IoT Based Bridge Monitoring using WSN: A Survey

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Abstract— The advent of ultra-technological devices in our day to day lives has made us smart and efficient. Such a transformation is required for any developing city for proficient managing of citywide activities and becomes a smart city. By the use of wireless sensor nodes, various types of data can be collected like weather conditions, sound, and air quality and data of high priority structures. Such data would also be useful monitoring and surveillance. The main aim of this paper is to develop a system that can prevent accidents or structural disasters of flyovers and bridges. This paper 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.

Key words: Bridge Monitoring, Flood Conditions, Structural Disasters, IoT

I. INTRODUCTION

As wireless smart sensor network plays a very important role in the application of remote monitoring [4][5][6]in widespread geographical areas. Such networks are helpful to monitor the structural health status of bridges as it connects roads in both rural and urban areas. It is cost effective and possible solution for monitoring the bridges. Bridges are an important aspect of traffic. Human life and property will be in a severe situation when bridges are damaged. Old bridges cannot face to the severe natural disasters. In other words, the bridges in such countries are likely to suffer from the damage. Since bridge pier scours is the main cause for bridge failure and collapse. Many of these bridges are subject to decline due to external and internal factors...

By using structural Health Monitoring (SHM) [6][11] we can mitigate the deficiencies and provide real-time diagnostic information regarding the bridge structural health.

We propose an integrated bridge monitoring system using IOT that can be used to prevent accidents or structural disasters of flyovers and bridges. The system continuously monitors the bridge condition. They use a different sensor [6] to get the bridge information like ultrasonic sensor, load cell sensor, vibration sensor, and temperature sensor. The bridge load is getting through the load cell sensor and the vibration is getting using a vibration sensor. By using the ultrasonic sensor system get the water level under the bridge. All sensors get the real-time value and send it to the server. If the sensor value is above then the limit then the system will play the buzzer and notify the peoples.

Bridge maintenance and infrastructure managers can easily use this application to secure the performance and safety of these vital structures. This application can also be helpful to monitor structural health in bridges, field inspection.

II. LITERATURE REVIEW

Amira Zrelli et al.highlight damage detection application for monitoring the Bridge Health in [1]. The system can locate and detect damages in bridges by the use of a wireless sensor network.

Ren-Guey Lee et al.[2] gives an efficient and reliable backup scheme for bridge monitoring system by using the wireless sensor network (WSN). By collecting the environment parameters transmitting the numerical data to the gateway through the multiple-hop relay, and then it further stores data in the back-end database for the specialized monitoring staffs to analyze and study. This system can able to improve the inconvenience to add or remove sensor nodes in an existing wired bridge monitoring network.

Mohamed Bouyahi et al.[3] gives the system that can provide a solution to measure temperature, humidity, and strain inside a concrete structure. Two sensors i.e. first is a sensor fiber optic Brillouin Strain and temperature, the second is the sensor fiber optic Bragg of Temperature and Humidity is used. The two sensors with Zolertia mote MSP430F2617 microcontroller allowing for the creation of an IEEE 802.15.4 network have been used.

Shivan Haran, et al.[5] discusses the monitoring of bridges using WSN. As a testbed, a heterogeneous network of WSN and conventional P2P together with a combination of sensing devices is to be used on a bridge model. Issues related to condition assessment of the bridge for situations including faults, overloads, etc., as well as analysis of network and system performance is discussed.

Dong Liang et.al [7], explained a multi-agent Fusion & coordination system. The proposed multi-agent system is illustrated through a large aerospace aluminum plate structure experiment. The multi-agent system is enhancing the strain distribution and joint failure monitoring performance for the large structure.

A. Engela, A. Friedmannb et.al [8], explained the detection and localization of structural damage, the energy-efficiency of the wireless data acquisition system.

Seno Adi Putra et al. gives a preliminary study of an Agent-oriented paradigm [9] to develop intelligent sensing in the single degree of freedom bridge. The finding of bridge condition assessment and load rating using dynamic response is done here. Sensor node capability to compute is the consideration to develop intelligent sensing on a sensor node in which signal processing with efficient resource consumption is performed.

