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Overview and an Approach for Bridge Safety Measures using IoT

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ABSTRACT:Aim of our project is to develop an IoT-based bridge safety monitoring system which is composed of monitoring devices installed in the bridge environment, communication devices connecting the bridge monitoring devices and the cloud-based server, a dynamic database that stores bridge condition data, cloud based server that calculates and analyses data transmitted from the monitoring devices.This system shall monitor and analyse in real time the condition of a bridge and its environment, including the water levels and other safety conditions.
In this paper, we've provided an overview of different bridge safety measures using IoT. After the study of the existing literature, we've briefly proposed our approach to tackle the issue.

KEYWORDS: Bridge Safety, Internet of Things, Disaster Management, Structural Health Monitoring

I.INTRODUCTION

SHM is a vital tool to enhance the safety and maintainability of critical structures like bridges. SHM delivers realtime and accurate information about the concerned structure giving detailed information about its condition. Now-a-days due to incidents of bridges or change in deflection of the bridge structure, or bridge piers severely damaged by moisture, or by excess variation in vibration are frequently reported annually. Different disasters and damaged sites require different professional disaster rescue knowledge and equipment so as to realize optimal rescue results. However, lack of data about the damage site can impede information management at the rescue center and operation, leading to poor rescue efficiency or maybe preventable causalities.

Generally, to perform SHM, firstly, data must be collected using sensors. The different types of sensors are often used by SHM to generate the signals traveling through solid configurations. Later, this data is collected from the sensors and must be analyzed by applying different signal processing techniques, because a minor variation within the system is triggered by various factors like noises, temperature changes, environmental effects, might cause significant changes within the response from the sensors, concealing the potential signal changes due to structural defects. Therefore, during this study, the IoT, Sensor networks are adopted to resolve the above-mentioned 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.

The system developed in this study can help promote the advancement of bridge safety management and control by providing breakthroughs to the above-mentioned problems of conventional systems. For developing bridge monitoring system, following technologies are going to be used. Diverse theories have been proposed and implemented to fulfill distinct requirements of structures. Integration of these various theories has helped not only to enhance the efficiency and performance of the SHM systems but also to scale back the computational time and costs. In order to share data and ensure reliability, the SHM systems use network-based services to coexist and interact with smart interconnected devices that are referred to as the IoT. The IoT brings new opportunities for our society.

With the maturity of the IoT, one of the recent challenges within the structural engineering community is development ofthe IoT SHM systems which can provide a promising solution for rapid, accurate, and low-cost SHM systems. Moreover, the combination of SHM, and therefore the IoT enabled ubiquitous services and powerful processing of sensing data streams beyond the potential of traditional SHM system. In this paper, an entire SHM platform embedded with IoT is proposed to detect the damage in bridges

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Following are some of the advantages of SHM system:
• The continuous monitoring of the structure since sensors are a part of it
• The possibility of real-time damage detection.
• The possibility of using sensor or actuator networks.
• Robust data analysis that can provide relevantinformation about the damage. • An automated inspection process to reduce the number of unnecessary maintenance tasks, thereby improving the economic benefits.
• Operational and environmental evaluation conditions.

II. IOT BACKGROUND

The Internet of Things (IOT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment. This term was coined by KevinAshtonofProcterandGamble, later MITs Auto-ID Center in1999.

Components of IoT

The Internet of Things (IOT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment. This term was coined by KevinAshtonofProcterandGamble, later MITs Auto-ID Center in1999. Components ofIOT: Sensors: according to(IEEE) sensors are often defined as a device that produces electrical, optical, or digital data derived from an event. Data produced from sensors is then electronically transformed, into resultant output information thatis useful in decision making done by intelligent devices or individuals.

The term IoT is semantically associated with two words “Internet” and “Things,” where Internet is understood as the global system that use TCP/IP protocol suite to interconnect different computer networks, while ‘Things’ refer to any object/device in the surrounding environment that has the potential to sense and collect data. Therefore, IoT is often defined as a global system which supports IPsuite, whichhas objects equipped with sensors, radio frequency identification (RFID) tags or barcodes have a unique identity, operate in a smart environment and are harmoniously integrated into the information network by using intelligent interfaces. IoT relies on a wide range of materials, network infrastructure, communication protocols, Internet services, and computing technologies. Among the range of various technologies involve within the IoT concept, WSN is one among the most important technologies that enable the integrationof sensing devices into IoT ecosystems.

Sensing devices are deployed in network to seamlessly collect and send real-time data through the web to gather at a data center. End users can remotely control the devices using Internet services. They will also access the data center via Internet anytime from anyplace - to retrieve, process, and analyze data. IoT architecture is an open architecture based on multilayers. Services-oriented architecture is one among the approaches that are adopted by researchers in recent years to implement IoT system. Different services like sensing, transmission, collection, storage, and information processing are offered due to the interaction between multiple layers. IoT devices and sensors suffer from computational and energy constraints. Therefore, to attain coaction across the heterogeneous networks and also allow coherent data exchange through the IoT system, various protocols and standards are established.

