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BRIDGE COLLAPSE AND CRACK DETECTION

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ABSTRACT

The proposed system are implemented using a real time wireless network for bridge monitoring system is of lossless data transmission over several minutes of continuous. Crack inspection is an important task in the maintenance of bridge and it is closely related to structural health of the bridge. Currently it is done through a very manual procedure, an experienced human inspector monitors the whole bridge visually and try to detect cracks on the bridge and marks the location of the crack. Proposed research focuses on implementing a system having a robot, equipped with a camera to collect the images of surface and a global map is created locating position of the cracks. The advancement in wireless technology has provided motives to authors to develop the wireless network base bridge health monitoring system.

Keywords: PIC Microcontroller, Vibration Sensor (ADXL335)MAX232 IC, GSM model, LCD, Relay Driver.

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I. INTRODUCTION

The surface of the bridge deck is affected by different environmental condition as well of direct vehicles so the bridge deck surface is the first component to be inspected and maintained. Inspecting and correcting minor deficiencies like cracks while the structure still in good condition will ensure the structural reliability and small repairs, activities will be performed to keep the bridge in good condition. Crack detection during experimental testing may require researchers to mark crack on the specimens ,whereas researchers can take photographs of the specimens from a safe distance and have the reconstructed model digital crack detection. Bridges play a significant role in the economic development for the conveniences to the traffic and transportation. The frequently collapsed accidents of the bridges endanger social well-being and stabilization. In the view of importance of bridge security,bridge health monitoring,especially in the field of crack monitoring, has made a rapid progressand become a hot topic in the current research. Safety is the major concern in post disaster reconnaissance; after an event such as an earthquake or tsunami, structures have to be examined to determine the extent of damage. By utilizing image based reconstruction, assessments can be made without placing the inspector or engineer in dangerous situations[1].

Current Bridge Analysis Methods:

Current bridge risk methods and tools developed are:
Current bridge risk analysis methods and tools developed are: Visual Bridge Inspections(VSI), Structural Health Monitoring (SHM) sensors, computerized simulations, and computerized knowledge-based systems.Many of the visual inspections, computerized simulations, and computerized knowledge-based systems discussed only assess the condition of individual components instead of individual components and the whole bridge system[4]. FTA assesses the condition of individual components and identifies the relationships between the different components to assess the failure risk of the whole bridge system. With exception to some computerized simulations, all the methods mentioned are not known to utilized or produce the visual model of bridge of system.FTA produces a fault-tree model which individually shows the individual bridge components with the chain of events leading to their failure and ultimately bridge failure, as well as, the relationships between the bridge components[2].

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Block Diagram :

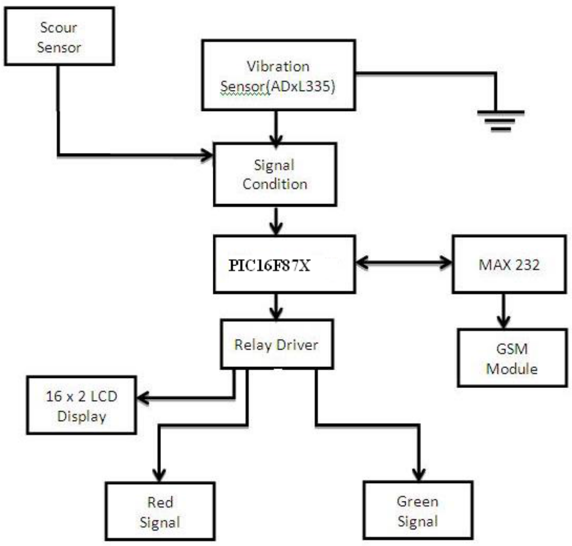

Fig 1. Block Diagram.

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.Scour occurs when water flows at fast rates around bridge piers or past bridge abutments and can produce instability in the bridge. Generally, scour takes place during times of flooding when fast moving water accelerates near bridge piers due to contraction of the channel, and the current carries away sediment near the pier foundation (Lu 2008).Permanent scour detection devices must be able to withstand the large current and debris associated with flooding. Many methods for measuring scour are mentioned by Lu. One system is bridge mounted sonar, which provides a continuous and accurate record of scour depth. The crack detection algorithm was performed on specimen T17 after failure when the crack widths are at their largest, thus the most visible. It was the only model with clear enough cracks to perform the CDA on due to lighting issues which will be explained later. Based on the figures below, it can be seen without running the CDA that the mesh generation produced the same cracks. The arrows in figure show which cracks from the photo corresponds with the cracks from the mesh generation. Using the CDA, the cracks in the mesh will be colored so that they are easier to identify and compare.

