Rock Monitoring 2022 – Low Power Modular Gateway

Rockslides have devastating consequences for the affected areas, and global warming has increased their frequency. The Rock Monitoring Project aims to detect 3-dimensional movements of rocks in order to protect affected areas in time. In order to enable the data transfer from a previously developed sensor node to the end user, we have implemented a low power modular gateway compliant to extreme environmental conditions, and bridging a LoRa network to an LTE network.

Concept

The Rock Monitoring System consists of two hardware parts. The first part is the sensor node, which has already been developed. The sensors used are an extensometer to make linear distance measurements and up to three accelerometers to measure tilts. The second hardware part is the gateway, which is the focus of our work. The gateway is modular (it can support different radio standards), low power, and it complies to extreme environment conditions. It is built based on an Arduino MKR WAN 1310 and a low power LTE (Long Term Evolution) module from the manufacturer Mikroelektronika. The two modules are connected with a self-developed adapter PCB. Furthermore, the power supply of the lead acid battery (suitable for low temperatures) and the voltage regulation is on the adapter PCB. Communication between sensor node and gateway takes place via LoRa (Long Range Wide Area). The measured values are converted into the correct values on the gateway and made accessible to the end users via the LTE network.

Implementation

Hardware

The hardware had to be implemented in such a way that all circuits and components were as energy efficient as possible. In addition, two other important criteria were that the components can withstand extreme temperatures and that they are currently available.

Software

In order to store energy, the gateway is in sleep mode for the majority of the time. The goal is to wake up the system when data is received and first check if an alarm was triggered. If this is the case, an alarm message will be sent immediately. If this is not the case, the received data can be processed and is then transmitted. It is important that everything runs as efficiently as possible, so the system is only awake for as short a time as possible.

Results and Outlook

A first prototype for the Rock Monitoring Gateway has been successfully developed. The hardware was tested in a laboratory setup and is functional. However, the layout should be revised in a new design. The temperature dependent resistor is very close to the main heat source, the MPP tracker. This causes the resistor to heat up and compensate for the incorrect temperature. Most of the software has already been written and tested with unit tests. In a further step, the software can be completed and the gateway can undergo a first field test. An advantage of the gateway design is that different communication methods can be implemented with little effort. This gives the gateway great flexibility.
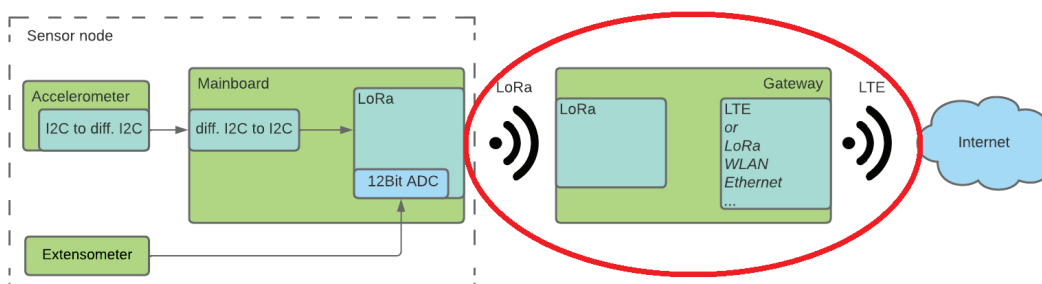
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Image 1: Rock monitoring system