

Bridge Safety Monitoring System using IOT

B Dhanalakshmi, A Prakadeesh, R Roshan Kumar



Abstract-- In this study, Bridge safety monitoring system using IOT is developed using the Wireless technology. With the help of Advancements in sensor technology have brought the automated real-time bridge health monitoring system. This system will help prevention in disaster management and recovery. IOT-based bridge safety monitoring system is developed using the Wireless Technology. By the use of wireless sensor nodes, various types of data can be collected like vibration, waterlevel and Bridge weight. These data would also be useful for monitoring and surveillance. The main motto of this paper is to develop a system that can prevent accidents or structural disasters of flyovers and bridges. This study gives the survey of various techniques used to monitor the conditions of the bridges and proposed a system for monitoring continuous structures and an ultrasonic sensor for monitoring the water level in the river to avoid traffic from a bridge in flood conditions using Kalman's Filter algorithm. In case of emergency situations the gates of the Bridge will be automatically closed. The obtained data are transmitted to the server and database for admins to have real-time monitoring of the bridge conditions via mobile telecommunication devices.

Keywords: Bridge safety Monitoring, Flood Conditions, Emergency Situations, IOT, Data Analysis

I. INTRODUCTION

Now a day it is very essential to monitor, the bridges in our country or state as there were incidences happen earlier. The reason behind these incidents as there is no such type of system, which will give information to the peoples if the bridge is not in good condition when sudden situations may occur like flood, earthquake. It means that the bridge is not in safe condition. When this kind of situation arises, bridge may collapse, which causes much kind of losses like accidents, human deaths, etc. This happens because there is no efficient system in existence, which will provide notification about conditions about current condition of bridge when bridge is not in safe mode.

In the existing systems, Zig-Bee technology was used which is cost consuming and quite time consuming, but this system used the TCP/IP protocol which is suited for all types of bridges.

Therefore in this study, the IOT wireless sensor network and smart building technologies are adopted to solve the various problems of bridge safety information transmission and management by developing an IOT based bridge safety monitoring system capable of monitoring the environmental data of a bridge and transmitting the data to the mobile devices of bridge safety management staff for reference and documentation. The Ultrasonic Sensors used through which system has to check manually the level of water. So for this the system is being developed an application in which everything is automated so less human efforts are required and this application is very much useful in the emergency condition like prevent from flood, earthquakes. The system was developed in this study can help to promote the advancements of bridge safety and recovery management.

The main objectives of the Bridge Monitoring System is:

- To provide safety for bridges.
- To avoid accidents in case of bad weather conditions.
- To improve the bridge efficiency.
- To overcome the technical and cost obstacles.

II. SYSTEM ARCHITECTURE

This system consists of following parts:

1. **Wi-Fi Module** - Through Wi-Fi module the status of the overall bridge will be sent to the monitoring system.
2. **Vibration sensor** - Vibration sensor senses the condition of bridge, whether it is in better condition or not.
3. **Ultrasonic sensor** - It is used to sense the wifi status.
4. **Barriers with servo motor** - If water level increased or the bridge becomes vibrate or bridge becomes more load then default value then barriers with servo motor will close.
5. **Management Centre** - All the necessary information related to status of the bridge is sent to and monitor by Management centre.[9]
6. **HX711 Weight Sensor** - It is used to measure the current weight of the Bridge.

Figure 1 explains the data Share between bridge and monitoring Centre is takes place via WI-FI module. The WI-FI module itself act as sever through which status of condition of bridge is transmitted to the monitoring Centre.

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The Monitoring devices like water level vibration sensor and weight sensor are continuously monitoring the structural health of bridge. If water level is increased or weight is too high and if bridge is being vibrated then barriers with servomotor will close and at the same time, status of bridge condition is directed to the monitoring Centre.

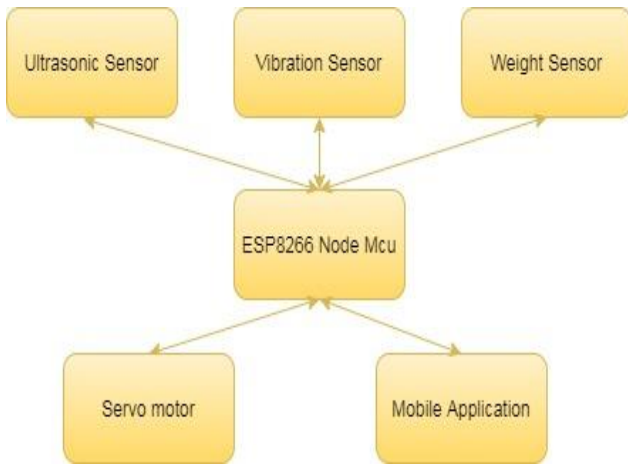


Figure 1. Architecture of Bridge Monitoring System

It has a technology called MBM (Monitoring Based Maintenance) that enables maintenance engineers to monitor the condition of the bridge in real time. The components that which are used to detect the strain, acceleration, cracks etc. The System includes the desktop application which is useful for the engineers working in the bridge department to monitor the current position of bridge.

