, etc., all the data are collected to a remote database for real-time visualization and archiving for further analysis.
The shell which covers the circuitry is 3D-printed with a high temperature and humidity-resistant material and it's also fully customizable by the user.

OBJECTIVES

Our goal is to make a multifunctional device with add on sensors capability that provides autonomous reset equipment functionality along with manual remote management of field stations through mobile phones. The device working with WIFI that minimizes the surge from network cables which destroy sensitive and expensive equipment.

Fig.1 GNSS receiver unit damage from surge voltage

METHODOLOGY

To accomplish our goal we use the main microprocessor unit with wireless connectivity, sensors for temperature, humidity and gas, a circuit which resets our telemetry automatically and our equipment manually, a server with a database to store temperature humidity and gas values, and a virtual server to register and control via mobile phone the microprocessor units.
As seen in the schematic the microprocessor unit runs a program which we made to take values from three sensors and through secure networking send them to a database (MySQL) for storing and further process for visualizing. Also the main unit is responsible to check the telemetry automatically and if it detects a dropdown hard resets the modem.
The registration of the units is made through a token that provides the server software, after the registration is complete we have full access to the units through a G.U.I. that installed into our mobile phones.

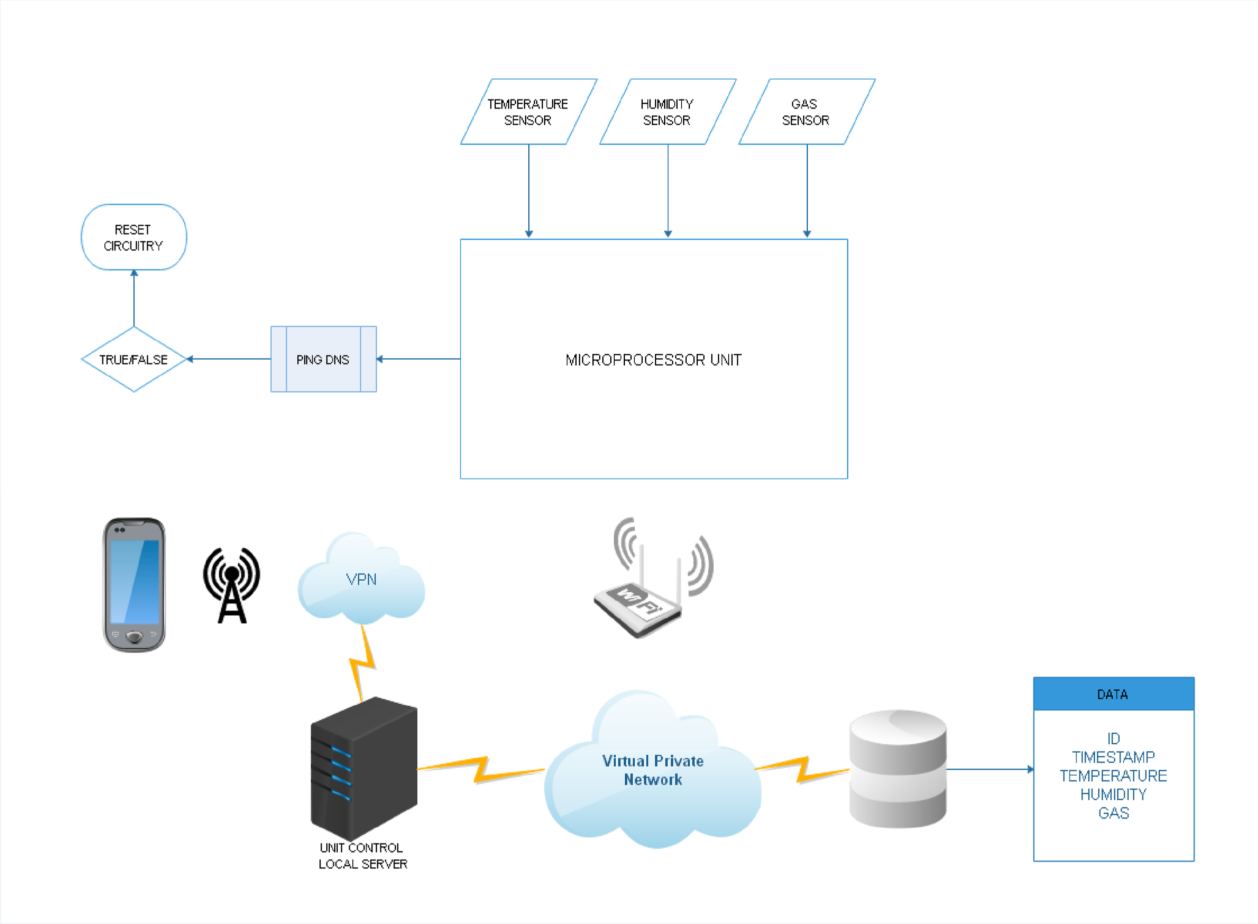

Fig.2 Schematic Diagram of unit working flow

A prototype device installed at seismological station KARY (Karystos Greece) of the UOA (University of Athens) for a year and so we discover that the data-loss of the station is completely removed.

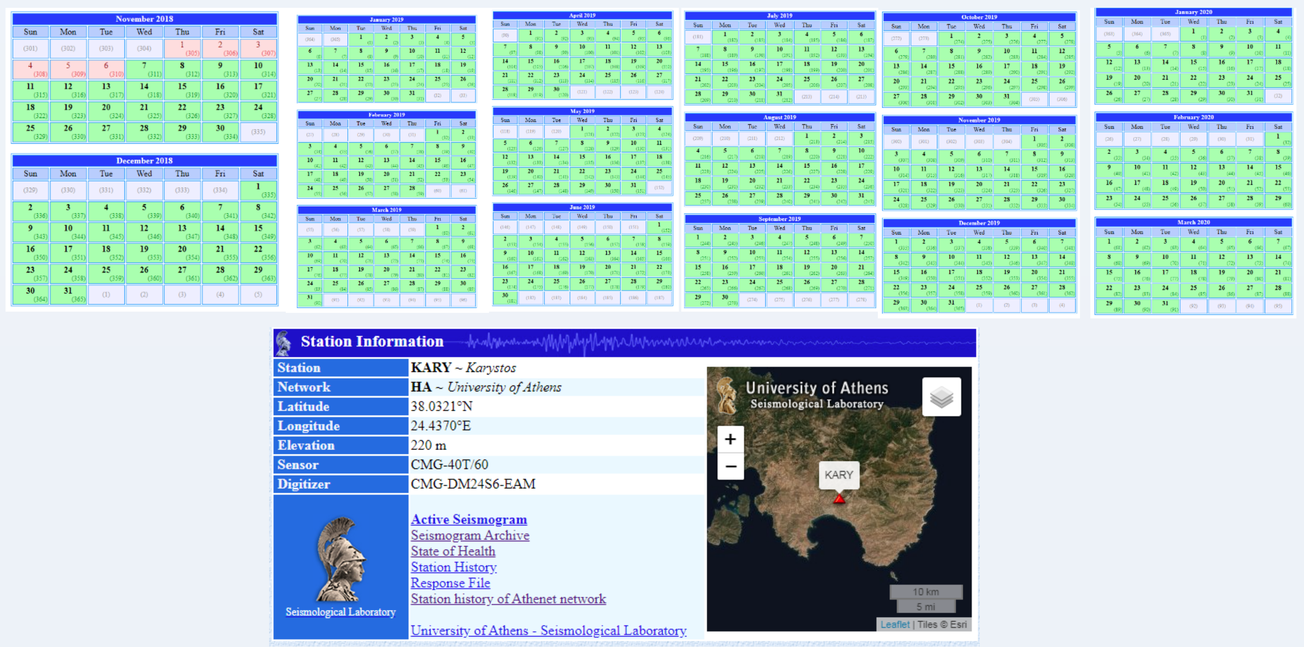

Fig.3 Station KARY (Karystos) file archive

MATERIALS AND CASE CONSTRUCRTION

The case of the unit is constructed with 3D printing and is customizable. A bibliography research of the elements that potentially is going to be used for our case is made.
Candidate elements are presented at the next table.

