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Survey on Bridge Structure Health Monitoring and Flood Detection

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Abstract

Many of the bridges in cities built on the river are subject to deterioration as their lifetime is expired but they're still in use. They are dangerous to bridge users. Due to heavy load of vehicles, high water level or pressure and heavy rains these bridges may get collapse which in turn leads to disaster. So, these bridges require continuous monitoring. This paper provides an overview of bridge health monitoring and damage detection with emphasis on enabling technologies namely weight sensor, water level point contact sensor, Wi-Fi module, Arduino microcontroller. This survey paper also highlights the monitoring aspects like detecting the load of vehicles, water level and pressure. If the water level, water pressure and vehicle load on the bridge crosses its threshold value then it generates the alert through buzzer and auto barrier to scale back and avoid the loss of living and finances.

Keywords: IoT, Bridge Monitoring, PZT, SHM, WSN

I. INTRODUCTION

Now-a-days because of incidents of bridges or bridge piers severely damaged by typhoon floods and earthquakes are frequently reported each year. In addition to floods, typhoons and earthquakes may also cause disastrous accidents of fires, explosive gas leakage and liquid chemical leakage. Different disasters and damaged sites require different professional disaster rescue knowledge and equipment in order to achieve optimal rescue results. However, lack of information about the damage site can impede information management at the rescue center and rescue operation, resulting in poor rescue efficiency or even preventable causalities. Engineering structures are responsible for economic growth, development and evolution of the nation. The structure includes buildings, dams, roads and bridges which affect day to day a life of people. Along with their own weight they are also affected by the environment. Scour is also one of the major causes for bridge failure. In 2016, a bridge collapsing incident occurred on Savitri River in mahad district due to sudden floods in the river. Apart from this, problem of collapsing may arise on airport boarding bridges. This paper provides an overview of bridge health monitoring and damage detection which monitors the bridges through sensors and generates the alert. It mainly focuses on aging bridges.

A. Internet of things (IoT)

The Internet of Things (IoT) is the network of interconnected sensors established on physical devices as embedded technology to speak and sense or interact with their internal states or the external environment. This term was coined by Kevin Ashton of Procter and Gamble, later MITs Auto-ID Center in1999.

B. Components of IoT

1. Sensors:

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According to (IEEE) sensors are often defined as: An device that produces electrical, optical, or digital data derived from a fitness or event. Data produced from individual sensors or network of sensors is then transformed, by another device, into required information (output) that's useful in deciding done by intelligent devices or individuals human entity.

2. Networks:

The second important step of this implantation is to send the signals collected by sensors over networks . To connect the different physical and logical aspects of networks to the sensors can be often done by different technologies including Wi- Fi, Bluetooth,, Wi-Max, Ethernet , Low Power Wi-Fi , Long Term Evolution etc. Layers of IoT: There are mainly three IoT layers: 1.Sensor Layer: mainly liable for sensing pressure of water, level of water within the river and cargo on bridges. 2. Network Layer: It is mainly responsible for transmitting data from sensor to bridge monitoring system. 3. Application Layer: It is mainly responsible for transmitting data from Bridge Monitoring System to Admin/users.

II. METHODS

A. "*To Identify structure based losses and risks of bridge with the aid of IoT*".

Crack is that the commonest threat to the security and integrity of bridges. This paper analysed the sensible application value of the web of Things technology within the crack identification and detection of bridge structures for a bridge structure health monitoring supported the web of Things technology. On this basis, this paper also studied a digital and real-time intelligent bridge crack detection method to enhance the efficiency of bridge structure safety diagnosis and reduced the danger factors [1].

The primary objective of this task is to develop a cheap bridge tracking mechanism for constant monitoring. This project aim to simplify the system in order to select bridge tracking devices. Many bridges within the India are structurally deficient to safely increase the life and durability of those bridges, annual inspection would be vital. Bridge engineers and observing authorities have many duties and it is far not possible to expect one to know all. Hence monitoring device will sense the crack inside the bridge and signal might be given to respective authority in order to immediately stop the cars [5].

This survey put light on the analysis of the threshold of vibration derived from the vibration of the rail, when the train passes. Vibration thresholds values are utilized for the process of railway arrival detection in a vibration based latch system. The threshold level of values of the sensor will be sent to the coordinator as the decision of the closing of the gate. In this research observation of how much vibration when there is no train or when the train passes is done [11].

This paper proposed and developed architecture for bridge health monitoring on a more secure level taking into consideration the various parameters that are involved in the structural health of bridges. Here a 3-level distributed structure is adopted in the monitoring system, which includes a central server, intelligent node, and main local controller. Intelligent Acquisition nodes are located across the bridge. One main local controller manages all the acquisition nodes. Every acquisition node has 8 different channels, which can easily and approximately sample the change of the line of sight, the vibration occurs in the bridge due to a load of various transports over it and as well the water level which when cross a threshold limit lead to a flood [3].

This paper highlights the damage detection application; especially the focus is on Bridge Health Monitoring Application. The network of without son sensor is the adopted technology to reach this vital goal. So, it should be capable to quickly provide, the information concerning the physical phenomena and deviation occurring in its environment and structure. In this paper, the principal

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objective is to locate and to detect damages in bridges by the use of wireless sensor network. Internet of things provides a solution for damage occurred in bridge for health monitoring [2].