There are three important chunks in the system i.e. Vibration Sensor, weight sensor and River water level sensor, which sends the details of bridge strength to the Management Center[12]. All the collected environmental data sent to the server system. So that as per situation Management Center takes immediate action for bridge safety and security. For example if water level increases beyond the default settled water level then system alerts the management center and barriers of bridge will automatically close by management center.

III. METHODS AND MATERIAL

A. The methodology implemented includes:

1. Structural Design Components
2. WI-FI Module & TCP/IP protocol
3. IoT Components
4. Experimental Setup

1. Structural Design Components

1. Design of Vibration sensor, weight sensor and Water level sensor which is the Assembly of communicating devices.
2. Ultrasonic sensor senses the water level.
3. Vibration sensor detect the motion of bridge in case of Heavy wind and environmental parameters.
4. Weight sensor detect the load of the bridge

5. The output value or status is collected on ESP8266.

2. WI-FI Module & TCP/IP protocol

- i. WI-FI module itself act as a server which is connected to the Nodemcu.
- ii. Through WI-FI module the status or condition of bridge is transmitted to the monitoring Centre. III. This transmission is done through TCP/IP protocol in the form of packets.
- iii. TCP/IP protocol is the transmission control protocol and internet protocol through which the transmission of data is easily possible without any interruption.

3. IoT Components

There are three layers in the architecture of an IoT:

1) Sensor layer:

The sensor layer leads to detect or collect all kind of necessary information from physical world like physical, identification, audio, video data.

2) Network layer:

The network layer mainly responsible for transmitting data reliably and safely through wider and faster networks connections like TCP/IP.

3) Application layer:

Application layer performs the function to support information coordination, sharing and interconnection across monitoring centre and bridge.

4) Experimental Setup

Figure 2 explains exact details about the actual setup of the Bridge Monitoring System.

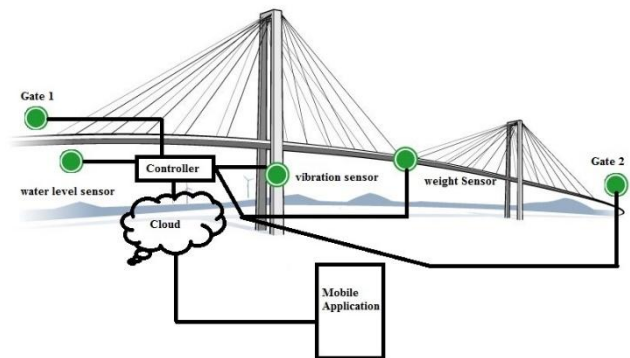


Figure 2. System Setup

Material Used:

Hardware required for implementation:

1.ESP8266 Nodemcu:

The ESP8266 is an micro controller which have the Inbulit WiFi module to Connect the device to internet. Esp8266 have 1 analog pin and 11 data pins to connect many sensors in an single system

2. Water Level Sensor:

Ultrasonic Sensors use to detect the level of substances that can flow. These kinds of substances include liquids, slurries, granular material and powders. These measurements can be used to determine the amount of materials within a closed container or the flow of water in open channels.

3. Vibration Sensor:

Vibration sensor is use for measuring, displaying, and analysing linear velocity, displacement and proximity, or acceleration.

4.Weight sensor:

The HX711 Load Cell Amplifier Module is uses 24 high-precision ADC converter chip hx711, is meant for high-precision electronic scale and style , with two analog input channel, the interior programmable gain amplifier was integrated with multiplier 128.HX711 uses a two wire interface (Clock and Data) for communication.

5.Servomotor:

A servomotor may be a simple motor ,controlled with the assistance of servomechanism. the motor as a controlled device, related to servo mechanism is DC motor, then it's commonly referred to as a DC Servo Motor. If AC operates the controlled motor, it's referred to as a AC Servo Motor.

V. RESULT



Figure 3. Bridge details been detected



Figure 4. Notification received

The Figures 3 & 4 depicts the result regarding the safety of the bridge and henceforth helps us to monitor and maintain the condition of the bridges in the Water Bodies and to prevent the public in the bridge at the emergency situations

VI. CONCLUSION

Bridge health condition monitoring in real time is very popular issue. The sensor technology is continuously and condition monitoring has never been accurate and easier before. With the help of wireless technology and water level sensor, smart system is developing for securing bridges.

This system checks the water level and the position of bridge for safety purpose. In the emergency conditions like earthquake, flood, etc. the facility of broadcasting the message is added. This System is unique in its ability to monitor the bridge environment, it transmits environmental data through wireless communication and sends alerts to the bridge management staff i.e. Monitoring Centre in real time for prompt action also to user's. The main objective of Bridge Monitoring System using IOT is to save the lives of the people, to protect from accident.

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