SMART BRICK

Although Structural Health Monitoring (SHM) is widely recognized as a major aid for safety improvement and maintenance cost reduction of infrastructures, at present only a small fraction of the existing structures feature some sort of automated monitoring device. In fact, apart from research applications, only structures with significant strategic, historical or economic relevance seem to justify the investments required for installing and running a SHM network. By analyzing the costs build-up, a dominant fraction of the required investment has been found due to the design, installation, software customization and calibration of the SHM network. Moreover, standard SHM installation may require a great variety of different sensors and related electronics, a condition that seldom follows to the basic rules of a scale economy.

A monitoring device was developed at the Center for Infrastructures Engineering Studies (CIES) to achieve a dramatic cut of both equipment and installation costs. The device, in its standard version, requires no cable connection, being powered by batteries and featuring self-referenced embedded sensors and GSM/GPRS cellular phone communication (see Figure 1 to Figure 3).

The standard alkaline batteries included in the shock-resistant submersible reinforced plastic case allow a typical device life of 3-4 years, although a much longer life can be achieved coupling optional lithium batteries and auxiliary solar cells. A digital camera, as well as displacement sensors, load cells, strain gauges and other potentiometric, voltage output and digital sensors can be added to the embedded ones, that include temperature, water-level tilt and acceleration sensors, without the need of any additional conditioning electronics or power sources.

In addition to the simplified device installation (it typically only requires two fasteners), its modularity saves time during the design phase, the PC-assisted configuration features and the “just one button” calibration procedure cuts costs in the set-up phases.

Data collected, as well as alarms configurable on each sensor and software anomalies are logged on the internal memory and automatically delivered to a number of recipients through SMS message, email and FTP file upload. Remote adjustment of parameters and software upgrades are also allowed.

The device, thanks to the cost savings obtained, has the potential to disclose the practice of SHM to a wider number of existing and new infrastructures, increasing their safety and reducing their running cost by allowing a better maintenance schedule and useful life extension.

The smart brick was recently installed on Osage Bridge in Osage County, Missouri in order to check its reliability (see Figure 4). Temperature, water level and inclination of the piers are measured daily and compared with USGS data. The instrument showed very good performance. The smart brick will be calibrated in the next few months in order to assess its capability to accurately measure accelerations.

