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Bridge Monitoring and Alert Generation System Using IOT

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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 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 which in turn leads to disaster. So, these bridges require continuous monitoring. So we are 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. If it is necessary, then the admin assign the task to the employees for maintenance.

Keywords: IOT, Bridge Monitoring, Alert Generation.

I. INTRODUCTION

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 [4]. Scour is also one of the major causes of bridge failure [2]. In 2016, a bridge collapsing [10] incident occurred on Savitri river in Mahad district due to sudden floods in the river. Apart from this, the problem of collapsing may arise on airport boarding bridges [3].

This paper introduces bridge monitoring system which monitors the bridges through sensors [5] and generates the alert. It mainly focuses on aging bridges.

A. INTERNET OF THINGS (IOT)

The Internet of Things (IOT) [1] 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 Kevin Ashton of Procter and Gamble, later MITs Auto-ID Center in1999.

Components of IOT:

Sensors: According to (IEEE) sensors can be defined as an electronic device that produces electrical, optical, or digital data derived from a physical condition or event. Data produced from sensors is then electronically trans-formed, by another device, into information (output) that is useful in decision making done by intelligent devices or individuals (people) [8-9].

Networks: The second step of this implantation is to transmit the signals collected by sensors over networks with all the different components of a typical network including routers, bridges in different topologies, including LAN, MAN, and WAN. Connecting the different parts of networks to the sensors can be done by different technologies including Wi-Fi, Bluetooth, Low Power Wi-Fi , Wi-Max, regular Ethernet , Long Term Evolution (LTE) and the recent promising technology of Li-Fi (using light as a medium of communication between the different parts of a typical network including sensors)[6-7].

Layers of IOT:

There are mainly three IOT layers:

1. Sensor Layer: mainly responsible for sensing the pressure of water, level of water in the river and load on bridges.
2. Network Layer: It is mainly responsible for transmitting data from the sensor to bridge monitoring system.
3. Applica-tion Layer: It is mainly responsible for transmitting data from Bridge Monitoring System to Admin.

II. LITERATURE REVIEW

[1]This paper mainly focused on cloud computing, modern data communication, and industry process data sensor technology. They provide the safety to bridge by monitoring strain and basic parameters of the bridge. They used Zigbee technology.

[2]This paper presents in-situ scour monitoring sys-tem. This system responsible to trace the scouring depth of bridge pile foundation. They used Wi-Fi and 3G technology.

[3]This paper presents the airport boarding bridge monitoring system. This system gave early warning of collapse crisis, which may endanger personal safety.

[4]This paper presents the details of SPANNeT system development. It aims at providing a real-time monitoring and warning mechanisms for bridge structures by applying wireless sensor network, real-time data stream processing and Weighted Attack Graph based upon the measured bending strains.

[5]This paper presents Bridge Safety Monitoring Sys-tem which monitor and analyze in real time the conditions of a bridge and its environment, including the waters levels nearby, pipelines, air and other safety conditions.

III. PROPOSED SYSTEM

In this proposed system, we will use sensors like weight sensor, water level point contact sensor [5] as sensing de-vices. These sensors will be responsible for sensing the load on the bridge, pressure of the water, level of the water rising in the river. The data sensed by sensors will get converted into an electrical signal. The devices which generate output are generally called as actuators (sound buzzer, auto barrier).Both sensor and actuator are collectively called as a transducer. The electrical signal will get transmitted to the Arduino Microcontroller.