Vibration Sensor (ADXL 335):
The ADXL335 is a small, thin, low power, complete 3-axis accel-erometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

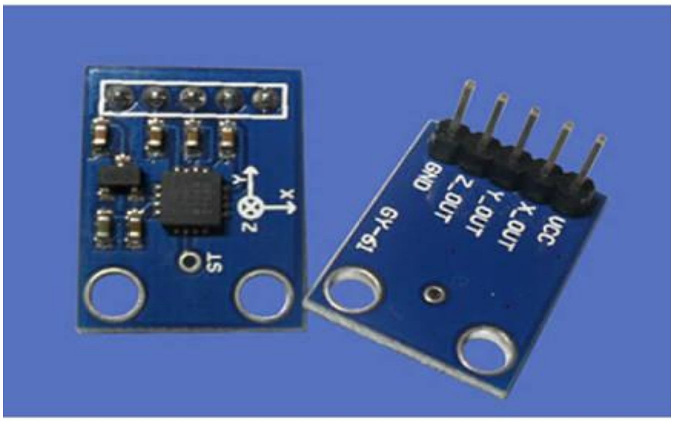

Fig 2.Vibration Sensor.

Scour Sensor:
Scour occurs when water flows at fast rates around bridge piers or past bridge abutments and can produce instability in the bridge. Generally, scour takes place during times of flooding when fast moving water accelerates near bridge piers due to contraction of the channel, and the current carries away sediment near the pier foundation (Lu 2008). Permanent scour detection devices must be able to withstand the large current and debris associated with flooding. Many methods for measuring scour are mentioned by Lu. One system is bridge mounted sonar, which provides a continuous and accurate record of scour depth. Another is Acoustic Doppler current profiling, which is portable and measures scour depth. This system is not well suited for flows with high turbidity or rapid flow rates.
A third method is the application of GPR (ground penetrating radar), which is also not well suited for flows with high turbidity or rapid flow rates. A fourth method involves the use of Fiber-Bragg grating. Sensors are placed along a vertical fiber optic strand. Sensors detect changes in strain, especially large changes, which will correspond to initial sub-surface sensors becoming exposed (Lin 2005). Another method utilizes numbered bricks. The numbered bricks are placed into an excavated river bed. Then, as sediment is washed away, the numberedbricks float to the surface or are washed away. The scour depth can be found by checking which bricks remain. The sixth method is the sliding magnetic collar (SMC), which uses a collar that slides down to the river bed and measures depth.

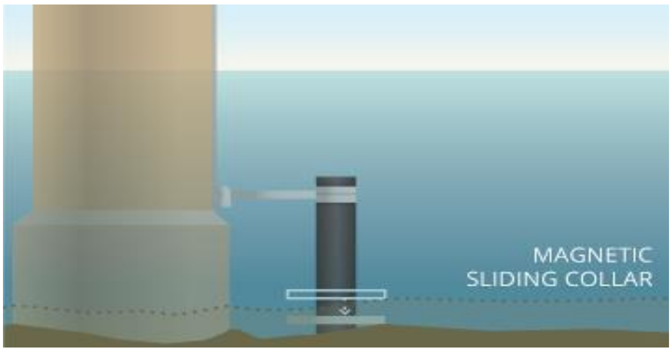

Fig 3.Magnetic Sliding Collar.

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GSM:

Fig 4.GSM model.

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service). GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. GSM services are also transmitted via 850MHz spectrum in Australia, Canada and many Latin American countries. The use of harmonized spectrum across most of the globe, combined with GSM's international roaming capability, allows travelers to access the same mobile services at home and abroad.GSM enables individuals to be reached via the same mobile number in up to 219 countries. Terrestrial GSM networks now cover more than 90% of the world's population. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

The PIC 16F677A board and PLCC modem 1187

Component	Specification
PIC 16F87XX	High performance RISC CPU.
Communication interface	ADXL335(Vibration Sensor)

Motivation:

State bridge engineers are responsible for many aspects of bridge networks. Due to the large number of systems that are available, it is impossible for an engineer to sort through all these systems without knowledge of: (a) the capabilities of a particular system and (b) which companies offer particular systems and services. This report briefly explains the concepts, advantages, and disadvantages behind commercially available health monitoring systems. It simplifies the task for system selection, from the large number of commercially available systems that exist, using a computer program to find the system that best fits the needs of a specific bridge.

Fig 5. Bridge Collapsed due to heavy rain.

