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A Review of Wireless Sensor Network For Structural Monitoring

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Abstract: Remote (wireless) devices have unique capability with a wide range. They invaded in field of medical. And hence by utilizing existing technology we are able to monitor patient detail with periodic interval. In order to overcome this, there was need to change recent remote technology. Here in paper we have presented a review (chronological) on existing technology for WSN health monitoring. We discussed advantages and challenges involved in remote medical device and technology respectively. As well we have focused on WPAN (Wireless Personal Area Network) technology, ZigBee, Wi-Fi and WiMAX.

Keywords: *Wi-Fi, WiMax, Structural-Health monitoring Design issues, Wireless Sensor Networks, etc.*

I. INTRODUCTION

The structural-health monitoring mechanism (system) helps to detect damage in aircrafts, ships, bridges and buildings. So, design of these systems have well established and active area research. And further by measuring force excitation or ambient structural response these systems will infer location and existence of damage. The remote sensor network is considered to be a natural candidate for the systems of structural-health monitoring as they can be dense sensing and simplification of instrumental deployment. However, these damage assessment techniques are complex. And so, remote networked structural-health monitoring systems are away for several years.

Remote sensor network need to have instant role for structural-monitoring. The total advances in area of structural engineering is depending on many detailed data-sets availability which record response of structures (not similar) to- the ambient vibration (which caused by wind, passing vehicles and earthquakes) or the forced excitation (which delivered by large shakers). Recently, structural engineer use single-hop or remote system of data-acquisition to- acquire data-sets. The system is consisting of the devices which stores and collects vibration measurements from sensors with small number. And wiring and power constraints are imposed by particular systems. They can increase data-sets acquiring cost, that further imposed significant setup-delays. And hence limit the location and number of sensors.

The Wireless (Remote) Sensor Network is the remote network that is autonomous sensor combination to- monitor or to control environmental conditions.

Data which are sensed or collected are pollutants, images, vibration, electromagnetic field, light, sound, heat, motion, humidity, pressure and temperature etc. etc. The WSN popularity has increased because of MEMS (Micro- Electrical-Mechanical- Systems) technology. And hence concept of remote sensor network is depending upon simple equation: Sensing+ CPU+ Radio= Thousands of (many of) potential applications.

The WSN- suits requirement of applications with comparison to remote sensing system, as it's easily reconfigurable and deployable. Where it is in an inaccessible area and reduces system installation and general condition monitoring cost. Remote sensor network helps to establish low-cost sensing environment. The remote sensor network are suited for-structural-health monitoring for the bridges, tunnels, coal mines, wind turbines, and buildings. In order to monitor a structure, here we have measured a behavior (displacement & vibration) of the structure & structural health analyses -based on measured data (collected information).

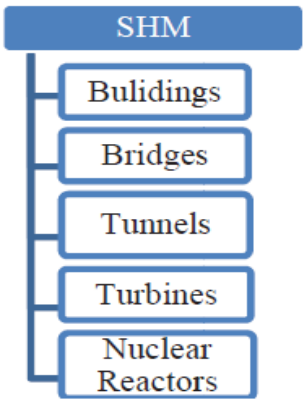

Figure 1: SHM for Numerous Applications**.**

Figure 1 Shows (Applications by utilizing SHM) A Large structures like bridges and building form a back-bone of society. They are important to the daily operation.

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II. REASONS FOR PERFORMING STRUCTURAL HEALTH MONITORING

SHM (Structural health monitoring) is a unconditional area amongst many-possible wireless-sensor networks applications. The SHM is a research area (emerging) and it is focused on infrastructure field namely on application and integration of communication technologies, signal-processing and sensors. These are the reasons for performing Structural-health monitoring.

A. Damage Detection

Detection of damage is one of common reason. The important aim is to continuous structure monitoring like without expensive and dangerous manual inspection and earthquakes.

B. Long Term Monitoring for Deterioration

Over a long period of time structure has detected. The main goal is to be assured with continued value of asset (under normal condition) and structural performance.

C. Determine "As Built" Structural Properties

The STMP (short term monitoring program) will used to determine actual dynamic properties structure. And this will used by designers in order to compare by designers with existing design value in order to verify assumptions of design. A forced and an ambient vibration will used to determine such properties at different motion levels.

III. RELATED WORK

In 2013 Nitya[et.al] presented a research paper. They proposed architecture of system for a smart health-care -based on the advanced WSN (Wireless Sensor Network). It targets assisted living-residents. Also it targets others who can benefit from the continuous, remote (wireless) health-monitoring. It is presenting best practice in WSN- design for the application of health care. Depending on some critical aspects such as security and power efficiency that guide development of application WSN- based.

Roozbeh Jafar[et.al] presented a research paper for health monitoring platform by utilizing WSNs- (wireless sensor networks). The platform is architecture named CustoMed which will reduce reconfiguration and customization time for the medical systems which use a re-configurable embedded-system. Architecture is system (network enabled) which supports numerous wearable-sensors & contains general computing capabilities (on board) for the execution of an individually-tailored network communication, event detection, and alerts with numerous services of medical informatics. As well customization of such type of systems with large-number of "med-nodes" is extreme fast. Particular research paper presented device architecture along an experimental analysis which evaluates system performance.

Apoorva Jindal[et.al] presented research paper in which a distributed computation problem over the WSNs- (Wireless Sensors Networks). While particular problem is applying to applications in order to keep a discussion-concrete. They have focused on a sensor-network, which used for the structural-health monitoring. In this paper to determine SVD- (singular value decomposition- a heaviest computation) is in order to extract mode-shapes (eigen-vectors) of the structure. The computation of SVD within network may result in lower delay and energy consumption.

