A LOW COST MULTI-SENSOR SYSTEM FOR INVESTIGATING THE STRUCTURAL RESPONSE OF BRIDGE

College : S J C Institute of Technology
Branch : Department of Electronics and Communication Engineering
Guide(s) : Dr. Nagendra Kumar M
Student(S) : Ms. Brunda N
  Ms. Dhanalakshmi Y S
  Ms. Hamsa V
  Mr. Jalajerla Pravalika

Keywords: IoT, Wi-Fi, Cloud, Private Channel, LCD.

Introduction:

The proposed system analyses the performance of IoT based bridge health monitoring system to determine the change in structures, overall weight of the vehicles on the bridge, vibration and deformation, also cracks at critical places. As per the report, as many as 1,217 people died and more than 5,000 people have been injured in incidents of bridge collapses throughout the country in past 15 years. The key benefit of using IoT is that it has a higher degree of output quality, and the introduction of new technology would make the system smarter and more receptive. Using IoT network, we can reduce the risk of human errors and harm to the bridge caused by human and natural disasters can be minimized. The surveillance of bridge is complex task, however employing IoT and cloud would make the system simple as stated further.

Objectives:

(a) The objective of this project is to focus on the deformation of the structures using multi sensors to know the structural response of any structure.

(b) This system helps to detect the cracks at exact location in the structure.

Methodology:

First initialize all the required sensors and libraries. Read all the sensors data of the bridge. If any one of the parameters has discrepancy immediately buzzer beeps. Otherwise the parameters data are live monitored on app with the use of IOT and displayed on LCD as well.

- Load upon the bridge is calculated using a load cell. This module uses 24 high precision A/D converter. This chip is designed for high-precision electronic scale and design, has two analog input channels. This sensor helps in identifying weight of the bridge.
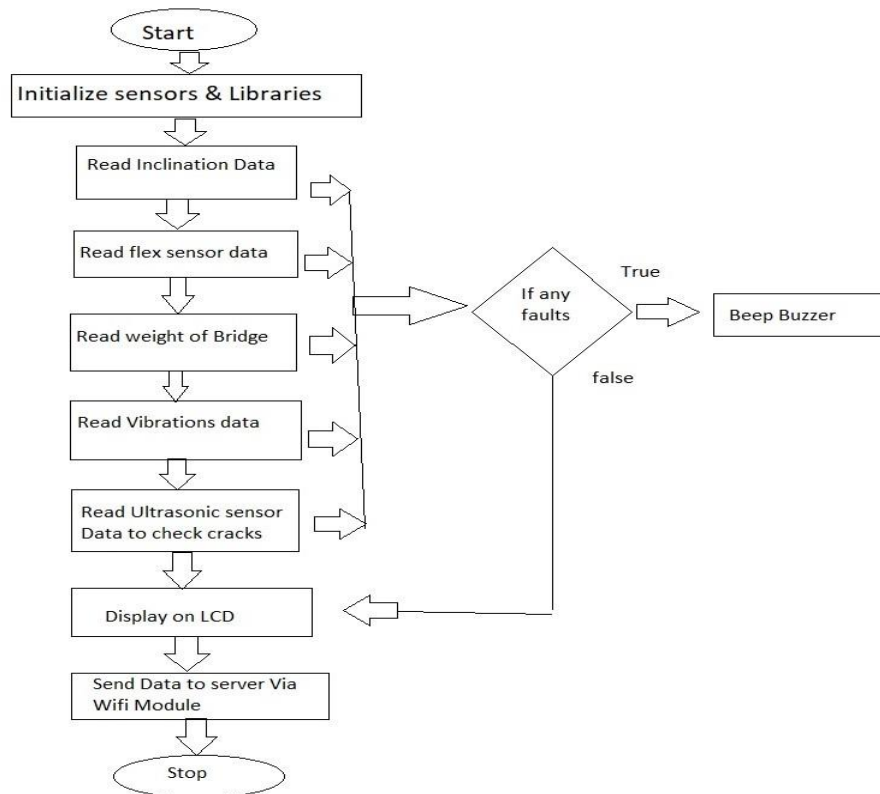
- Flex sensors are used in detection of structural bends. flex sensor is a kind of sensor which is used to measure the amount of defection otherwise bending. If any bends are found then it can be easily identified. Dynamic vibrations are sensed using vibration sensor.
- Ultrasonic sensor to track any cracks. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.
- Accelerometer's sensor for any tilt. This sensor helps in identifying is there is any tilt or structural change.

