DETECTION AND MONITORING OF BRIDGE HEALTH STATUS USING WSN AND ARDUINO

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ABSTRACT

This paper focuses on preemption system for infrastructure like bridges. The stability of the structure is directly related to the structural strength. The structural analysis of such a bridge can be analyzed using vibration pattern and comprehensive study. MEMS based accelerometer is used to analyze the vibration patterns. The vibration signal measured by the node is communicated over WSN. Three levels of vibrations are detected. If the vibrations are in Safe level no action is taken. If the vibrations are in warning level a signal is sent to the monitoring person through RF. If the vibrations are in critical level then the bridge is closed for traffic. The inspection of building structures especially bridge structures is currently made by visual inspection. Structural health monitoring is a field that relies on different methodologies to develop procedures that characterize the dynamic properties of physical structures to identify possible deteriorations of their behaviors. The few non visual methodologies make use of wired sensor networks, which are relatively expensive, vulnerable to damage, and time consuming to install. Systems based on wireless sensor networks should be both cost efficient and easy to install, scalable and adaptive to different type of structures. Acoustic emission techniques are an additional monitoring method to investigate the status of a bridge of its components. Micro-Electro-Mechanical-Systems (MEMS) and hybrid sensors form the heart of network nodes.

Keywords: Transmitter Section, Receiver Section, MEMS, ARDUINO

I. INTRODUCTION

Existing monitoring systems use traditional wired sensors technologies and several other devices that are time consuming to install and relatively expensive as compare to value of the structure. Typically they are using a large number of sensors (i.e. more than ten) which are connected through long cables and will therefore be installed only on few structures. A wireless monitoring system with MEMS sensors could reduce cost significantly. MEMS are small integrated devices or systems combining electrical and mechanical components that could be produced for 50 euro each.

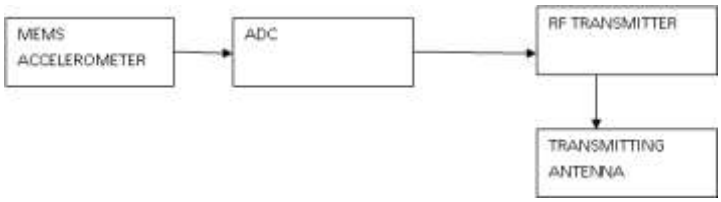
II. EXISTING SYSTEM

Now days the structural stability of the bridge is monitored by manually and also the traffic control of heavy duty vehicles over the bridge are also done manually. Rather the traditional structure monitoring system can be done using wired technology. Manual control of bridge leads to wastage of manpower and will not be effective during the time of calamities. Also wired system is too expensive, power hungry and difficult to implement and maintain. In this method, the same pattern of the bridge has been designed with the same composition of material as that the one used in the bridge. And by performing several tests like destructive testing on the bridge

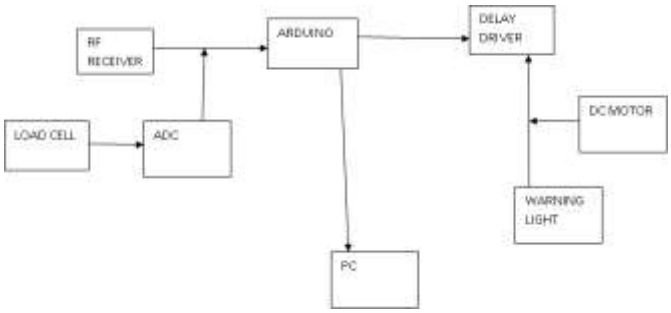
model, the strength and the life time of the bridge has been calculated. Ultrasonic C-scan imaging is done by sending out ultrasonic waves into a material. The reflections of these waves are read by a transducer and sent to a computer program. This program processes the data and creates a two-dimensional map of the bridge components.

III. PROPOSED WORK

3.1 Transmitter Section



3.2 Receiver Section



A practical solution to overcome this problem is by using wireless sensor network with MEMS accelerometer which is the integration of mechanical elements, sensors and etc., It is used to measure the vibration from dynamic load and also parameters such as strain, acceleration and angular displacement with strain. The wireless technology here we are using will be RF through which constant monitoring through pc is made easy and effective.

MEMS technologies are well suited to improve the performance, size, and cost of sensing systems. MEMS can be used in both monitoring and testing of transportation infrastructure systems. Several applications of MEMS in bridge engineering field are reported. Differential settlement between bridges and pavements causes bumps or uneven joints at the bridge ends. When vehicles, especially heavy trucks, approach and leave bridges, the bumps cause large impact loads to the bridge and pavements.

The pre stress forces can also be adjusted to deal with cracking issues in both positive and negative moment zones. With the combined application of the smart bearings and smart stands, the bridge can adjust its internal force distribution and mobilized each element to adopt itself to different environmental loads. Wireless monitoring system with MEMS sensors could reduce installation and maintenance cost dramatically.

The devices would performs sensing and signal interpretation, and would report their findings remotely. The concept is to build an ultrasonic flaw detection system on a chip using a MEMS device as a receiver array with, a mm scale piezoelectric element as a ultrasonic source. The system is intended to scavenge power from structural strains and to report results with fly-by polling using radio frequency communications. The concept requires the development of phased array signal processing, and signature analysis signal processing, to perform flaw detection (flaw imaging) from the fixed location of a resident transducer.

The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labeled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches. Micro-electromechanical systems (MEMS) are Freescale's enabling technology for acceleration and pressure sensors. MEMS-based sensor products provide an interface that can sense, process and/or control the surrounding environment.

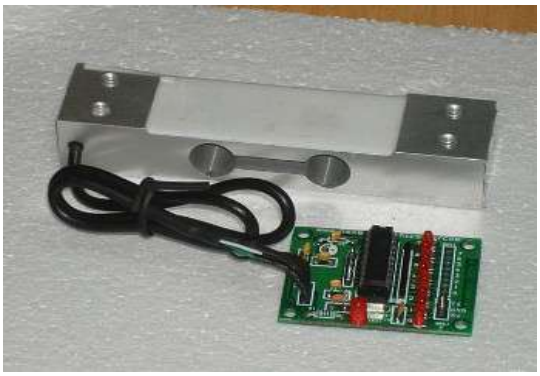


Figure 1: Load Cell

In addition, the environment in which the MEMS devices has to operate and the possible effect of the environment on the performance of the MEMS device has to be assessed. MEMS device against damage from installation or construction procedures as well as from contact with materials is paramount. Furthermore, there is the need to carry out extensive experimentation to ascertain the reliability and consistency over time of the information obtained from the embedded devices. The impacts of the infrastructure system dynamics on the embedded device have to be evaluated and vice versa.

IV. CONCLUSION

In this paper, an attempt is made to provide a general overview of application of MEMS and nano technologies for civil engineering and transportation. The synthesis provides information on current and potential applications, especially in bridge structures. Several case studies in the literatures demonstrate that MEMS technology has the potential to offer significant benefits to the civil engineering and transportation field. Finally the challenges in the application of MEMS technology into transportation infrastructure systems are summarized.

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