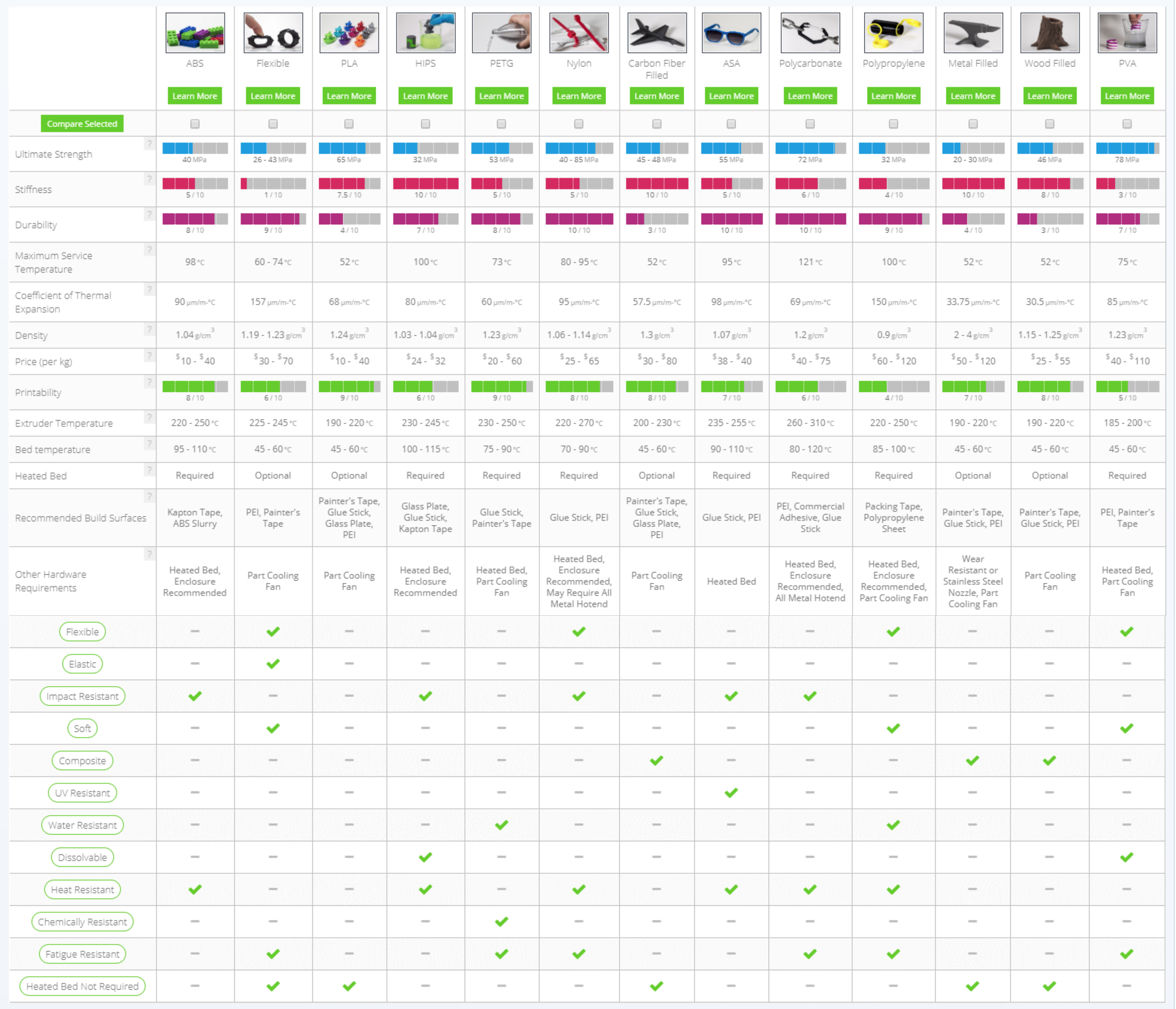

Fig.4 3D Printing Filament materials

Primarily for prototyping propose the PLA (polylactic acid) filament is used due to low price, ease of printing, and satisfactory temperature and strength resistance. The case is modified to our needs and keeps upgrading.

