iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4059

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Bridge Health Monitoring System

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Abstract: This project system uses wireless network on real time basis for bridge health monitoring purpose. It can transmit the data continuously for several minutes. In that detection of 'vibrations', 'crack' & 'sand level at the base' occurred . Currently Bridge Inspection is done by manually each time and also takes lots of time to find & detect any fault. It requires specialized or experienced man for inspection of bridge. They have to monitor the condition of bridge by visual inspection thoroughly.Conventionally, a technician is responsible to detect and measure cracks in the field.Then implementi.ng the correction process for any crack, sand level of the bridge is difficult. Also the more attention required at the time of rainy season. In order to test the proposed methodology in this paper, several experiments were conducted in a controlled environment and their results were compared with other methods. In addition, experiments with real structures were conducted. Our proposed project research is focussing of implementation of system having sensors, GSM technique which informs bridge condition to nearby officers. This advance technique using gsm is very helpful to human And nation also.
Keywords: PIC Microcontroller, MAX 232 IC, GSM model, Vibration Sensor(ADXL335), LCD.

I. INTRODUCTION

The most common reason for bridge collapse are Crack the element of bridge & level of sand at the base of bridge Monitoring the health condition of the bridge is an increasing concern for the benefit of all living beings. Our proposed system uses the advanced GSM technique for saving the life of living beings.

The main challenge is to ensure that the health condition of the civil infrastructure bridge is able to stand with the cumulative weight of all the vehicles which travel on the bridge and the capacity to bare the speed of flow of water. This system comprises of sensor technology and GSM technology.

Our proposed system have many different types of sensors. The data or information of bridge health condition is collected by sensors. According to that data is processed through the programmed microcontroller. If any fault arise in the heath of bridge at the time of inspection or detection.

It sends the data or informs the data related to nearby RTOs, police Stations & Hospitals. The Result of processed data is displayed on the LCD display, which is placed on the both side of bridge for understanding of people. Also gives an indication of the Red & Green signals for transportation of vehicles on the bridge.

The role of bridge is very important in the nation's economic & infrastructure development for the conveniences to the people , transportation and for connecting & communicating two areas.

For the security of the Bridge point of view purpose to monitor the health condition of bridge, especially monitoring the sand level at the bottom of bridge piller, any crack detection in the bridge is the main topic in any research. Safety is an major issue after the big incident happened such as Earthquake, Flood, Tsunami for examining purpose to determine the damages in what extent. 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.