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Fig. 1. Arduino Microcontroller Some Pins Have Specialized Functions

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip. External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details. PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function. SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library. LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

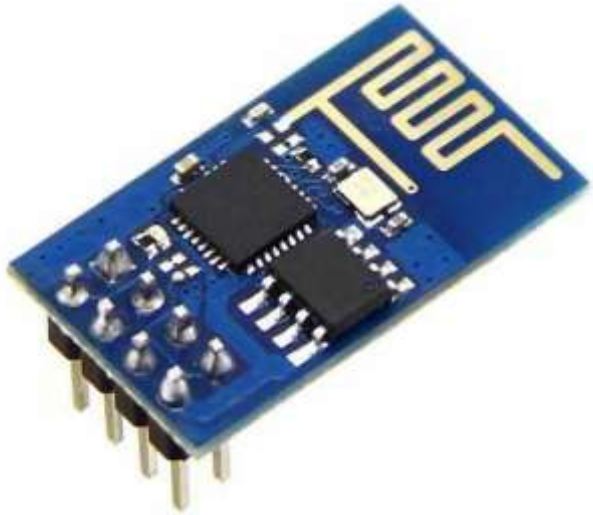

Fig. 2. Wi-Fi Module

To communicate with the ESP8266 wifi module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 wifi module using UART having specified Baud rate (Default 115200).

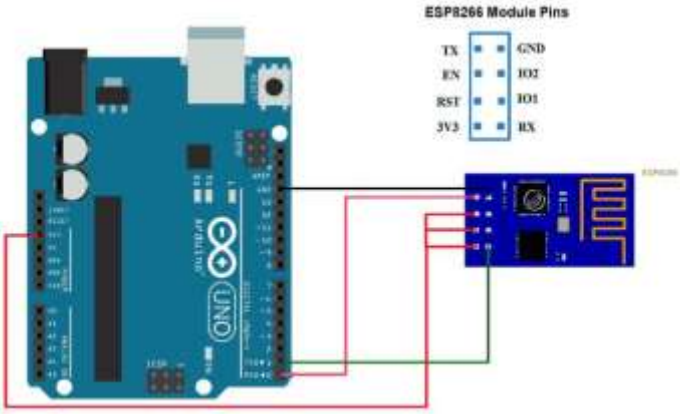

Fig. 3. Interface between Microcontroller and Wi-Fi Module

The server will receive data from a microcontroller using Wi-Fi module, then it will transfer the data further to the web application using a servlet.

A servlet is a small Java program that runs within a Web server. Servlets receive and respond to requests from Web clients, usually across HTTP, the Hyper Text Transfer Protocol.

In this way, the admin will get the data and alert will be generated through buzzer and auto barrier on the bridge. If it is necessary then the admin assign the task to the employees for maintenance.

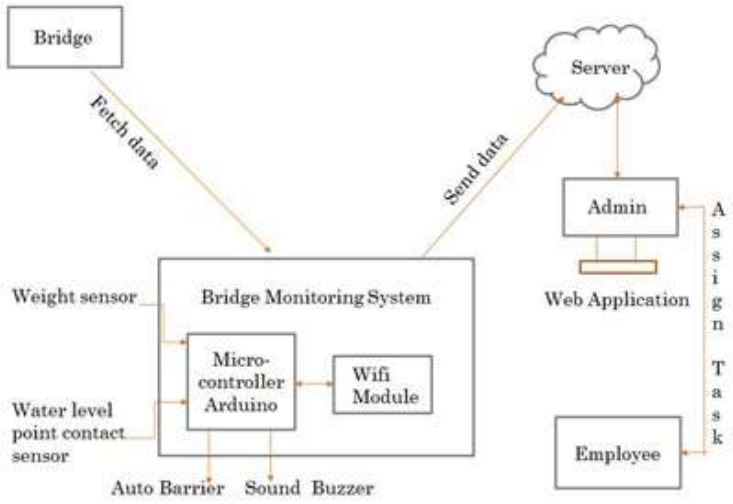

Fig. 4. Proposed System

IV. ADVANTAGES

- It generates the alert if flow, water level, and the load are increased.
- It saves the life of people.
- It provides live data of the load, water level, and pressure.
- Quick action and responses. Reducing resources.

V. APPLICATIONS

To monitor the bridges.

VI. CONCLUSION

Bridge Monitoring and alert generation system using IOT, to alert using buzzer and auto- barrier when there are signs of collapsing the bridge. This system will help to reduce big disasters in future. This system can save the lives of many people.

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