IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

IoT Based Monitoring and Maintenance of Highway Bridges using WSN

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Abstract: *This paper presents a WSN-based IOT-based bridge monitoring system. The automated real-time bridge health monitoring system has been made possible by sophisticated modifications to sensor technology; this system will aid in disaster management. The technology used in this development is a wireless sensor network (WSN). This system uses a variety of sensors to continually monitor the state of the bridge. These sensors include an accelerometer to identify jerks in the bridge, a vibration sensor to identify vibrations occurring on the bridge, a flex sensor to identify bends in the bridge, and a water level sensor to identify the water level. To determine the weight on the bridge, use the load sensor. The barrier is detected by an IR sensor. Only the buzzer will activate when these are high. Additionally, a microcontroller processes the data from many sensors and transmits it to a server and management system so that real-time bridge condition monitoring via a mobile device using the GSM model is possible.*

Keywords: Microcontroller (PIC18F4520), Bend sensor, Accelerometer, water level sensors, vibration sensors, GSM, LCD

I. INTRODUCTION

The structural integrity of the bridge is monitored via the bridge monitor system. Monitoring the condition of essential bridge maintenance and operational components is achallenging task. With the development of sensor technologies, an Internet of Things-based automated real- time bridge health monitoring system is now possible. Numerous bridges in numerous nations have outlived their 50-year lifespan. Antiquated bridges are vulnerable to multiple natural calamities. In these nations, bridges most likely sustain damage.

The bridge monitor system keeps an eye on the bridge's structural integrity. It is difficult to keep track of the state of crucial operating and maintenance components for bridges. An automated real-time bridge health monitoring system based on the Internet of Things is now feasible because of advancements in sensor technologies. Many bridges in many countries have outlived their 50-year design life. Older bridges are susceptible to several natural disasters. Bridges in these countries are probably damaged.

Japan and Korea have implemented this real-time health monitoring system on numerous long-span bridges. Thus, the IoT and WSN is used in this paper's real-time bridge monitoring system[4]. GSM is utilized for long-distance (between the bridge and the management system) data communication for communication purposes. We can refer to this technology as Monitoring Based Maintenance or MBM.

Fig.1 The Charilaos Trikoupis Bridge in Greece

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II. THE PROPOSED ARCHITECTURE

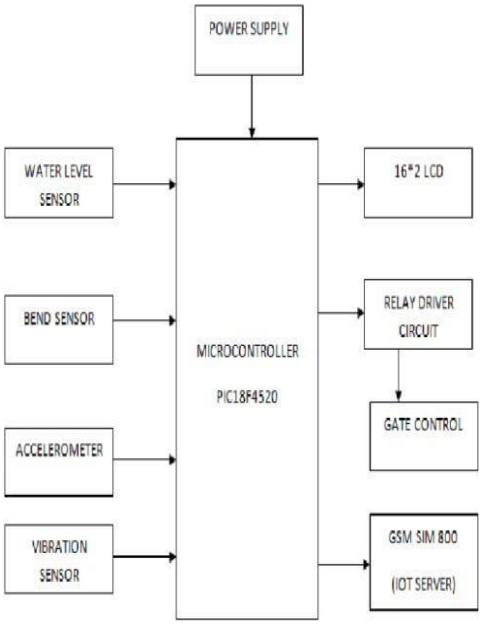

Fig.2 Proposed Architecture For Bridge Unit

The suggested system is an Internet of Things-based bridge monitoring system. The bridge's condition is regularly monitored by the system. To keep an eye on the environmental state of the bridge, sensors are positioned along its length. Thesystem makes use of a wide range of sensor, including accelerometer, vibration, water level, flex, and sensor, to obtaininformation about the bridge.

When a parameter crosses a threshold value, the communicationsystem alerts the management system so that preventive measures can be taken.

III. METHODOLOGY

The proposed paper is the advancement of observing framework utilizing IOT. The framework constantly screens the extension condition. The sensors are inserted ondifferent pieces of the prolongation to screen the ecological condition on a scaffold. The framework utilizes distinctive sensor to get the scaffold data like water level sensor, flex sensor, vibration sensor, Accelerometer and sensor. At anytime if any boundaries pass their boundary esteem the correspondence framework educates the administration framework giving a caution for making prudent moves.

This framework comprises of one expert unit and no of slaveunits. The slave unit comprise of no. of sensors which will use to detect the distinctive boundary like speed increase, curve, vibration and level of water.

The information gathered by the sensors is handled by the microcontroller and this information is likewise store to the cloud through IOT. In the event that any of the boundary pass their boundary esteem, regulator naturally close the entryway on connect and the correspondence framework (for example, GSM module) illuminate the administration framework. Expert unit comprise of LCD show which showcontrast boundary or status of all sensors of slave unit. The extension breakdown identifies by utilizing distinctive sensor. The wellbeing level ringer will blow &GSM will send SMS to the board framework.

In the preliminary hardware unit testing stage, we systematically examined the various inputs of the system to validate the sensors measurements. Evaluation factorsincluded load variations, vibrations, traffic scenarios, and environmental conditions. Each factor was methodically examined to validate the system_s accuracy functionality inreal-world bridge health monitoring scenarios using the built prototype.

Different kinds of loads were applied to the bridge, finally providing in noticeable changes in the deflection. The prototype bridges real deflection was measured carefully and compared with the deflections reported by the BMS. The variance in between these two measurements will fell within the range of 1mm, providing special importanceto the precision and accuracy of the recorded values.

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Fig.3 Data structure and flow using IOT

IV. ADVANTAGES

- Real-time monitoring.
- Early Detection.
- Enhanced Safety.
- Cost effective maintenance.
- Improved Safety.

V. APPLICATIONS

- Traffic management.
- Emergency response system.
- Environmental monitoring.
- health monitoring.
- Maintenance planning and optimization.

VI. CONCLUSION

This System proposed using a WSN. The system uses a sensor network for data collection and that collected data is also stored to the cloud using IOT. The GSM module is for carrying out communication link between the bridge and management center. In this system obtained outcomes are matched with the threshold value if the obtained value are below or above the threshold value then appropriate action will be taken by management. This method has advantages of real-time alarming and little computation, which provides an efficient and effective algorithm for real-time alarming of new advancements in sensing technology, Internet of Things (IoT), and WSN, this system gives an optimal illusion of design parameters to point out the limitations of current monitoring methods. By adding up easily relatable criteria such as deflection, vibration, temperature, and humidity with wind speed sensors alongside fuzzy logic control, the system provides affordable, precise, and real- time assessments of bridge health. The system also provides an early warning systemfor rural settings where visual inspections are not easily scheduled at regular intervals. This accompanying early emergency signal mechanism is accessible via a user-friendly mobile application and provides overseeing specialists with timely signals and the indicators, providing informed decisions and related preventative actions to minimize the impact of the potentialfor catastrophic bridge failures. The cost efficient technology system is intended to provide to the UN Sustainable Development Goals #9—building resilient infrastructure to promote inclusive and sustainable industrialization and foster innovation, as well as #11—make cities and human settlements inclusive, safe, resilient, and sustain.

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