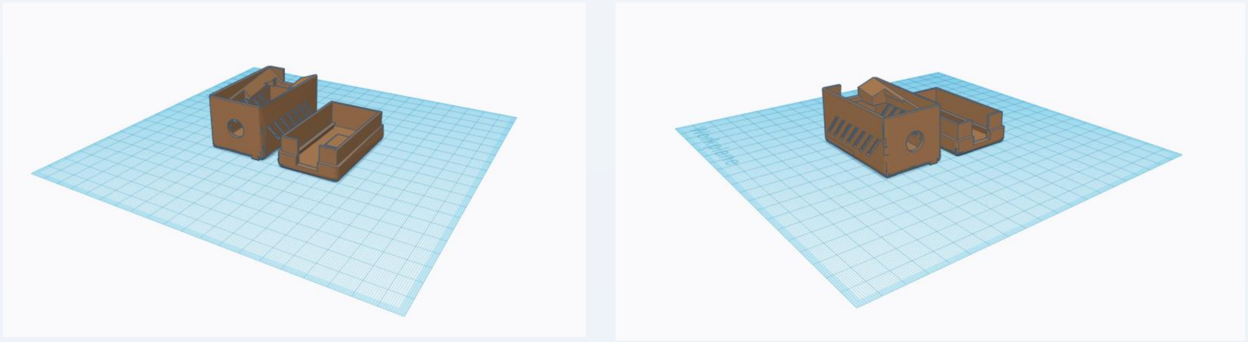

Fig.5 3D case design

A working temperature test is being conducted to the main unit and shows great results as shown below.

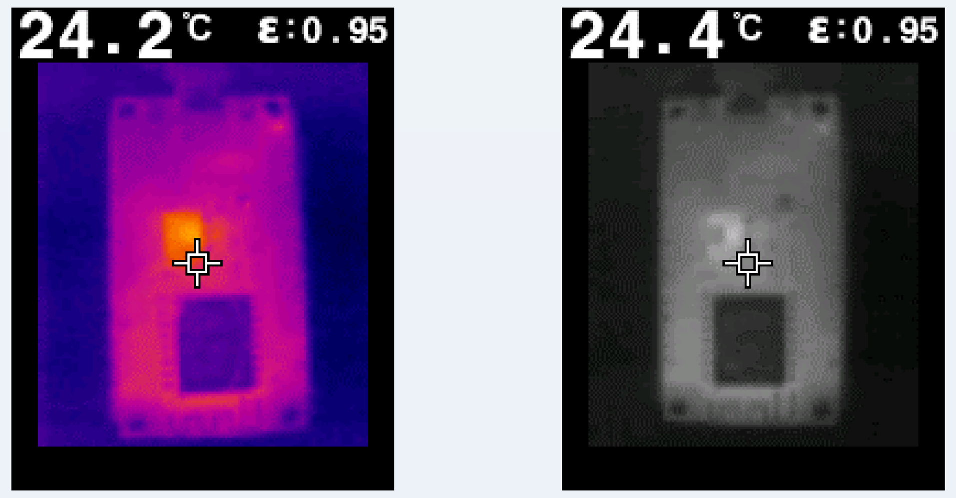

Fig.6 Temperature testing

POWER SUPPLY UNIT

A Solar Panel and an MPPT (Maximum Power Point) Power Supply is selected to charge the battery which powers the main unit. Also, the power supply is controlled by the main microprocessor unit to avoid using extra circuitry. Autonomously is succeed with the power supply for harsh environment field stations.

