International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Structural Health Monitoring With the Help of Wireless Sensing Network

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Abstract: **On 3thJuly 2018, a Railway Footbridge of Andheri (West) of Mumbai collapsed because of suffering from Structural damage from heavy rainfall and weathering conditions and negligence of proper maintenance given by Railway Board Authority.6 people were injured during this event. We collected raw data of Structural Health Monitoring on Infrastructure. In India there are various regions where Structural Health Monitoring is required for forecasting the need of maintenance to certain structures due to damage caused by Environmental effects and natural disasters and risk of failure. We observed that Structural Health Monitoring with the Help of Wired Sensors is Power and Time consuming and costly, and it needs to be replaced by more efficient system to be used in engineering application, using different routines (steps).**

Keywords: SHM-Structural Health Monitoring,WSN-Wireless sensing Network, Smart Sensors.

1. INTRODUCTION

With an approach of every single new structure coming up at this period, when India is contending in the present aggressive worldwide market, one can't have a tendency to overlook the reality that India worries about the concern of various old structures possessed by the state as well as the general population. These old structures have known for obscure inadequacies and can't be recognized except if a catastrophe is experienced. Be that as it may, it would be past the point of no return by then as the harm would have just occurred regarding human misfortune. This prompts the current situation with the poor undertakings and necessities a cautious thought to be genius dynamic to lead wellbeing observing and giving legitimate arrangement, and afterward it would be up to the proprietor, may it be private or government to execute it in the national intrigue.

Auxiliary wellbeing observing (SHM) is a procedure for giving precise and opportune data about the condition and execution of a structure. It very well may be either here or now (ex. repairs adequacy) or a long haul (checking parameters consistently or occasionally) process. A requirement for SHM emerges with the way that properties of both cement and steel relies upon countless, which are frequently difficult to anticipate practically speaking. The agent parameters chose for wellbeing checking of a structure can be of mechanical, physical and substance in nature.

In India because of carelessness and non-accessibility of innovation, SHM has not been considered important and subsequently, misses its maximum capacity. In the event that security benchmarks are underscored and taken after SHM will develop to its maximum capacity and be a vital piece of basic support and administration. Security is a major issue and ought to be tended to legitimacy later on. In this proposition,

Structural Health Monitoring essentials are secured and required on Indian situation. Additionally introduced are encounters in some SHM work, which has been embraced.

What's more, its effect on the structure both in the United States and in India..

2. METHODOLOGY

1. Collecting information and studying various research papers of IEEE Papers and Professional Handbook on Wireless Sensing Network.
2. Collecting required materials such as Sensor Platforms and various types of Sensors.
3. Making the model for sensor.
4. Testing the sensor on the field on previously decided structure.
5. Processing the data received by the receiver.
6. Taking continuous readings.
7. Comparing with SKF Microlog Analyzer Proseries.

2.1 Collecting Required Materials

2.1.1 Ardino Uno

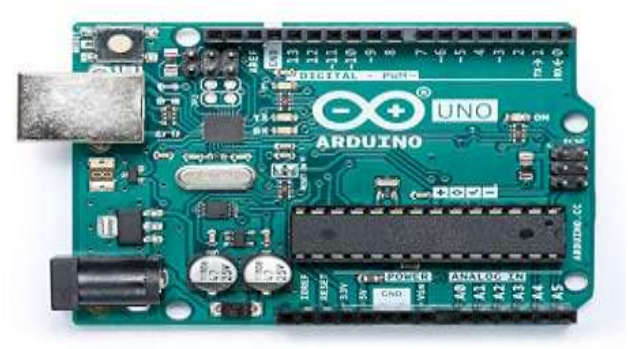


Fig. No.2.1.1 Ardino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It is used to support the microcontroller.

2.1.2 Piezoelectric Cell

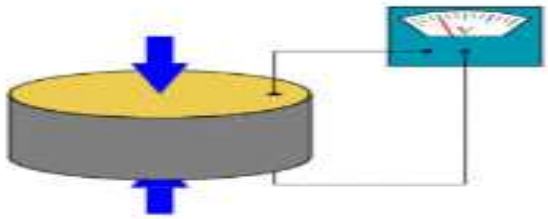


Fig. No.2.1.2 Piezoelectric Cell

Vibration sensors, also known as piezoelectric sensors, are versatile tools for the measurement of various processes. These sensors use the piezoelectric effect, which measure changes in pressure, acceleration, temperature, strain or force by converting them to an electrical charge.

2.1.3 Temperature Sensor

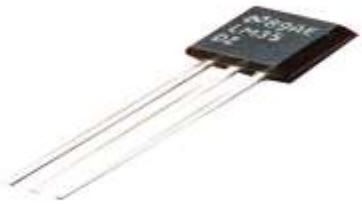


Fig. No. 2.1.3 LM35 Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

2.1.4 Wi-Fi Module

Fig. No. 2.1.4 Esp8266 Wi-Fi Module

ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

2.1.5 Bluetooth Module

Fig. No. 2.1.5 Hc 05 bluetooth

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

2.2 Assembling all these components on a Base Plate to make the Sensor Model.

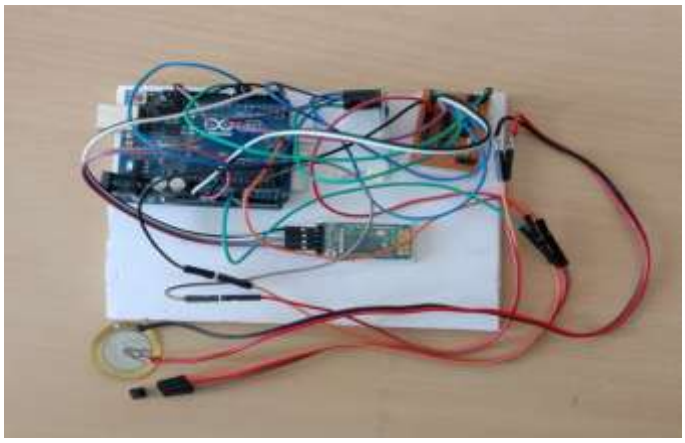


Fig. No. 2.2 Wireless Sensor Unit

2.3 Testing the sensor on Field

Fig. No. 2.3 Setup for the Experiment

The Wireless Sensor was connected with SKF Microlog Analyzer to the Cut Section Model of Industrial Gear Box (Motorized) and readings were noted.

