A low cost solution for remote Monitoring of structural health of aged civil structures.

Monitoring the structural health of aged civil structures like archeological sites, old temples has gained significant attention in recent times.

Civil structures degrade over a period of time owing to many factors. One such factors is poor maintenance and non-human natural factors like impact caused owing to earthquake, floods, storms etc

While proper design engineering and maintenance can help to mitigate such impacts considerably, measuring the extent of degradation or in other words monitoring the health of civil structures become very important and crucial to carry out any maintenance and restoration work.

With advancements in sensing, processing and networking it has become easier to adopt these advancements in technology to engineer a solution for monitoring the structural health of any civil structure.

The solution developed by IIT Madras Civil and Structural engineering department and CSE Department consists of “Off the shelf hardware components” and “Software developed in house”.

The temple at Kedarnath, Utharkhand was chosen for the pilot deployment and study.This structure had undergone a considerable amount of damage during cloud burst and following disaster triggered by flash floods in 2013.

The solution deployed by IIT Madras measures the inclination/tilt of the structure and sends a periodic readings every five minutes (configurable) to a remote server located at IIT Madras. The system is also engineered to wake up upon an impact of (.063g), measure the acceleration associated with it for 90 seconds and the inclination owing to this impact.

The remote connectivity is enabled by the cellular services provided by BSNL.

At the remote server located at IIT madras the data collected is presented for further analysis to evaluate the effect of any impact and also periodaically monitor the inclination.

As kedarnath is located in a very high altitude region, the structure is inaccessible for a period close to six months every year, when power and cellular connectivity will not be available.

Pilot studies are being taken up to ensure continuous working during this time when the system would run on a battery and store the data locally.

The data could be collected manually or transferred automatically and used for further analysis once the accessibility to the deployment site is established and subsequently power and cellular connectivity are restored.

The solution attains significance owing to many factors like

- Automated and periodic process to monitor, read, collect, store and transmit data to remote locations.
- Designed to work under sub-zero temperatures up to -25 ° C .
- Wake up on impact to measure the acceleration and ambient temperature subsequently.
- Back-up data for six months when the site becomes inaccessible during winter.

Following table lists the off the shelf hardware components of the remote structural health monitoring solution.

Hardware Component	Reference	Name /Reference of the component	Significance
Processing platform	Refer Figure	GW5200	This is a small size micro controller PCB which has a dual core processor, Cellular and network connectivity slots, interfaces for sensor connectivity. This PCB also has an accelerometer and a temperature sensor
Sensing Platform	Refer Figure	D801	This is a tilt/inclination meter used to measure inclination in the range of ±3○
Remote server	Refer Figure		A PC with Ubuntu linux which records and stores the data collected and sent by the hardware system located at kedarnath

A schematic view of the entire solution and the off-the shelf components is presented