IOT Based Bridge Health Monitoring System

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ABSTRACT

The aim of this paper is to support the construction of an efficient Health Monitoring System for ensuring the safety, using-life of bridges, preventing from the collapse affairs,protecting peoples' living environment, and reducing unnecessary finance expenses. In developing countries like India there is strong focus on national infrastructure .New bridges are build every year. The maintenance of these bridges is many times overlooked. And the present systems use complicated and high cost wired network and high maintenance optical fiber system. So the main objective behind this project is to build a cheap bridge health monitoring system for developing countries.

KEYWORDS

Intel Edison Breakout Board, Python, AMQP (Advanced Message Queuing Protocol)

INTRODUCTION

In recent years, with the widespread construction of bridge, there are more and more bridge accidents happened in India, even all over the world, which cause property loss. All we know the incidence of Savitri river in Raigad district where two buses and ten private vehicles fallen into river ,at least 29 peoples were missing at that time. Bridges are continuously subjected to destructive effects of material aging, widespread corrosion of steel reinforcing bars in concrete structures, corrosion of steel structures and components, increasing traffic volume and overloading, or simply overall deterioration and aging. These factors, combined with defects of design and construction and accidental damage, prompt the deterioration of bridges and result in the loss of load carrying capacity of bridges. Bridges can suffer structural deterioration due to aging, misuse or lack of proper maintenance. In this project two wireless sensors are used which is accelerometer sensors and Intel Edison Breakout Board. These two sensors are collecting the information about bridge structures. This sensor data is transmitted to the Amqp cloud. The Intel board detect the any change in the bridge health and it send a information to the cloud. Cloud store the information and the cloud send the message to the both the end of the bridge if the bridge is safe then the signal is green or if any unconditional change is occur then it is turn to red. From these signals the vehicle driver easily get the message that is the bridge is healthy or not.

LITERATURE SURVEY

Some failures are sudden and catastrophic, and some failures just take their time. Structural Health Monitoring (SHM) can be very helpful in serving as an alarm system for preventing both types of failures.Bridge Engineers need scientific tools which can give quick information about the health of a bridge. Such instrument shall supplement the periodical manual inspections. But when failures happen with any kind of structure there is loss of human lives, money and many more, most of the times. For example, during the bridge construction boom of the 1950's and 1960's, little emphasis was placed on safety inspection and maintenance of bridges. This changed when the 2,235 foot Silver Bridge at Point Pleasant, WV, collapsed into the Ohio River, on Dec. 15, 1967. 46 people were killed. Hence to ensure the safety of bridges, the Bridge Health Monitoring System was introduced.

SAVITRI RIVER BRIDGE COLLAPS INCIDENCE:

Due to lack of monitoring an old bridge connecting to the Mumbai-Goa highway collapsed and was washed away by the Savitri river late on Tuesday night. Authorities believe 10 vehicles might have fallen into the river. At least 29 people are missing since two buses and about 10 private vehicles fell into a swollen Savitri river after a British-era bridge was washed away near Mahad on the Mumbai-Goa national highway.The bridge collapsed around midnight on Tuesday, but vehicles, unable to see the missing section in the dark, too fell into the river. Two Maharashtra State Road Transport Corporation (MSRTC) buses were among the vehicles, carrying 17 passengers in total.Twelve of the 17 passengers were identified on Wednesday. A family of five who live in the city are among them.Even after hours of searching, the rescue teams were unable recover anyone suspected to have been washed away. The three teams of the National Disaster Response Force (NDRF), two helicopters each from the Navy and the Indian Coast Guard along with local river rafting teams were carrying out the search and rescue operation.Locals, however, found the bodies of two men 8 km downstream from the site of the collapse. State authorities, including the Raigad collector and the state public works minister, said the bodies were yet to be identified. Stalled traffic from the collapsed bridge was diverted to a parallel bridge, the collector said.

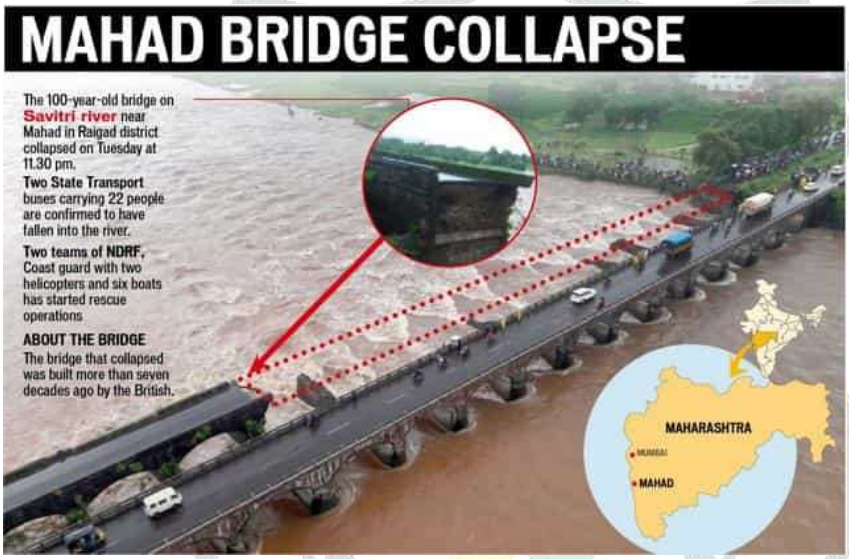

Fig.1.Mahad bridge collaps incidence

AKASHI KAIKYO BRIDGE:

