ISSN: 2581-4419 Volume 1 Issue 1

IoT Based Bridge Health Smart Monitoring System

AKSHATA DHURI[1] , SNEHAL KADAM[2] ,PRATIKSHA JOGALE[3] ,LATIKA KAWADE[4] PROF. SHUSHMA KORE[5]

[1-4] Students, Assistant Professor[5]

Department f Electronics and Telecommunication

K.C. College of Engineering & Management studies & Research, Kopri, Thane (E)-400 603, India.

Abstract—Now days, natural disaster is happening mostly in all over the world. This is because of change in natural conditions. These types of disasters will destroy the many structure like bridges and this will damage the life. Hence to always monitor the conditions on bridge we use the system called bridge monitoring system. Bridge monitoring system will help to know the current natural conditions on bridge like wind speed, temperature, weight etc. and inform us. According to the readings of different sensors we can compare it with critical values and we will be alert before any disaster.

Keywords- Bridge health, Crack detection, water level, Ardunio Nano, Vibration detector

I. INTRODUCTION

The mishap happened on The Colonial-era Bridge on the Mumbai-Goa Highway caved in around Tuesday midnight owing to an incessant down- pour, which lashed the Konkan, causing the river to swell and maul the weather-beaten bridge. Two State Transport buses, and a number of private vehicles, unable to see the ruptured span, plunged into the raging wood waters below. To overcome such incident, we can have data- acquisition systems are used in structural projects ranging from simple beam-fatigue analysis, to structural mechanics research, to continuous monitoring of large, complex structures. Our systems provide remote, unattended, portable monitoring for bridges. They are compatible with a wide variety of sensors and peripherals to your exact needs.

This report aims to simplify the process of selecting bridge health monitoring systems for the bridge engineer. Hundreds of bridges in the state on Maharashtra are obsolete or structurally deceit. These inspections are both costly and time consuming. However, the field of bridge health monitoring may be able to relieve some of the cost and burden on the bridge engineer. Our system will sense the water level angle if crack in the bridge will me sensed and signal will be given to the vehicles to stop and will automatically give red signal and will close the gate and will send details of sensor to control room.

II. LITERATURE SURVEY

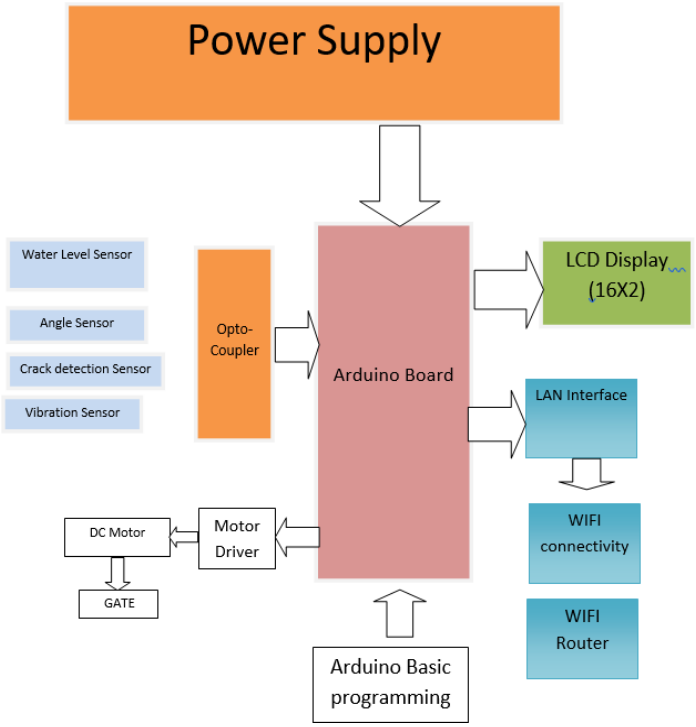
According to paper "Wireless Sensor Network Based Crack Detection on Concrete Bridges/Buildings "The method of Detection and Recognition of Bridges' Cracks Based on Deep Belief Network adopts Raspberry Pi to collect and pre-process images, to transmit images data by the GPRS / 3G or wired networks. And it uses high- level image servers to make image analysis. According to the characteristics of bridges cracks" images, this method selects and improves the best processing algorithm, as well as detects and recognizes the true bridges cracks

So, these bridges require continuous monitoring. So, we are proposing a system which consists of a weight sensor, water level point contact sensor, Wi-Fi module, and Arduino microcontroller. This system detects the load of vehicles, water level, and pressure. If the water level, water pressure and vehicle load on the bridge cross its threshold value then it generates the alert through buzzer and

auto barrier. If it is necessary, then the admin assign the task to the employees for maintenance.