Haitao Xiao et al.[10] propose a Distributed data Aggregation active Monitoring System, that provides failure detection and symptom alerts, while being frugal in the use of energy and bandwidth. In order to improve the performance of active monitoring method an distributed data aggregation method is used to reduce the amount of

communication and energy consumption. The monitoring system contains three functions, monitoring the health of nodes, monitoring the link quality and monitoring the healthiness of bridge diagnosis data. Key performance measures of this system include high detection accuracy (low false alarm probabilities), high responsiveness (low response latency), low energy consumption and low complexity. We debug the system in the wireless sensor network developed for bridge diagnosis and obtain the result in the field experiment.

The paper [11] presents a useful wireless sensor network system to monitor structural health in bridges, field inspection. The vibration sensing mechanism is used to detect the bridge scour by using the accelerometer sensor. Humidity and strain are measured with the help of humidity sensor and strain gauge.

III. PROPOSED SYSTEM

The proposed system is the development of bridge monitoring system using IOT. The system continuously monitors the bridge condition. They use a different sensor to get the bridge information like ultrasonic sensor, load cell sensor, vibration sensor, and temperature sensor. The bridge load is getting through the load cell sensor and the vibration is getting using a vibration sensor. By using the ultrasonic sensor system get the water level under the bridge. All sensors get the real-time value and send it to the server. If the sensor value is above then the limit then the system will play the buzzer and notify the peoples. The detail description of proposed system is as follows:

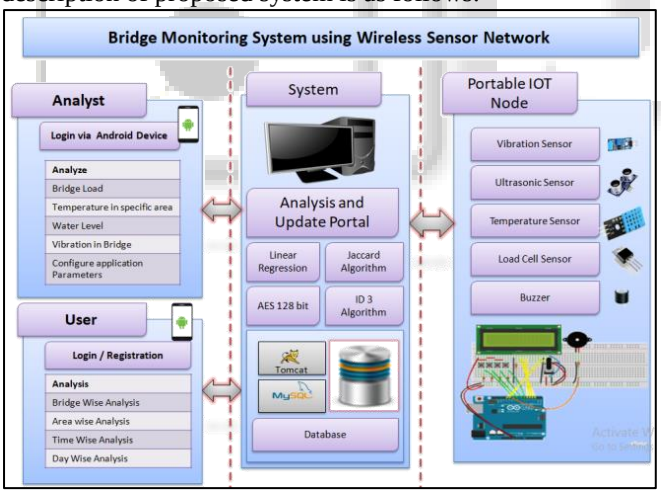

Fig. 1: System Architecture

A. Register Kit & Bridge

Add the Bridge information and the kit id for registration of the Bridge and kit. The data will be stored on the server

B. Sync Data on Server

Kit is connect with the different sensor like vibration sensor, ultrasonic sensor, load cell sensor, temperature sensor which can continually collect the data and send it on the server.

C. Inform nearby in Emergency Situation

On the collected data from sensors the kit can compute and if the resultant data shows emergency situation then it Gives alert by playing buzzer placed on the kit.

D. Set Parameters of Bridge

The admin can set the parameters of the bridge as per the structure and capacity of bridge is as follows.

1) Load on Bridge
2) Water level.
3) Vibration in Bridge.

E. Data Analysis

Following parameters are shown in analysis to the users of the system.

1) Bridge wise Analysis
2) Day wise Analysis.
3) Time wise Analysis.
4) Area wise Analysis.

IV. CONCLUSION

Here we discussed the different methods used by the researcher to monitor the bridge condition. Such a system will help to control the dynamic parameters of the bridge for preventing it from the disaster which can save the many lives and also wealth.

The proposed system continuously monitors the bridge parameter value and judges whether the bridge is safe or not for traveling. In case the parameter values are beyond the threshold values then an alert sound is given to the people. This implementation is greatly useful to provide safety for the human.

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