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Review on 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.*

Key Words: *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.

2. LITERATURE REVIEW

Literature review related to the structural health monitoring was carried out. The objective was to know the stability and the performance of different structural units in design. It was noticed that many researchers, engineers and consultants have worked extensively on nondestructive tests, wired sensors as well as wireless sensors.

2.1 COLLECTION OF DATA

1. Adam B. Noel, Ahmed Badway "SHM Using Wireless Sensor Network : A Comprehensive Survey" Ieee Communication Surveys And Surveys Volume 19 N No 3 ,2017.

"In this paper they present a compressive survey of WSN Based SHM system. The foundation information relating to Structural health monitoring such as basic parameters, and damage detection. The main challenge of this system is scalability, time synchronization and sensor placement Optimizing the data processing were presented and solution of this problem"

2. B. Arun Sundaram, K. Ravishankar, R. Senthil "Wireless Sensors For Structural Health Monitoring And Damage Detection Techniques" current Science, Vol.104 No 11, 10 June 2013.

"In this article they discussed about the recent research and development and application of sensing. Monitoring and damage detection for civil infrastructure. Sensors such as wireless sensors, optic fiber, piezoelectric sensors and their application were discussed. Recent Development are present ambient vibration based monitoring, damage assessments using soft computing., WSNs using without data collision, local damage detection using wireless sensing system."

3. Billie F. Spencer Jr."Smart Sensing Technology For Structural Health Monitoring "13th World Conference On Earthquake Engineering Paper No .1701, August 2004

"In this paper they provided a brief introduction to smart Sensors technology, determine the number of the opportunities, and challenges of this system. Smart sensors are based on mote paradigm will provide the impetus for development of SHM."

4. Charles R. Farar, david w. allen "coupling sensing hardware with data interrogation software for structural health monitoring"ISSN -1070, 2006.

"In this paper they discussed about the current health monitoring system whose process was statically loaded to the monitoring node before the node was deployed in the field but with the help of software paradigm that allows working independently and uploaded to the monitoring node without taking the node out of service. This system was specifically designed for SHM to obtain data acquisition, normalizing and processing. The design for SHM system was around the diamond II SHM data interrogation software."

5. Fabio federici , Roberto Alesii, Andrea Colarieti, Marco Faccio, Fabio Graziosi, Vincenzo Gatuulli, Francesco Potenza"Design of Wireless Sensor Nodes for Structural Health Monitoring Applications" Procedia Engineering 87 (2014) 1298-1301.

"In this paper they give an experimental setup allowing the evaluation of WSN in a field of post disaster SHM application. The choices of design and development of the health monitoring system were reviewed, both the cases of commercial platform as well as custom platform development, for different classes of SHM application."

6. Giuseppe Anastasi, Giuseppe Lo Re, Marco Ortolani "WSN for Structural Health Monitoring of Historical Buildings" Catania, Italy, May 21-23, 2009.

"This paper described the system characteristics of WSN that are not only used for a pervasive sensory system, but also as a distributed computational entity. The user interaction with the system will help to collect data and improving its behavior in order to tune into the specific and dynamic changes. This paper described the whole scenario where the system is working in actual project that required health monitoring a baroque church after renovation work has been carried out to restore in after a minor earthquake."

7. Jennifer A. Rice, B. F. Spencer "Structural Health Monitoring Sensor Development for the Imote2 platform" Proc. of SPIE Vol. 6932, 693234 (2008).

"This paper described the features of Imote2 platform which was in well demand for SHM applications. The limitations of the recently available Imote2 sensor boards were reviewed, its requirement of more versatile signal processing has been discussed. The design and validation of Imote2 for SHM sensor board with flexible signal process capability were present. Future versions of the SHM board were planned and will improve the signal output quality and capabilities, and the design."

8. J. P. Lynch, Y. Wang, A. Sundararajan, K. H. Law, A. S. Kiremidjian "Wireless Sensing for Structural Health Monitoring of Civil Infrastructures"

"In this paper described about SHM with help of WSN. The Wireless sensing network includes the data processing ability to perform as its core. This core's microcontrollers facilitate local data to prior transmission network. This paper focused on measuring acceleration and also other sensors such as strain, temperatures and other environmental effects."

9. Jerome Peter Lynch, Arvind Sundararajan, Kincho H Law, Anne S Kiremidjian, Ed Carryer "Embedding Damage Detection Algorithms in A Wireless Sensing Unit for Operational Power efficiency" Smart Mater, Struct. 13 (2004) 800-810

"This paper has discussed on illustrating the performance of the wireless sensing unit and the damage detection problem. A statistical pattern recognizes the damage detection with the help of AR and ARX time- series ideal models. The WSN is relevance of independent caring out of a task of the embedded damage detection algorithms."

10. Sukun Kim, ShamimPakzad, David Culler, James Demmel, Gregory Fenves, Steven Glaser, Martin Turon "Health Monitoring of Civil Infrastructures Using Wireless Sensor Networks" IPSN'07, April 25-27, 2007

"This paper discussed the wireless sensing unit where three major contributions are required. First, it required the certified obtain data of sufficient quality having real value to civil engineering researcher's for SHM. Second, the system was designed into no of nodes to allow all coverage of nodes to the real world. Third, this network was developed for the real world structure solving problems solved in difficult situations in real development. This structural monitoring with the help of WSN was carried out on golden gate bridge. In this survey the major difficulty it had to face was that heavy traffic of straw prevented mini route from estimating link quality correct. Therefore after some time performance transmission, the routing layer brakes down."

11. Tracy Kijewski-correa, Martin Haenggi, PanosAntsaklis, "Wireless Sensor Networks for Structural Health Monitoring: A Multi-Scale Approach" 17th Analysis and Computation Specialty Conference, St. Louis MO, May 18-21, 2006.

"In this paper it was described that nowadays number of Countries were facing a problem regarding to restoration of infrastructure likewise bridge, railway route, dam. It required time to time maintains, so it needed to monitoring system which gave the proper information to the structure so we needed structural health monitoring system for a multi scale approach."

2.2 COMPONANTS OF SHM

1) STRUCTURE

Concrete is one of the most durable building materials. It provides superior fire resistance compared with wooden construction and gains strength over time. Structures made of concrete can have a long service life. Concrete is used more than any other artificial material in the world

2) HARDWARE

Accelerometer board has sensors and signal processors (low-pass filter, analog to digital converter). A mote stores data from the accelerometer boards, and later sends the data through an antenna.

3) SENSORS

Uses of smart sensing technology there are various smart sensors available

Fiber Bragg grating (FBG), Sensors Fiber-optic sensors (FOS), Wireless sensors, MEMS, PZT sensors, BERKELEY-MOTE

Required Sensors Based on what to measure, different sensors available

[1]Strain Gauges, [2]Accelerometers, [3]Temperature Sensors and Monitoring, [4]Wind Measurement Sensors, [5]Seismic Sensors, [6]Load Cells

4 DATA ACQUISITION SYSTEMS

Data acquisition is the process of sampling signals that converts the resulting samples into digital numeric values

3. METHODOLOGY

1. Studying literature related to Structural health monitoring and smart sensors.

2. A thorough study of the working of wireless sensing network.

4. CONCLUDING REMARK

After reviewing whole literature it was seen that extensive Research has been carried out for finding out the health of the structure, analysis of data recorded by wireless sensors in wireless sensing network and methods to implement them on field. Although normally traditional method where use the, digital instruments give accurate results. Hence it is mandatory to use smart sensors to conduct structural health monitoring study.

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