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A. Block Diagram

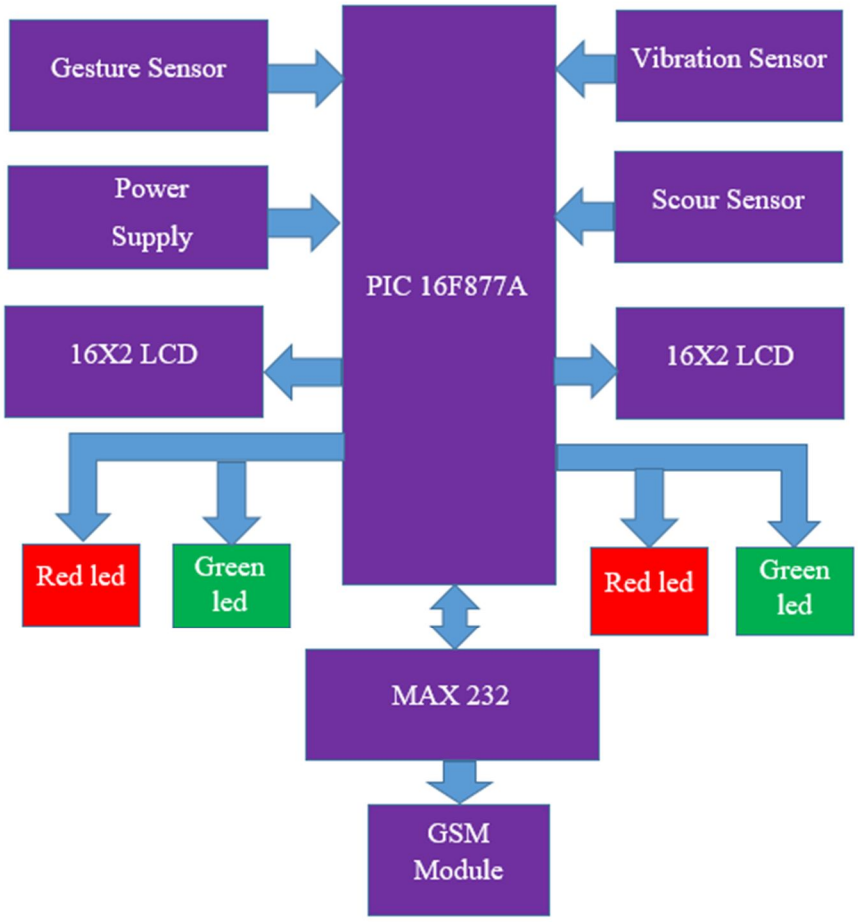

Fig 1. Block Diagram.

B. Vibration Sensor (ADXL 335)

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.



Fig 2. Vibration Sensor.

C. 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

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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 numbered bricks 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.

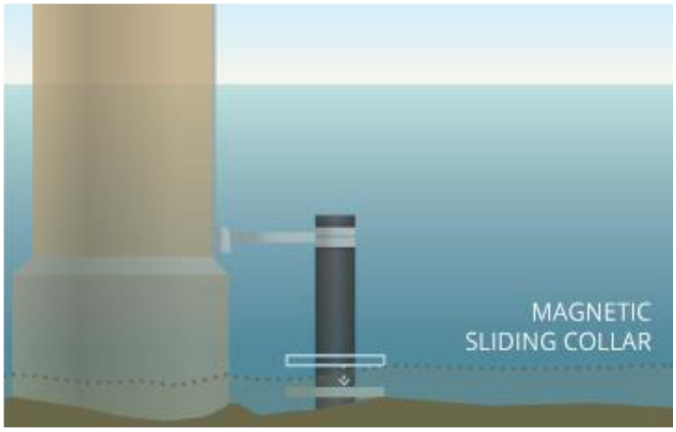

Fig 3. Magnetic Sliding Collar.

D. GSM GPRS SIM900A Modem



Fig 4. GSM model.

GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The on board Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet through simple AT commands.

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E. PIC16F877A

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.

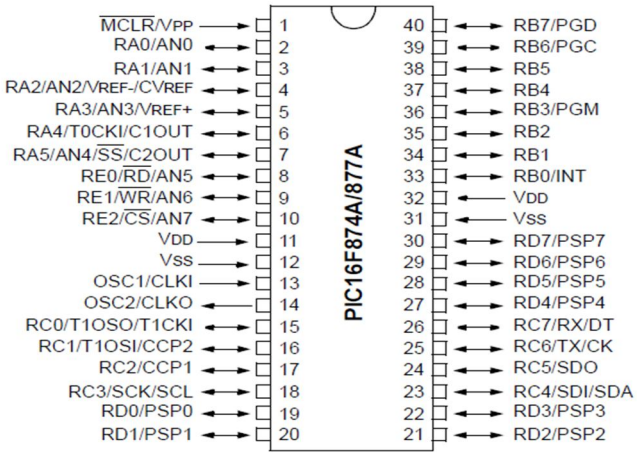

Fig 5. Pin Diagram

F. Motivation

On 4th Aug 2016, an old bridge connecting to the Mumbai-Goa Highway Collapsed. The bridge collapsed around Mid Night. In this accident 29 people were died and 10 Vehicles fall down into the river.The searching operation of finding vehicle and dead bodies carried about 15 days. If this proposed system invented earlier to this accident, we would have been able to save those lives.



Fig 6. Bridge Collapsed due to heavy rain.

G. Objectives

Our research focuses on using bridge vibrations created by passing traffic to power a sensor permanently deployed on a highway bridge. Vibration is one of the most accessible ambient energies; vibration levels are substantial at most locations along the span and sensors can be placed in hard-to reach places or even embedded into the structure. Energy harvesting 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.

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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 and modem are connected to the controllers. The modem 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.

II. 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.

A. Result

An added feature to automated crack detection is the ability to perform digital crack measurements with increased safety. Crack detection during experimental testing may require researchers to mark cracks on the specimens, whereas researchers can take photographs of the specimens from a safe distance and have the reconstructed model digital crack detection. Automated crack detection along with digital crack measurements will increase the quantity of cracks observed and measured. Increased quantity could reduce cost of field inspections by reducing inspection time.