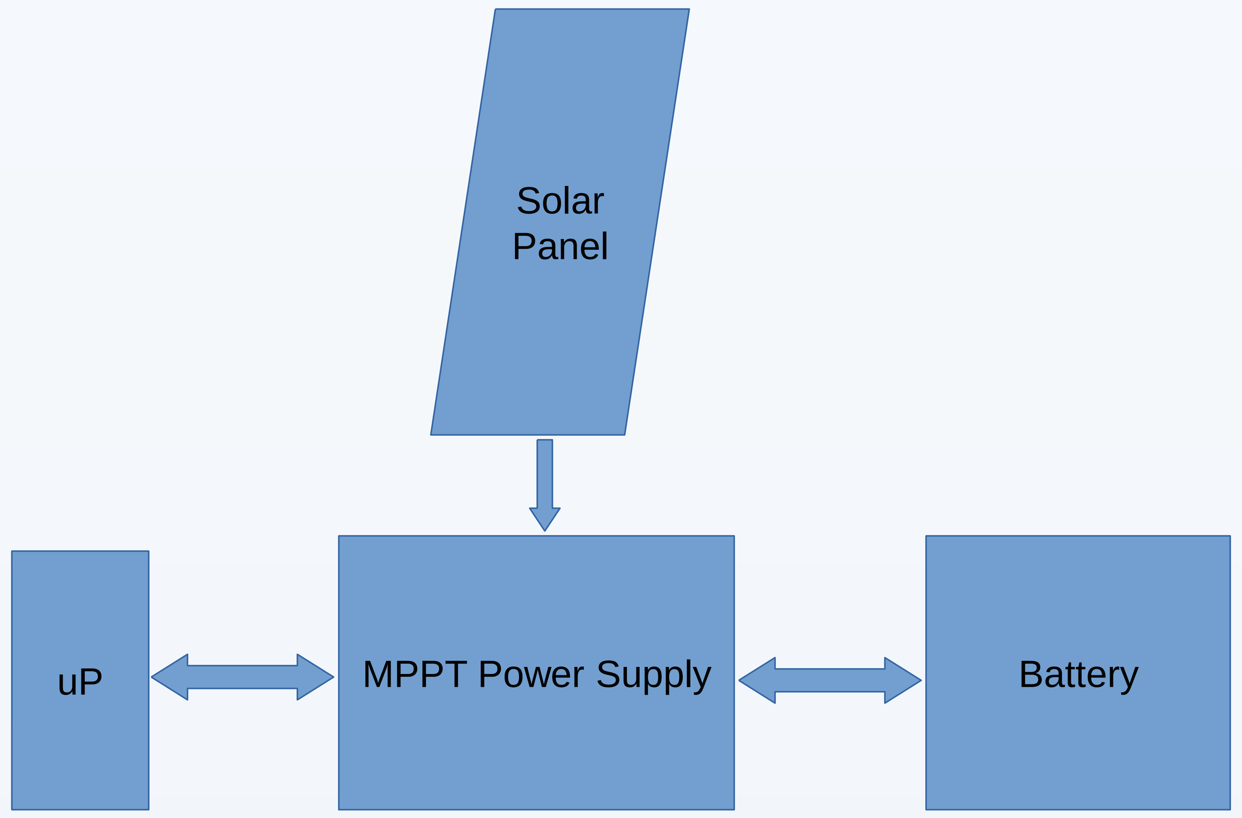

Fig.7 Power Supply schematic

CONCLUSIONS

A multipurpose IoT network watchdog device with the capability of add on sensor created for remote and inaccessible field stations. In the case of station KARY, a tremendous reliability raise was observed. The modification of the software is feasible and also the design of the case. The variety of the filament material gives us the opportunity to adapt the case to several environment and sensors. The power supply gives us autonomy and extra protection of power surge.
Finally the temperature tests give us the advance to find an overload of the microprocessor unit either from software or from sensors.
Further info is accessible through contact with the authors.
The construction of the unit, programming and testing is self-funding.

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