RESULTS AND CONCLUSIONS:

A multifunctional IoT bridge monitoring system has been developed for concurrent deployment of sensors. The sensing capabilities of this nodes satisfies the immediate requirements for economic, low maintenance load ratings and short term dynamic measurement in addition to provide hardware functionalities of long-term continuous bridge monitoring system.

This system can help in monitoring the bridge in an efficient, cost effective and reliable manner. The immediacy, low cost, low energy and compact size add up to a revolution in bridge safety monitoring. The results are displayed on LCD.
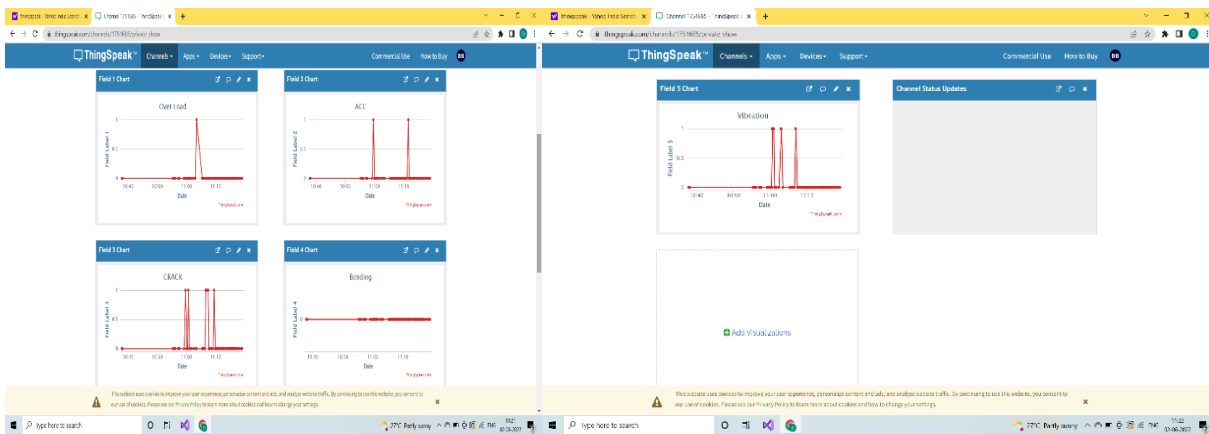

Figure shows the graph of the various sensor values that will be plotted continuously and the numerical data of the current bridge condition will be shown through private channels on the Thing Speak website or through the Thing Speak mobile application.

The project mainly focus upon developing an IoT Based Bridge Health Monitoring System. The system was designed with the help of various type of sensors(Ultra Sonic, Vibration, Flex,weight and Accelerometer) and Arduino mega micro-controller and IoT module. There are many objectives focusing towards development of Software and Hardware, firstly deploying various sensors on the bridge for gathering different parameters of the bridge as mentioned. Second objective is estimation of different parameters by the signal obtained from the sensor, to create a network around the bridge to send the periodic information to the control room and finally creating a local cloud with the help of IoT module and uploading the information of the bridge to cloud. By constructing the prototype of the bridge for achieving the above listed objectives. The sensors has been successfully deployed and tested. The sensors were tested on the bridge surface and gave expected result as discussed . The IoT Based Bridge Health Monitoring System was implemented by using IoT module with the help of libraries and coding environment based on the Embedded C programming. Bridge algorithm was successful in detecting the values by outlining the object of interest and identifying the vibration, cracks, bending, acceleration and load of the vehicle on bridge.

FUTURE SCOPE

The proposed system can be enhanced in the future for different objectives:

(a) As of now we are only focusing on the deformation monitoring of the bridge using flex sensor, by using high quality digital flex sensor we can calculate the crack at exact location in the bridge.

(b) Laser technique can be used i.e. passing a laser beam at one point of bridge and receiving at another point, by implementing this technique, we can detect the crack without the image processing technique.

(c) By using image processing technique we can find the crack at exact location by using aerial camera or drone cameras, because the camera one which is fixed on the bridge can't capture the image of crack as the bridge tend to vibrate as the vehicle travels.

(d) By installing high frequency 3D sonar around the pillar of the bridge which has submerged underwater to find the aging of a bridge's pillar.