III. DESIGN SYSTEM

1. Block Diagram



2. System Specifications and working

The entire system consists of an Arduino Nano which controls the interface between the different components of the system i.e. sensors, motor driver, LCD Display, Wi-Fi Modem . The power supply is given to Arduino Board which is smaller in size and has a microcontroller. The board is connected to the Opto- Coupler, LCD Display, LAN interface and Motor Driver. Here we have used LCD 16x2. The opto-coupler is connected to the sensors i.e. water level sensor, angle sensor, crack detection sensor, vibration sensor to have interfacing between two or more devices. The function of opto- coupler is to prevent high voltages from affecting the system receiving the signal. Here for angle sensor we are using accelerometer and for crack detection we are using wire mesh.

Thus, when the sensors sense some harm or detect values above the threshold value, it sends signals to the Arduino Board through opto-coupler. The program installed in the Arduino will start to execute and according to the flow of the program it will send the signals to the respective components. Arduino Board sends warning signal to the motor driver. The motor driver has been attached to a boom barrier which blocks the vehicles from moving ahead to prevent accidents from happening. All sensors get the real-time value and send it to the server and android through the Wi- Fi modem to the cloud. The analyst is already logged in to the android device and analyzes the data that was sent to the control room by the system. It sends the data to the user. User can see the data who has been already registered in the database and can see this data. This data will help the user to see the details of the bridge. These data can be helpful to avoid accident from happening and all that data will be display on the LCD so that the coming vehicles could see the information from not so far distance and inform the other passage vehicles.

3. COMPONENTS LIST AND SPECIFICATION.

i. Accelerometer

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Basic structure of accelerometer consists fixed plates and moving plates (mass). Acceleration deflects the moving mass and unbalances the differential capacitor which results in a sensor output voltage amplitude which is proportional to the acceleration. By sensing the amount of acceleration, users analyze how the device is moving.

Fig (1) Accelerometer

ii. Vibration Sensor

Vibration sensor is different from resistive. Or vibration which is produced when earth- quake occurs when the piezo film is bent from the mechanical neutral axis, a very high stain within the piezo polymer is created and genera voltage. This voltage is created only as the sensor is deformed. The sensor produces positive voltages when they're deformed in one direction, and negative voltages when deformed in the other. As in other project we have used piezo sensor for sensing the impact of high tsunami waves. A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal.

Fig (2) Vibration Sensor

iii. Crack Detection Sensor

The crack/ wire mesh collects data in digital form. The sensor data is sent to base station database via Wi-Fi modem.The base station database stores the value coming from sensor which can be visualized in a cloud dashboard. The cloud dashboard has sensor data which is collected at every time, instant with data and time. These values are monitored continuously and when the desired threshold is reached. A warning message is sent to authorized person as well as to the public.

iv. Water Level Sensor

The sensor probes actually act as their own sensors and do not pass electricity through the probes which keep them from fouling, degrading and deteriorating. Also, all of the electronics are built into the head so you can connect directly to your control panel. Once the water level is detected by one of the sensors, this causes one of six alarms to be triggered (High Alarm, Low Alarm, Fill Start, Fill Stop, etc). Depending on the type of float switch you have, there can be single point alarm or a multipoint alarm that is triggered. Different alarms control different start and stop mechanisms

v. Ardiuno Nano

Arduino Nano is a microcontroller board designed by Arduino.cc. The microcontroller used in the Arduino Nano is Atmega328, the same one as used in Arduino UNO. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. It has 22 input/output pins in total,14 of these pins are digital pins,8 analogue pins, 6 PWM pins among the digital pins.It also has a mini USB Pin which is used to upload code and Reset button. its is used in Embedded systems, automation, robotics, etc.

Fig (4) Ardiuno Nano

IV. EXPECTED RESULTS

The system collects the data from sensors and the status is collected by the controller and is transferred to wireless network. This data at transmitter is sent to the receiver and is analysed by the Arduino. Analysed data is sent to the management centre and an alert message is sent to the operator mobile number. The data sensed by sensors will get converted into an electrical signal. The devices which generate output are generally called as sound buzzer. Both sensor and actuator are collectively called as a transducer. The electrical signal will get transmitted to the Arduino. All sensors get the real-time value and send it to the server and android. The analyst login the android device and analyse the data that was sent by the system. It sends the data to the user. User can see the data which are already registered in the database these data will help the user to see the details of the bridge. These data can be helpful to avoid accident and all that data will display on the LCD. If the sensor value is above then the limit then the system will play the buzzer and notify the peoples.

V. FUTURE SCOPE

- System can be implemented at a global level in which different countries can manipulate data of their bridges at a single server.

- Implement on high cost suspension bridge. 3.Monitoring Structural Performance and Applied Loads.

VI. CONCLUSION

In this paper, the working principle of Bridge Monitoring and alert generation system using IoT, we display data using LCD display and IOT when there are signs of collapsing the bridge. This system will help to reduce big disasters in future. This system can save the lives of many people.

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