III.CONCLUSIONS

This paper presents a prototype of a novel self-powered wireless system for applications of structural health monitoring of bridges. Conducted theorotical analysis facilitates selection of a natural frequency with the highest energy content and quick estimation of parameters for an electromagnetic harvester. Field tests sensor show the feasibility of the proposed approach for applications of structural health monitoring.

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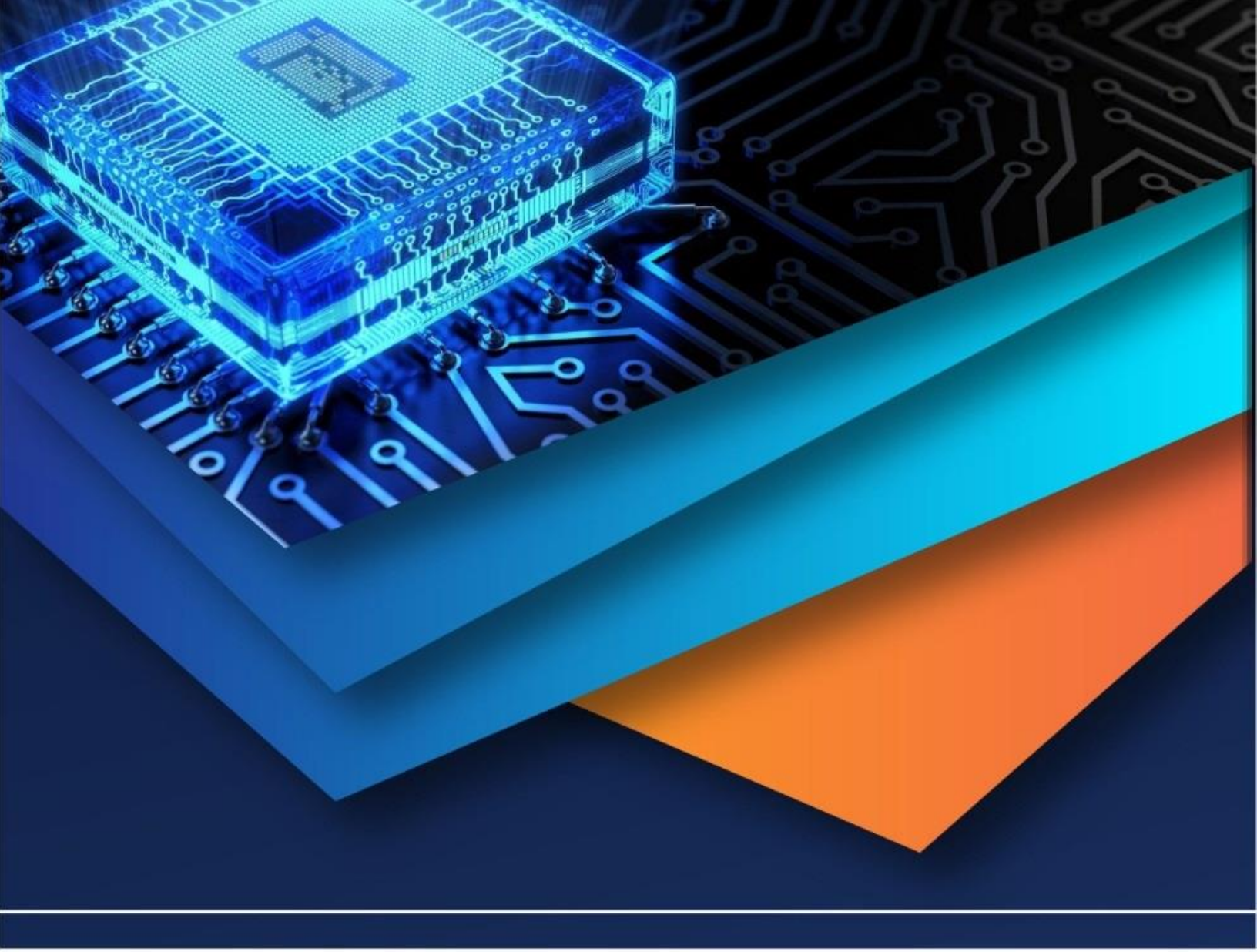

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