2.4 Collection of Data

The readings from the sensor can be received in 3 methods

1) On mobile through Bluetooth Module connected to the Ardino Uno.
2) On laptop by connecting it directly to Ardino Uno Module through Data Cable.
3) On Online Server 'Thinkspeak.com' connected to internet through Wi-Fi Module on Ardino Uno Platform after creating a account on the webpage according to ouSr requirements for Data Processing.

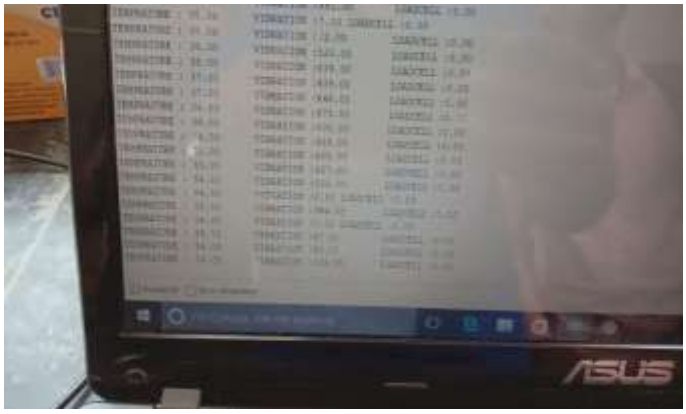
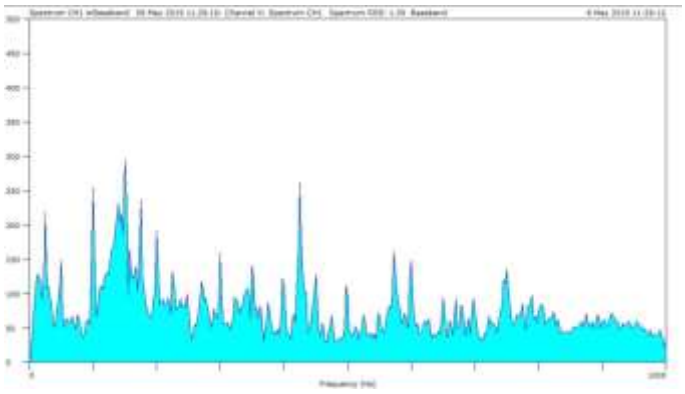


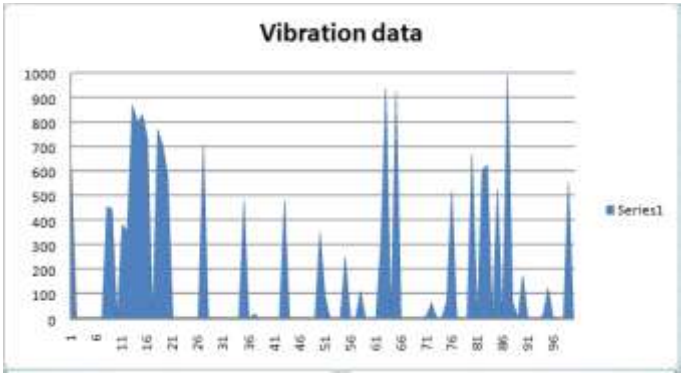
Fig. No. 2.4

2.5 Comparing these Results with the Results obtained from SKF Analyzer



Graph No. 2.5.1

Calculated by SKF MICROLOG ADVISER PRO SERIES



Graph No. 2.5.2

Calculated by SHM with the help of wireless sensor

3. RESULT

After performing the experiments with the wireless sensors and studying the results, we have concluded that the readings obtained from the receiver of the sensor and SKF Microlog Analyzer Proseries are approximately the same.

To obtain better and accurate results, we can increase the intensity and other parameters of the sensors, so they can be applied on various types of structures.

4. CONCLUSION

We can conclude that this system can be used for Structural Health Monitoring in a effective way as the conventional types with better results. If the necessary changes are made in the sensor they can be applied on any structure with better outcome.

5. FUTURE SCOPE

The sensors can be modified as per our requirements to find temperature, load vibration, etc. We can also use the smart sensors to get the higher accuracy of the sample by detecting signal down to 500μG without significant distortions' such as noise flour of the system (including accelerometer, amplifier, ADC, etc)., installation error, and temperature variation .this means low jitter. Jitter is a variation in sampling interval. The sensors can be synchronized in time. So all the nodes in the network start at the same time. Otherwise, shift in signals between different nodes can give distorted picture of the structure. The sensors can also be modified for high frequency sampling to be implemented on the large scale by using large scale multi-hop network for the structures having span of long distance making the communication impossible. The smart sensors can be used for reliable data collection. Thus, not only command, but also the data can

be transferred reliably. Missing sample makes the analysis hard or even impossible. Uses of smart sensing technology there are various smart sensors available

1) Fiber Bragg grating (FBG) Sensors

2) Fiber-optic sensors (FOS)

3) Wireless sensors

4) MEMS

5) PZT sensors

6) BERKELEY-MOTE

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