STRUCTURAL HEALTH MONITORING

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ABSTRACT

The early-stage damage detection in offshore structures requires continuous structural health monitoring and for the large area the position of sensors will also plays an important role in the efficient damage detection. Determining the dynamic behaviour of offshore structures requires dense deployment of sensors. The wired Structural Health Monitoring (SHM) systems are highly expensive and always needs larger installation space to deploy. Wireless sensor networks can enhance the SHM system by deployment of scalable sensor network, which consumes lesser space. This paper presents the results of wireless sensor network based Structural Health Monitoring method applied to a scaled experimental model of offshore structure that underwent wave loading. This method determines the serviceability of the offshore structure which is subjected to various environment loads. Wired and wireless sensors were installed in the model and the response of the scaled BLSRP model under wave loading was recorded. The wireless system discussed in this study is the Raspberry pi board with Arm V6 processor which is programmed to transmit the data acquired by the sensor to the server using Wi-Fi adapter, the data is then hosted in the webpage. The data acquired from the wireless and wired SHM system were compared and the design of the wireless system is verified.

Keyword : *condition assessment, damage detection, structural health monitoring, structural response, wireless sensor network*

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1. INTRODUCTION

Structural Health Monitoring (SHM) is referred as the process of implementing damage detection and characterization strategy for engineering structures. The changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity which adversely affect the systems performance, is defined as damage. In SHM process we observe system using periodically sampled dynamic response measurements from an array of sensors. Then the extraction of damage, damage-sensitive features from these measurements are carried out. To determine the current state of system health, the statistical analysis of the features is performed. There will be inevitable aging and degradation in the structure resulting from operational environment. Long term SHM is defined as output of this process that is periodically updated regarding the ability of the structure to perform its intended function. Regarding the integrity of the structure, SHM is used for rapid condition screening and to provide near real time reliable information, for example in case of extreme events such as earthquakes or blast loading [1]. To estimate the state of structure health, SHM detects the changes in structure that effects its performance. Time- scale of change and severity of change are two major factors. How quickly the change occurs is time- scale of change, and degree of change is severity of change. SHM has two major categories: disaster response (earthquake, explosion, etc.) and continuous health monitoring (ambient vibration, etc.). SHM has two approaches: direct damage detection (visual inspection, and X- ray , etc) and indirect damage detection (change in structural properties/behaviour). A typical SHM system, in general During tunneling or mining, monitoring of heritage and other structures is a major concern.

1.1 Goal of the project

The primary Goal of this project is to create a system which can identify structural damages and use them to convey information or device control by using sensors. In this project we will be implementing structural damage detection for security from natural and global crises. Our project focuses on different types of sensors that can be used to detect structural health monitoring and can also recognize the activity in indoor scenario. This project will demonstrate a case of Buildings ,bridges where these algorithms can be used to achieve effective control .However possibilities of using these algorithms for various more applications are much more provided the necessary additional hardware. In can be used in various areas, for example in industries, factories ,buildings ,bridges, dams and other places.

2. Block Diagram

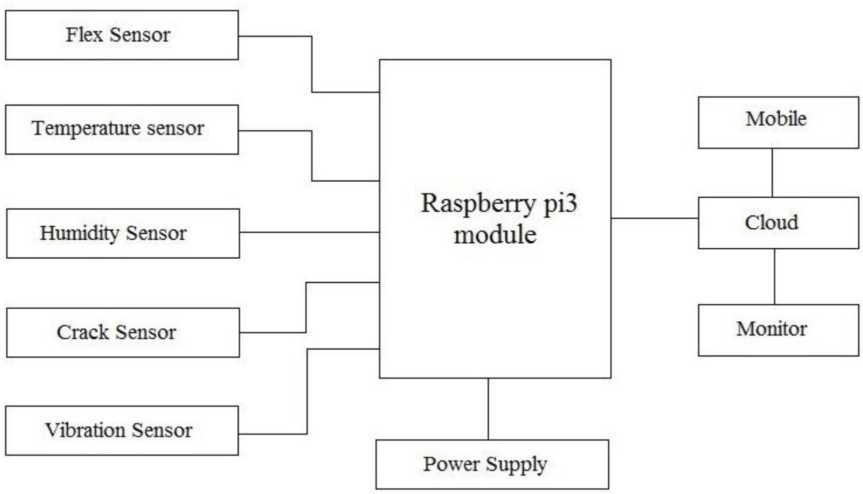

Fig -1: Block Diagram

2.1 Flex Sensor

Flex Sensor 2.2" RoHS Compliant Description: A simple ex sensor 2.2" in length. As the sensor is exceed, the resistance across the sensor increases. The resistance of the ex sensor changes when the metal pads are on the outside of the bend (text on inside of bend). Connector is 0.1" spaced and bread board friendly. Note: Please refrain from exing or straining this sensor at the base. The usable range of the sensor can be exed without a problem, but care should be taken to minimize exing outside of the usable range. For best results, securely mount the base and bottom portion and only allow the actual ex sensor to ex.

2.2 Temperature and Humidity Sensor

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds.

2.3 Vibration Sensor

The proposed module of earth quake prediction method is shown in fig 2. This module is mainly proposed to predict the earth quake before known by the human knowledge. It can measure the start of an earth quake. So it is need to identify the vibration which is induced by an earth quake. The main cause of earth quake induced damage is ground vibration. To measure this vibration, accelerometer and strain sensor is used. Accelerometers are placed in every floor of the building and strain sensors are mounted in base of the building.

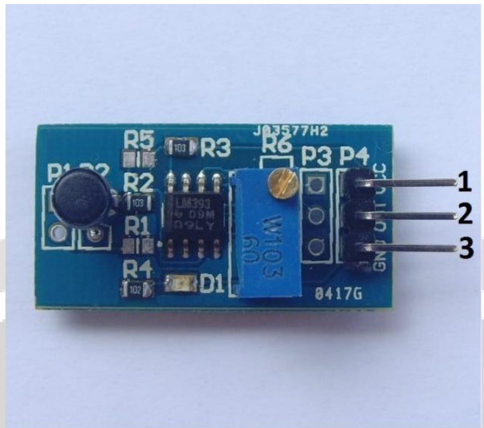

Fig -2: Vibration sensor

3. Raspberry pi3

The raspberry pi3 model is the third generation raspberry pi. This powerful credit card sized single board computer can be used for many applications. Whilst maintaining the popular board format the raspberry pi3 brings you a more powerful processor 10x faster than the first generation raspberry pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs. The raspberry pi3 has 1GB RAM so you can now run bigger and more powerful applications. It has 40 pin extended GPIO to enhance your real world projects.

Fig -3: Raspberry pi3

4. CONCLUSIONS

This book presents the state of the art of structural health monitoring (SHM): history, applications it can be concluded that long-term SHM of civil structures is still in its infancy. This can be clearly seen from the rarity of successful real world applications Changes in natural frequencies due to changes in environmental conditions (temperature , humidity, wind, additional dead loads ,etc.) may mask the effect of small structural damage and consequently may lead to inaccurate results of damage identification .In continuous monitoring of a structure, huge amount of data may be recorded every second and the data acquisition, transmission and archiving system must be designed to accommodate that.

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