Figure 1 – Smart Brick

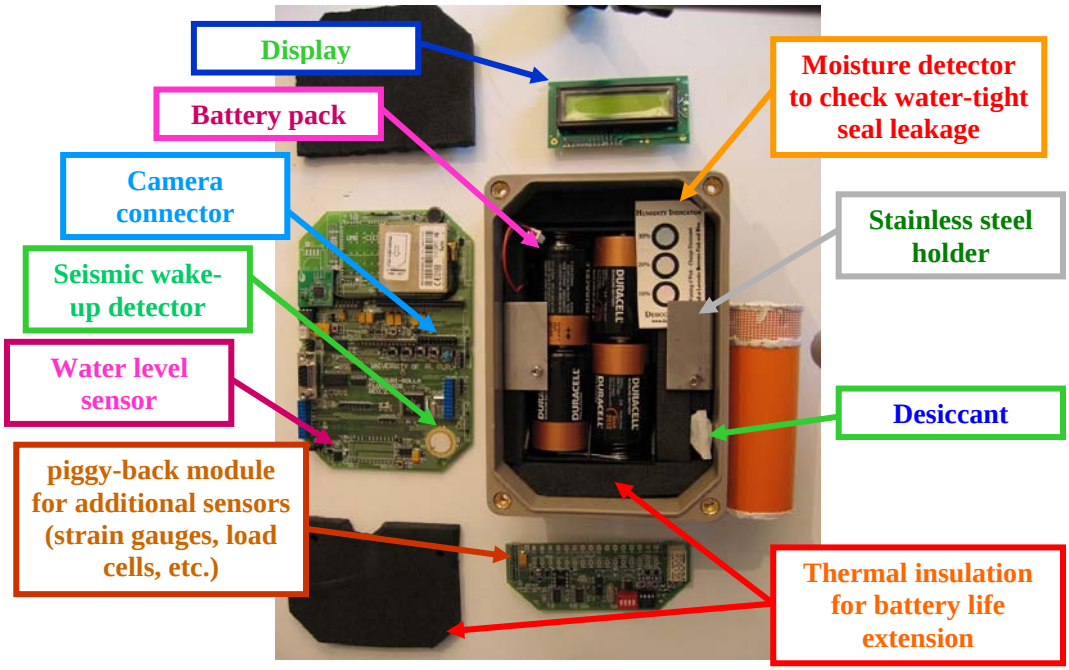

Figure 2 – Inside the Smart Brick

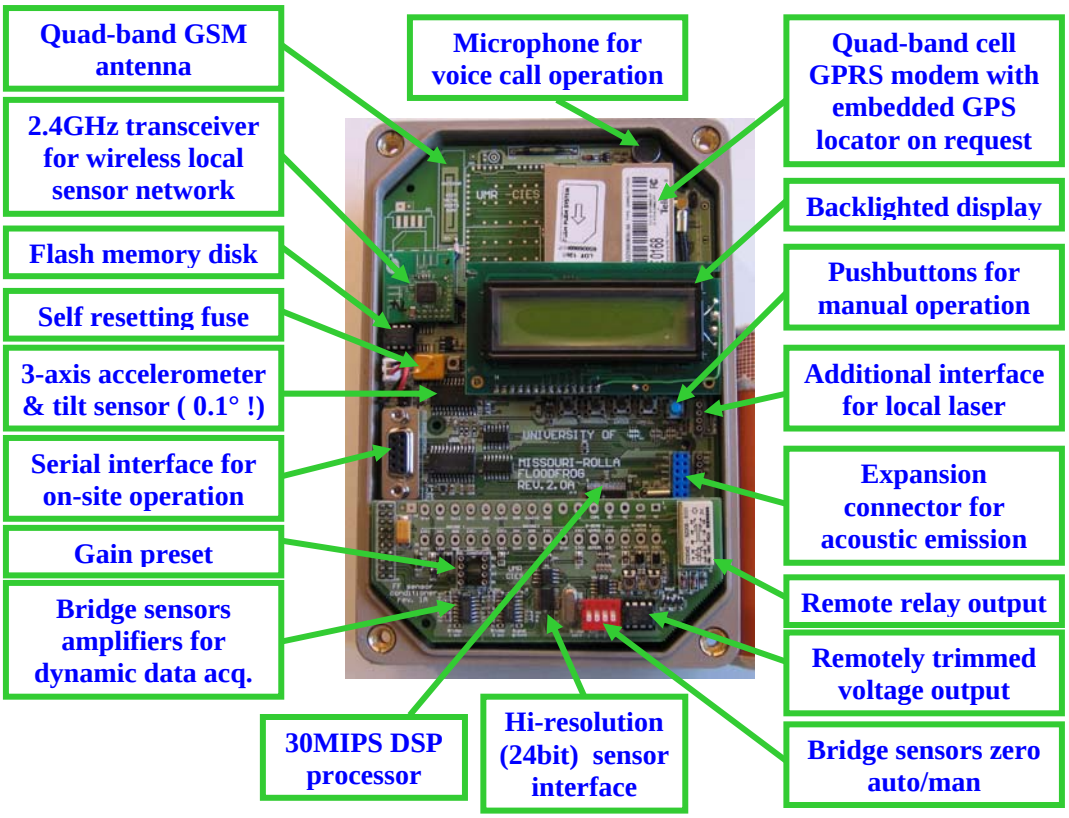

Figure 3 – Circuital Details

Figure 4 – Installation of the smart brick