Akashi Kaikyo Bridge is not only famous for world longest suspension bridge but also for its advanced health monitoring system. It has a technology called MBM (Monitoring Based Maintenance) that enables the bridge maintenance engineers monitor the condition of the bridge in real time. The sensors installed on main cables, hangers, decks, towers, etc. detect the strain, acceleration, temperature and wind. The sensory inputs are process to represent the condition of the bridge against seismic loads and wind loads. Like Akashi Kaikyo Bridge, there are many bridges that have real time monitoring system in Korea. Akashi Kaikyo Bridge has the sensors placed on various parts of the bridge. On September 22, 1998, Typhoon No.7 occurred in the central area of the Kii Peninsula (east of Akashi Kaikyo Bridge). The wind direction and wind speed was measured by the anemometer near the middle of the center span and so did the transversal displacement of the related girder. By applying wind-tunnel test results and the wind resistant design guidelines for Akashi Kaikyo Bridge, a transversal displacement of 5.41m and vibration amplitude of 2.56m were calculated. The field-measured values showed a transversal displacement of 5.17m and vibration amplitude of 0.78m. It is confirmed that the field-measured values for transversal displacement have good agreement with the calculated results, but the vibration amplitude was about one-third of the calculated value.

- The Akashi Kaikyo bridge has a center length of 1991m , and it extremely flexible structure with low natural frequency which makes high wind resistance necessary
- Therefore the wind resistance design standards for the Akashi Kaikyo bridge were established (HSBA1990).
- During construction the bridge was tested which showed its wind resistance to be 78m/s
- When the wind speed exceeds this value a warning is given by the monitoring system.
- The Akashi Kaikyo Bridge can handle accelerations due to earthquakes of magnitude of 8.5 Richter scale.

Fig.2.Akashi Kaikvo Bridge

PROPOSED SYSTEM

Proposed system consist of structure diagram of IOT based bridge health monitoring system as well as three step description is given in methodology. System combines technologies like IoT, cloud computing. Overview of the system can be seen in fig.1

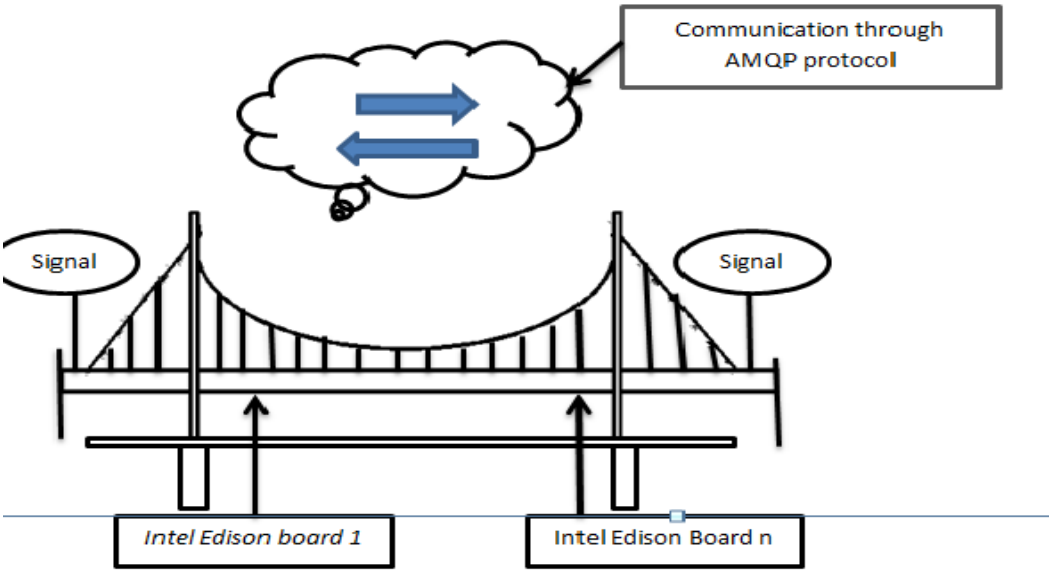

Fig.3. Overview of system

a) Components

A. Hardware Components:

1.Intel Edison Breakout Board-Used as a sensor to detect the damage

B. Software Components:

1AMQP :-Message protocol for communication.

2.Python 3.6 :- Basic programming language used for programming

b)Methodology

Phase I: Identification of Damage in the bridge

In this phase we use,Intel Edison breakout board.The Intel Edison is a computer-on-module that was offered by intel as a development system for wearable devices and internet of things divices.In this project according to the size of bridge we are going to use number of boards.Below the bridge we placed the Intel boards 70 to 100 meters apart from each other.The board is itself working as a sensor,it detect the change in the bridge and it send information to the cloud.It has Atom 2-core (Silvermont) @ 500 MHz.The memory size is LPDDR3 1 GB and the storage is 4 GB EMMC.

Phase II: Communication between signal ends

In this phase,we use AMQP clod**.**AMQP stands for Advanced Message Queuing Protocol is an open standard application layer protocol for message-oriented middleware. The defining features of AMQP are message oriented, reliability and security. By using this cloud the user can able to send minimize data packets, low power usage and efficiently share the information to the receiver. In this project we are going to use the cloud to store the information which is received from the sensors and then the cloud transfer this information to the end user.

Advantages and Disadvantages

1.Advantages:

- Improved understanding of in-situ structural behaviour
- Early damage detection
- Assurances of a structure’s strength and serviceability
- Reduction in down time
- Improved maintenance and management strategies for better allocation of resources

2.Disadvantages:

- The only disadvantage is that the sensor should not fail when there is an adverse condition.
- So there must be system incorporate witch will detect sensor failure.

Conclusion :-

- In present situation, the technologies used have certain disadvantages.
- we suggest our system with the advantages described earlier can overcome the disadvantages.

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