III. PROBLEM STATEMENT

· The research community has been developing Structural Health Monitoring (SHM) techniques to aid in the ongoing bridge management efforts of local bridge authorities.
· The current standard bridge inspection practice is based on biannual visual inspections, which are subjective by nature.
· The transition of the traditional SHM techniques from the research community to the practical field implementation still needs to overcome difficult challenges due mainly to technical and economic considerations.

IV. EXISTING SYSTEM

Now days the structural stability of the bridge is monitored by manually and also the traffic control of heavy duty vehicles over the bridge are also done manually. Rather the traditional structure monitoring system can be done using wired technology. Manual monitoring systems for the bridge engineer. Hundreds of bridges in the State of Maharshtra

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are obsolete or structurally deficient. To safely extend the life of these bridges,rigorous inspection would be necessary. These inspections are both costly and the time consuming. However, the field of bridge health monitoring may be able to relieve some of the cost and burden on the bridge engineer. Bridge engineers have many responsibilities and it is impossible to expect one to know. Our system will sense the water level angle, if crack in the bridge will be sensed signal will be given to the vehicles to stop and will automatically give red signal, will close the gate and will send details of sensor to control room.

Limitations of Existing System ¬

1. Fails to collect data or monitor on-site conditions in real time.
2. Data collection through visual assessments or use of large size electronic equipment has higher cost or higher power consumption. This often results in inaccurate data.
3.They require a sophisticated and expensive electronic infrastructure with installation, maintenance and power support.
4. It also involves physical inspection of the bridge and determining its health.
5. Very few data samples are collected.

V. LITERATURE REVIEW

[1] A new cable-stayed bridge is currently under construction across the River Yamuna in Wazirabad, Delhi. The bridge will have a total length of 675 m, with a main span of 251 m. Its steel-concrete composite deck, with a total width of 35.20 m, will carry four lanes of traffic in each direction. Its dramatic inclined steel pylon, with a height of 154 meters, and elegant stay cable design, will make it a particularly attractive and imposing addition to the Wazirabad skyline. The bridge will be equipped with a sophisticated structural health monitoring system, supplied by a joint venture of Mageba India, Mageba Switzerland and Vienna Consulting Engineers.

The paper describes the purpose of the system and the requirements it will fulfill, and presents the general system layout, a description of the equipment and the technical solution for data transfer. A special focus is given to the subject of data management, which includes the archiving, analysis and presentation of the recorded data. In addition to the compulsory control room devices, the system will include a user interface which allows secure internet access to the monitoring data and results, from any location at any time. [2]

With Japan facing the recent social infrastructure issue of aging infrastructure, NTT DATA developed a solution which remotely monitors bridges in real time to provide valuable information for maintaining bridge structures, and estimating the extent of structural fatigue. NTT DATA helped the company by implementing the bridge monitoring system- BRIMOS with the support of ODA (Official Development Assistance) and successfully took the first step to expanding market share in SouthEast Asia. Challenge: The Cau Can Tho Bridge is a newly constructed bridge built over the Mekong Delta basin where the foundation is naturally very soft. The client was concerned about the possibility of adverse influences of ground subsidence on the bridge's foundations (such as unexpected large-scale deformation). The bridge is used by a particularly high number of large vehicles carrying unusually heavy cargo as the logistics industry in vietnam that is still under development. [3]

The grant, entitled "A Remote Bridge Health Monitoring System Using Computational Simulation and GPS Sensor Data" is collaborative effort with Cranfield University, Railtrack, W S Atkins and Pell Freischman. The work expands and carries forward previous work started at the University of Nottingham in 1994. The work focuses on using kinematic GPS to create and validate finite element models of bridges, allowing the deflections and vibrations of the structures to be analyzed for any uncharacteristic movements. The paper details the progress of the work to date, including the way in which the field data gathered and analyzed by the Nottingham group is used by the Cranfied Group in order to assess the quality of structures. In addition, the use of a Cyrax laser scanner to create a finite element model of a bridge is discussed. [4]

In bridge health monitoring system, sensors and ZIGBEE modules are combined to be ubiquitous-node (unode,) which are installed on the members of bridges and sends data to the u-gateway (ubiquitous gateway) that sends data to the management center wirelessly over CDMA technology. Based on the currently installed sensors on Yong-Jong Bridge, total 66 locations were carefully selected for four types of sensors.