This paper suggests that there is a need to design a system which will continuously observe and monitor condition of bridges. It is useful for public safety and reduction in human losses. Such system will help in disaster management and recovery. IoT-based bridge health monitoring system is developed using the wireless sensor network technology. Proposed system will made up of: Monitoring devices installed in the bridge environment, communication network which connect the various sensors and the cloud based server, a dynamic database that stores bridge condition data, cloud based server evaluate data transmitted from the sensors as monitoring devices. This system can monitor and analyse in real time the condition of a bridge and its environment, including the water levels and other safety conditions. This paper presents a comprehensive survey of SHM using WSNs outlining and algorithm like damage detection and localization, network design challenges and future research direction.

B. **"***To detect water level under the bridge that can help to take important decision during flood conditions***".**

"To detect water level under the bridge that can help to take important decision during flood conditions".

Many of the bridges built on the river are subject to deterioration as their lifetime is expired but they are still in use. They are dangerous to bridge users. Due to heavy load of vehicles, high water level or pressure, heavy rains these bridges may get collapse or damage which in turn leads to severe disaster. So, these bridges require continuous monitoring and observation. So this paper is proposing a system which consists of a weight sensor, water level point contact sensor, Wi-Fi module, and Arduino microcontroller. This system detects the load of vehicles, water level, and pressure. If the water level, water pressure and vehicle load on the bridge cross its threshold value then it generates the alert through buzzer and auto barrier to avoid further circumstances. If it is necessary, then the admin authority assign the task to the employees for maintenance [8].

In this paper, first, a new sensing device that can continuously monitor urban flash floods and traffic congestion has been observed. Such sensors are based on the combination of ultrasonic range and remote temperature detection and can monitor both phenomena with a level of accuracy using a combination of L1-regular reconstruction technique with artificial neural networks to process measured data.. Second aspect is that, corresponding algorithms have been implemented with a low-power wireless sensor platform, and their performance during water level estimation in six months of test involving four different types of sensors is illustrated properly. The findings show that urban water levels can be measured with error of more or less than 2 cm, and also that the pre-processing and machine learning schemes can be run in real time on wireless sensor platforms currently available[12].

In this paper, the focus is to monitor the specific parameters of the bridge which will help to maintain the bridge and detect the faults. There all time safety evaluation of bridges includes the following components: (1) real-time analysis of weight. (2) real-time analysis of flood and water level.(3)The sensors will detect the condition of the changing parameter of the bridge The good results show that the proposed systems will have the required potential to provide real time information of water level. Also it will continuously monitor Water level below the bridge and keep a track of flood like situation to avoid accidents. The main aim of this project is to minimize the structural damages and prevent the loss of life and property [7]..

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C. **"***To assess the Bridge's load carrying ability*".

This paper proposes a system that can deals with above mentioned problem, using the model of Internet of Things (IoT) and combining multiple autonomous sensors, such as infrared sensor, ultrasonic sensor and load cell, to monitor each required condition. The output of the machine is data that will be displayed on user's phone, in order to help user in monitoring [10].

Many of the bridges in cities built on the river are subject to deterioration and damages as their lifetime goes on to expire but there is still a need to use them in country like India. They are dangerous for the bridge users. These bridges that collapse due to heavy loads of vehicles, high water levels or strain, which in turn leads to disaster. So, these bridges require continuous monitoring. So we are proposing a system which consists of weight sensor, water level point contact sensor, Wi-Fi module, Arduino microcontroller. This system detects the load of vehicles, water level and pressure. If the level of water, pressure of water and vehicle load on the bridge crosses its threshold value then the alert is generated by means of buzzer and auto barrier[4].

D. "*"Active monitoring and evaluate of Bridge's structural stability in real time to avoid civilian casualties and economic loss*".

It is necessary for engineers and electric companies to track and sustain the leakage current at the bottom, this paper describes the highlighted leakage current concepts for general electrical devices or instruments. Besides this, different methods of measuring leakage current are examined. It also reports the current sensors according to principle to mention their positive and negative effects. Whereas some of the current sensing techniques rise with the new principles, for example Hall-effect sensors and fluxgate sensor or advanced technologies such as magneto resistance effect sensing and Fibre optic technologies providing alternatives in current sensing, almost at an inexpensive price compared to conventional technologies such as shunt resistors. In addition to this, the system will be modified with transmitter block and receiver block which are connected to leakage current sensor and remote controller respectively. This can be used for data processing and storage of data [9].

Now a- days the situation of Traffic is getting intense day by day. The traffic is major factor which contributes to the delay in reaching destination. This delay can be a matter of life and death in case of emergency vehicles like Ambulance, Fire Brigade etc. This paper proposes an approach which controls the Traffic Signals so that when the emergency vehicle is on its way to a destination. The location of vehicle is tracked by using GPS. This location is send to the application. The application performs the algorithm with the help of this data and the Google map. It controls the signals on its path. This paper also introduced a new blue light to traffic signal to avoid the chaos in the mind of the people waiting at the traffic signal. Above survey shows the literature review for our system, from this review we are getting idea for our project. In some paper, from this review we were studied the uses of sensors which were used in different system. According to this paper review, we also know different methods and different sensors used to monitor bridge. With the help of this study, it is easy to implement our project based on different sensors [13].

III. CONCLUSION

The paper provides an overview of an IoT based system for the Bridge Health Monitoring, Damage and Flood Detection. Environmental sensors provide water level, current sensor value, vibration sensor value, and load cell and gate status of every bridge to control room, Observation authorities. This review highlights the technology that can be helpful to provide the accurate condition of the particular Bridge and its structural health audit. Thus we can conclude that this system will act as a lifeguard to every person travelling from particular Bridges.

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