Scope :

State bridge engineers are responsible for many aspects of bridge networks. Due to the large number of systems that are available, it is impossible for an engineer to sort through all these systems without knowledge of: (a) the capabilities of a particular system and (b) which companies offer particular systems and services. This report briefly explains the concepts, advantages, and disadvantages behind commercially available health monitoring systems. It simplifies the task for system selection, from the large number of commercially available systems that exist, using a computer program to find the system that best fits the needs of a specific bridge.

(Top Row) Prior work uses images that are high contrast and low cluttersimilar to the images shown. Simple methods such as edge detection and thresholding for binarization can be applied for these images. (Bottom Row) Realbridge deck images from our work shows significantly more distractors and posea more challenging crack detection problem[6].

Fig 6. Cracks Detection.

Wireless monitoring systems have many advantages over

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traditional wired systems. These advantages include low cost
of the sensors, ease of installation and maintenance, andability to be applied to existing highway infrastructure.However, wireless systems typically rely on battery energysources for operation. Given the potential scale of sensorinstallations on highway bridges, the cost of periodic battery
replacements would constitute a major expense that can be
prohibitively high. Energy harvesting could present a potential
solution and enable permanent unattended sensor installations.
Energy harvesting gained significant interest in recent years due to the widespread availability of inexpensive and lowpowerRF chipsets and microcontrollers that could form thecore of a self-powered sensor system.

Objectives :
Our research focuses on using bridge vibrations created bypassing traffic to power a sensor permanently deployed on a
highway bridge. Vibration is one of the most accessibleambient energies; vibration levels are substantial at mostlocations along the span and sensors can be placed in hard-toreachplaces or even embedded into the structure. Energyharvesting of vibration energy has been utilized in a variety of
applications and studied for feasibility of use on bridge structures.

1) Selection of PIC 16F877A microcontroller:

The PIC microcontrollers is one of the most renowned microcontrollers in the industry. This controller is very convent to use the coding or programming of this controller is also easier One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output.PIC16F877A also have many applications in digital electronics circuit.

2) PCB designing:

One of the key concept in electronics is the printed circuit board or PCB .It's so fundamental that people often forget to explain what a PCB is this tutorial will breakdown what makes up PCB and some of the common terms used in the PCB world. In our project we are suppose to use glass epoxy as type of PCB for designing circuit layout.

3)Selection of Sensors:

Sensors are used to perform many application. In our system Eye Blink Sensor, Alcohol Sensor, Accelerometer & Pressure Sensor, Temperature Sensor, Obstacle Detector Sensor.

4) Interfacing:

In interfacing, relays and modem are connected to the controllers. The relays are connected to the ports of PIC 16F877A microcontroller. The 16*2 LCD display or LED's are also interfaced with PIC 16F877A to indicate the output.

5)Analysis on Software:

In our project, we are using MPLAB software for programming of PIC microcontroller. This MPLAB software is specially designed for programming of PIC. This software is very convent to use.

Literature Survey :
Prof. Ms. B. Hombal developed by Bridge Condition Monitoring System using micro-controller.In this paper they describe as per with the help of wireless technology many problems due to data cables and expensive optical cable are now minimized and eliminated.GSM is proved to be excellent solution for data communication. Edward Sazonovdeveloped by Self Powered Sensors For Monitoring Of Highway Bridges.In this paper he describe Structural Health Monitoring(SHM). We see the recent news of bridge collapse due to some weather conditions and massive traffic.We see the bridge collapse in Mahad(Maharashtra)due to sand mining, Shimla(Himachal Pradesh)due to massive traffic and Kolkata(West Bengal).

A multi-functional wireless bridge monitoring system has been developed for concurrent deployment of accelerometers, and scour sensor. The hybrid sensing capabilities of these nodes satisfies the immediate requirements for economic, low maintenance load ratings and short-term dynamic measurements in addition to providing the hardware functionality for development of a long-term continuous bridge monitoring system.

Result :
An added feature to automated crack detection is the ability toperform digital crack measurements with increased safety. Crack detection during experimentaltesting may require researchers to mark cracks on the specimens, whereas researchers cantake photographs of the specimens from a safe distance and have the reconstructed modeldigital crack detection. Automated crack detection along with digital crack measurements willincrease the quantity of cracks observed and measured. Increased quantity could reduce costof field inspections by reducing inspection time.

Conclusion :
This paper presents a prototype of a novel self-powered
wireless system for applications of structural healthmonitoring of bridges. Conducted theoroticalanalysis facilitates selection of a natural frequency with thehighest energy content and quick estimation of parameters foran electromagnetic harvester. Field tests sensor show the feasibility of the proposed approach forapplications of structural health monitoring.

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