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VI. POSSIBLE APPROACH

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Block diagram

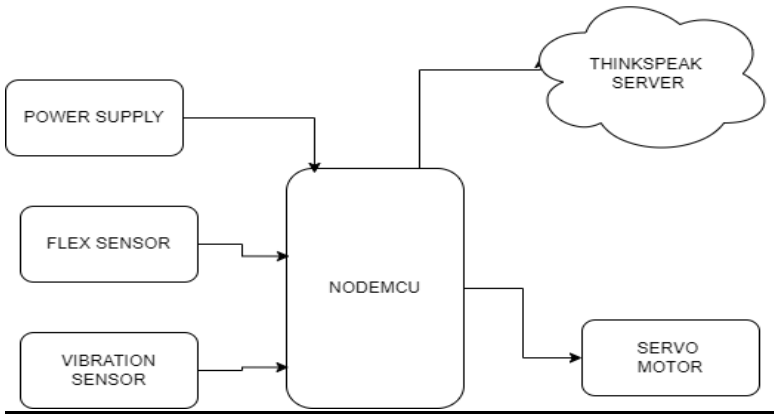

Fig. 1: IoT-based bridge safety monitoring system

In these project we used Node MCU as microcontroller. we used flex sensor and vibration sensor as input which is connected to NODE MCU to give data . the servo motor is connected as output device to microcontroller . Using IOT think speak is connected to microcontroller.

VII. 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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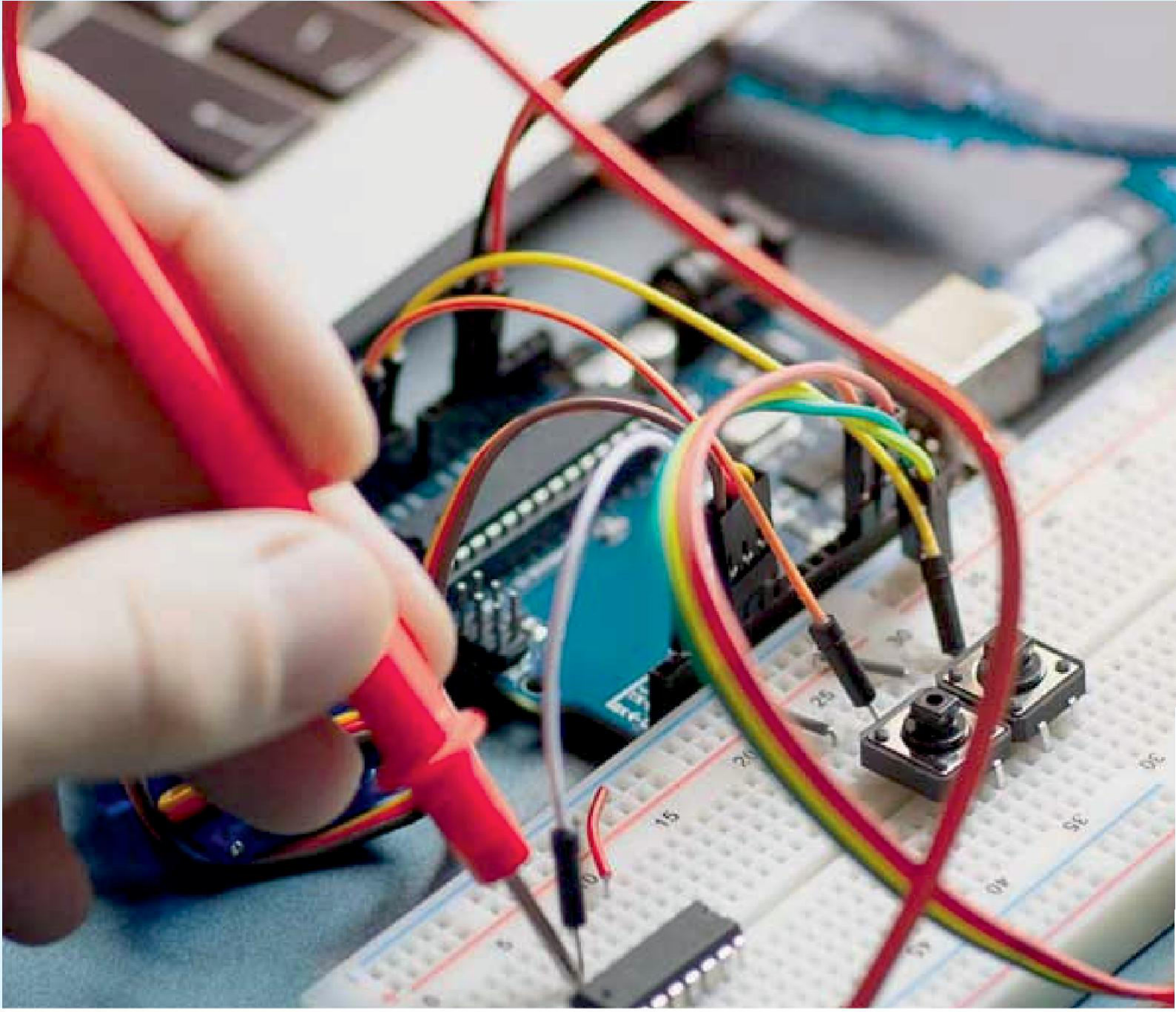

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