In comparison with collection of vibration data (raw in nature) and central location SVD- performing within network may result significantly less delay and energy consumption.
They have shown which reduces to generalized- clustering problem, and to establish which it's NP-hard. Hence by relaxing delay-constraint, we have derived lower-bound. Also they have proposed an ILP (Integer Linear Program) in order to solve constrained-problem exactly. As well as, it is an approximate algorithm with the ratio of proven approximation. They have further presented distributed version- of an approximate-algorithm. They have presented in all two experimentation and simulation results in order to demonstrate an effectiveness of such algorithms.

Benny P.L. Lo{et.al] has presented a research paper for latest advances in WSNs- (wireless sensor networks) and an embedded-computing technology. It is miniaturized with devices of pervasive health-monitoring have become a practically feasible. In order to provide continuous analysis and monitoring of a physiological-parameters, they've recently proposed BSN (Body Sensor Networks) incorporates with context. And It is sensing for- increased specificity and sensitivity. In order to facilitate a development and research in multi-sensor data- fusion and BSN, the BSN- HD (hardware development) platform has presented. It is with compact design, flexible and low power. A BSN- node has provided the versatile environment for the remote (wireless) sensing development and research.

Krishna Sampigethaya[et.al] has presented a research paper for a potential-driver for the future E-enabled AHM (airplane health management). It is proactive and continuous. Particular paper is considered a secure and beneficial use of radio frequency and remote sensors or an AHM- identification system. They find out faults in E- enabled AHM. It may pose concerns with the potential solutions, present requirements, aircraft maintenance in order to mitigate threats and to discuss big challenges. They also presented some critical issues with the remote sensor potential use for real time aircraft control and operation.

Ming-Yuan Cheng[et.al] presented a paper for rare-catastrophic events such as earthquakes. It may cause a substantial-damage

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in very short time span. The information or Data on stress level further sustained by the buildings & other important infrastructure gained during an event may significantly help in an assessment of buildings' structural-integrity and post-disaster recovery. While sensors installation and data acquisition isn't difficult it is ensuring which there's a power in order to drive sensors at important moment of an event is challenge. EDEH (event-driven energy-harvesting) WSN (wireless sensor network) in that sensors are then powered by an energy-harvested from consequence of an event that is, shaking of buildings during earthquake. Harvested scarce amount of energy during occurrence time of short-event poses greatest challenges for MAC (medium access control)- design, that is focus of research. Further, when all the sensors are harvest-energy from event, they will become simultaneously active leading to a serious channel problem of contention. They'll examine an amount of harvestable-energy. It shows analytically which our MAC- protocol can provide a higher-packet delivery ratio than the conventional remote technology. That is IEEE-802.15.4.

Ying Lei[et.al] has presented a research paper for a WS (Wireless sensing) system. In recent years, it has proposed for the structural-heath monitoring. Wireless sensors are cost competitive. The real-merit lies in embedded-computational capabilities. Prototype of wireless sensing (academicals) is co-developed by University of Michigan and Stanford University at Stanford University which characterized by University of Michigan with low-power consumption and powerful computational core. The information or Data on stress level further sustained by the buildings & other important infrastructure gained during an event may significantly help in an assessment of buildings' structural-integrity and post-disaster recovery. While sensors installation and data acquisition isn't difficult it is ensuring which there's a power in order to drive sensors at important moment of an event is challenge.

Ying Lei[et.al] has proposed two algorithms (embedded engineering), such as FFT and PPA (peak-picking algorithm). They are implemented in wireless- sensing and then validated by the laboratory and field-experimental studies. The remote (wireless) sensors are then applied to problem of identifying structural-modal parameters and the forces in bridge-steel cables. The results of identification have derived from wireless (remote) sensor by utilizing a computing-core are then compared with obtained by the engineering analysis (off-line) of measured data time-history. Such type of comparison are serves to a validate effectiveness of computational core (powerful) of an intelligent remote (wireless) sensor. It's shown that a self-interrogation of a data measurement by utilizing two algorithms (embedded) greatly minimize data amount transmitted by WSN (wireless sensing network). So, remote (wireless) sensor offers network solutions scalable which are power- efficient.

Ning Xu[et.al] has presented a research paper for an analysis and collection of different structural-response to a forced excitation. Its crucial application of embedded sensing networked with a significant-commercial potential. And sensor networks first generation for a structural-monitoring are made to be a data-acquisition systems which collect a data at single-node for a centralized processing. In particular paper, we have discussed evaluation and design of WSN- (wireless sensor network) system (is called Wisden) for the structural data-acquisition. Wisden- in- corporate- two novel technique (mechanism), with reliable data-transport by utilizing hybrid of hop- by- hop and end- to- end recovery, and LODTS (low-overhead data time-stamping) that doesn't require a synchronization of global clock. They studied applicability of the WCT (wavelet -based compression techniques) in order to overcome bandwidth limitations which imposed by the wireless radios (low- power). We have described an implementation of such mechanisms on Mica- 2 -motes & to evaluate implementation performance.

IV. CONCLUSION

The remote (wireless) technology is enhancing steadily and the many of different applications are already implemented successfully in different scenarios of application. And hence, structural-health monitoring is an area along numerous possible applications of WSNs. In this particular paper, we have described different concepts and techniques that are utilizing for structural analysis. Also, we have given a review on some of papers, in that they described techniques used for the structural analysis/monitoring.

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