IoT Based Bridge Health Monitoring System and Boat Height Estimation Using MATLAB - A Survey

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Abstract- *The survey describes an IoT based bridge health monitoring system and boat height collision avoidance using image processing. This system consists of (1) monitoring devices installed in the bridge (2) a dynamic database that stores bridge condition data and (3) a cloud server that calculates and analyzes data transmitted from monitoring devices. This system can monitor and analyze the conditions of a bridge and its environment in real time, including levels of vibrations and other security conditions. The detected bridge conditions are transmitted to the server and database for real-time monitoring via IoT*

Keywords- IoT, Sensors, WI-FI Module, Management center, MATLAB

I. INTRODUCTION

Every year, incidents of bridges or bridge piers severely damaged by typhoon floods and earthquakes are frequently reported because of Taiwan's insular climate and location on the Pacific Rim of Fire. Typhoons and earthquakes can also cause disastrous fire accidents, explosive gas leakage and liquid chemical leakage in addition to flooding. In order to achieve optimal rescue results, different disasters and damaged sites need different professional disaster rescue knowledge and equipment. However, lack of information on the damage site can impede the management of information at the rescue center and the rescue operation, leading to poor rescue efficiency or even preventable causes.

Traditional methods of bridge safety management have the following problems: (1) failure to collect data or monitor on-site conditions in real time and failure to comprehensively record or analyze data collected from on-site conditions in real time, resulting in poor efficiency in disaster rescue; and (2) data collection by visual assessments or the use of large-scale electronic equipment, often with resistance. In order to solve the above problems, an IoT-based bridge safety monitoring system is therefore developed in this study. In addition, solar energy is used as a supplementary power source for the system to reduce its costs. 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.

II. LITERATURE SURVEY

Ahmed Abdelgawad and Kumar Yelamarthi [1] have proposed an IoT platform for structural health monitoring. This system consists of a Wi-Fi module, Raspberry Pi, DAC, ADC, buffer, and PZTs. The two PZTs are mounted on the structure and connected to a high-speed ADC. A buffer was used as a level conversion and to protect the Raspberry Pi. To determine the presence of damages, the pitch-catch technique is used. The first transducer (PZT1) excites the signal to the second transducer (PZT2) and captures waves that were reported back from damage which cannot be reached by the second transducer using the pulse-ecological technique. If any damage is found, a technology of pulsing echo is used for determining the location of the Damage. The second, PTZ2, receives pitch catch feedback on the wave and the structure health status was transmitted to an Internet server using Raspberry. The data have been stored on the Internet server and can be remotely monitored on any mobile device

Shachi P, Manjunatha S [2] have proposed an automatic bridge health monitoring system using wireless sensor network. This system consists of three different sensors to detect the bending and a CC 2500 RF module which are all interfaced with PIC18 microcontroller. This data is passed to the pi module already interconnected with the CC-2500 receiver module. Here the pi monitor or analyze the data and sends an alert when parameters exceed threshold values to the management center. Clear error information will be sent via GSM connection to the PI management center.

Z M C Pravia and J D Braido [3] have proposed measurement of bridges vibration characteristics using mobile phones. This system uses mobile phone of Motorola RazrTM D1 and a computer. The mobile phone was fitted with a triaxial accelerometer to extract the viaduct acceleration reactions. In addition, natural frequencies have been determined by the computer to process the data collected. Vibration monitoring software is a free application that has been developed for the Android system using Mobile Tools.

The application recorded in real time the vibrations of the mobile device and kept them in the memory. The accelerometer with a resolution of 0,0039 m / s2 was calibrated by the vibration table.

Vinodini R, Nalini S, Muthumurgesa [4] have proposed detection of structural damages in bridge based on Zigbee network using sensors. This framework is used with ATMEL 89C51 Microcontroller to identify damage on bridges. The internal and external damages and the maximum load capacity that can be tolerated by the bridge is monitored by Flex, Vibration and load sensor respectively. In the LCD you will see the changes of the sensing values. Zigbee is used for controlling and monitoring the sensors and then transmitting the detected values to IC. The Zigbee transceiver then transmits a signal via antenna to the Zigbee receiver. Using the PL-2303 serial port the alert will be passed to base station

Mr. B.M. Pawar, MS.B. Hombal, Miss J.D Kadam, Mr. A B Yadav [5] have proposed Bridge condition monitoring system using PIC microcontroller. This system uses lm35 thermometer, accelerometer, strain gauge, and anemometer sensor which senses a bridge condition that is interfaced with a microcontroller PIC 16f87xa. It also displays these parameters on LCD if there are any changes to the sensor bridge parameter & sends information to the control room via GSM network.

Chae M J, Yoo H S, Kim J R, Cho M Y [6]. They have proposed a bridge condition monitoring system using wireless network. Sensors and Zigbee modules are combined in a bridge health monitoring system in order to be an all-round node (u-node) on bridge members and send data to the u-gateway which wirelessly send data to the management center via CDMA technology.

N. Bonessio, P. Zappi, G. Benzoni, T. Simunic Rosing, G. Lomiento [7] have proposed structural health monitoring of bridges via energy harvesting sensor nodes. An SHM algorithm that is able to detect damage on wired-sensor bridges was improved to benefit from innovative WSN computational capabilities. The sensor nodes have been designed to implement a triggering strategy and a data condensation technique. The triggering strategy enables the recognition of important vibration events and excludes outer values that are unrelated to bridge dynamics. Although data compacting by the use of the RD Technique on trigger events has been reduced, they have shown that they improve the quality of modal identification by means of the data recorded.

Konstantinos Loupos, Yannis Damigos, Angelos Amditis, Reimund Gerhard [8] have proposed a structural health monitoring system for bridges based on skin like sensor. This paper presents the progress in the Senskin EC project aimed at developing the dielectric elastomer and micro-electronics sensing membrane for tracking transportation infrastructure bridges, formed out of a highly extendable capacity sensing membrane supported by advanced microelectronic circuits. The actual sensor, along with the data acquisition module, communication and power electronics all are integrated in a compact unit, the energy-efficient SENSKIN device requires simple signal processing and it is easy to install in various surface types. SENSKIN devices interact in terms of communication with one another in order to form a SENSKIN system, a fully distributed and independent, self-monitoring wireless sensor network. In order to ensure that the stress measurements are received by the base station even in extreme conditions, where normal communication is interrupted, SENSKIN uses delays / disruptions / tolerant networking technologies.

Edward Sazonov, Haodong Li Darrell Curry, and Pragasen Pillay [9] have proposed a self-powered sensor for monitoring of highway bridges. This system harvests the vibrations of the bridge created by passing traffic, which is converted into usable electrical energy by means of a linear electromagnetic generator. The use of an electromagnetic generator in this particular design allows the harvest of up to 12.5 mW of power in the resonant mode with the frequency of excitation at 3.1 Hz.

REFERENCES

[1] Ahmed Abdelgawad and Kumar Yelamarthi “WIRELESS COMMUNICATION AND MOBILE COMPUTING” Volume 2017, Article ID 6560797,

[2] Shachi P, Manjunatha S “AUTOMATIC BRIDGE HEALTH MONITORING SYSTEM USING WIRELESS SENSORS” International Journal of Science and Research (IJSR) "

[3] Z M C Pravia and J D Braido “MEASUREMENT OF BRIDGES VIBRATION CHARACTERISTICS USING MOBILE PHONES” Volume 8, Number 5 (October 2015) p. 721-743

[4] Vinodini R, Nalini S, Muthumurgesa “DETECTION OF STRUCTURAL DAMAGES IN BRIDGE BASED ON ZIGBEE NETWORKS USING SENSORS” IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 3, No 1, May 2013

[5] Mr.M.V.N.R.P.Kumar,Ms.B.Hombal, Miss. J.D. Kadam, Mr. A. B. Yadav, Mr. B.M. Pawar. "BRIDGE CONDITION MONITO-RING SYSTEM USING PIC

MICROCONTROLLER" International Journal of Research in Advent Technology, Vol.3, No.5, May 2015.

[6] Chae M J, Yoo H S, Kim J R, Cho M “BRIDGE CONDITION MONITO-RING SYSTEM USING WIRELESS NETWORK (CDMA AND ZIGBEE)” ISARC2006

[7] N.Bonessio, P. Zappi, G. Benzoni, T. Simunic Rosing, G. Lomiento “HEALTH MONITORING OF BRIDGES VIA ENERGY HARVESTING SENSOR NODES”

[8] Konstantinos Loupos, Yannis Damigos, Angelos Amditis, Reimund Gerhard “STRUCTURAL HEALTH MONITORING SYSTEM FOR BRIDGES BASED ON SKIN LIKE SENSOR” IOP Conf. Series: Materials Science and Engineering 2017

[9] Edward Sazonov, Haodong Li Darrell Curry, and Pragasen Pillay “SELF-POWERED SENSOR FOR MONITORING OF HIGHWAY BRIDGES” IEEE sensors journal, vol. 9, no. 11, November 2009