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REAL TIME 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 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 water level ,water pressure and vehicle load on the bridge crosses its threshold value then it generates the alert through buzzer and auto barrier.

Keywords: *IoT, Bridge monitoring, Alert generation*

I INTRODUCTION

Engineering structures are responsible for economical growth, development and evolution of the nation. The structure include 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 for 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, problem of collapsing may arise on airport boarding bridges[3]. This paper introduces bridge monitoring system which monitors the bridges through sensors[5] and generate 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:

1.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 transformed, by another device, into information (output) that is useful in decision making done by intelligent devices or individuals (people)[8-9].

2.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 pressure of water, level of water in the river and load 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.

II MOTIVATION

To provide alert using a buzzer and auto barrier so that people get to know about the upcoming problems of

bridge collapsing caused due to the overflowing of rivers and due to heavy load of vehicles.

III OBJECTIVES

The objective of the system is to continuously monitor the bridges, sense the environment and send the data to web application through the server, generate the alert with the help of buzzer and auto-barrier if load of vehicles and level of water in river crosses its threshold value.

IV PROPOSED SYSTEM

In this proposed system, we used sensors like weight sensor, water level point contact sensor[5] as sensing devices. These sensors are responsible for sensing the load on the bridge, level of the water in the river. The data sensed by sensors converted into electrical signal. The devices which generate output are generally called as actuators(sound buzzer, auto barrier).Both sensor and actuator are collectively called as transducer. The electrical signal 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 a AC-to-DC adapter or battery to get started.

Figure 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 attach Interrupt() 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 SP 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.

Figure 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).

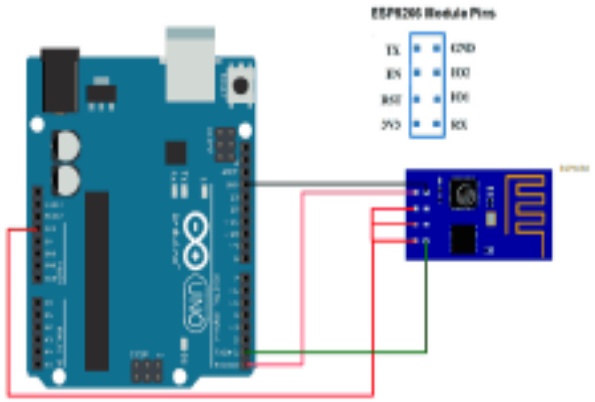


Figure 3 Interface between microcontroller and wi-fi module

Server received data from microcontroller using Wi-Fi module, then it transferred the data further to the web application using 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. Through the server, the admin got the data of the bridges and in this way he monitored the bridges.If the values of weight, water level goes above the threshold value, then alert generated through sound buzzer and auto barrier on the bridge as well as a pop up message will be displayed on the admin's screen even if the admin has login or not login.

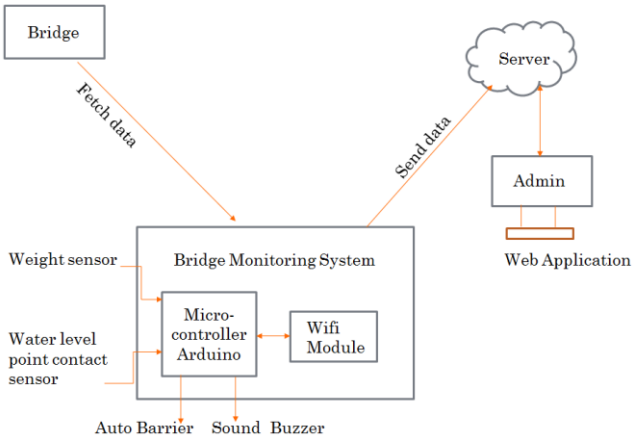


Figure 4 Proposed Systems

V IMPLEMENTATION

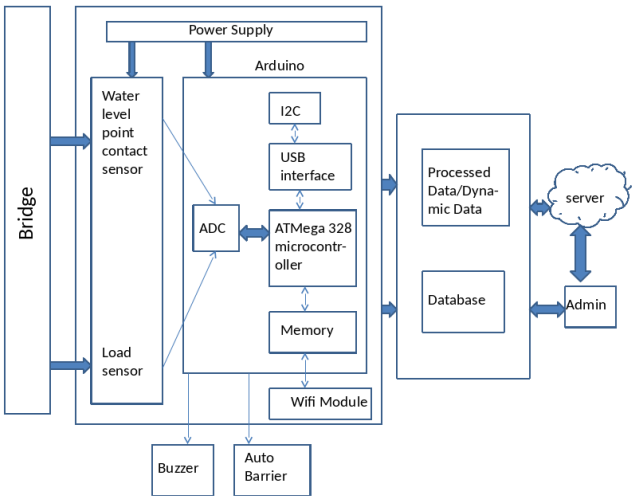
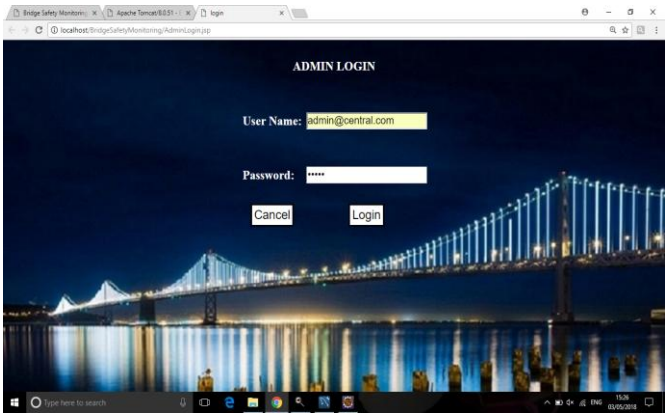
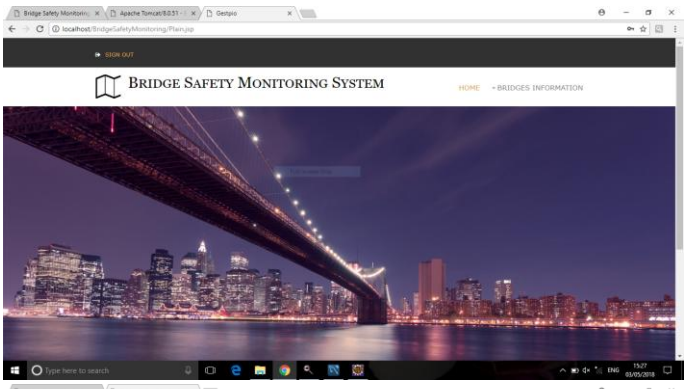


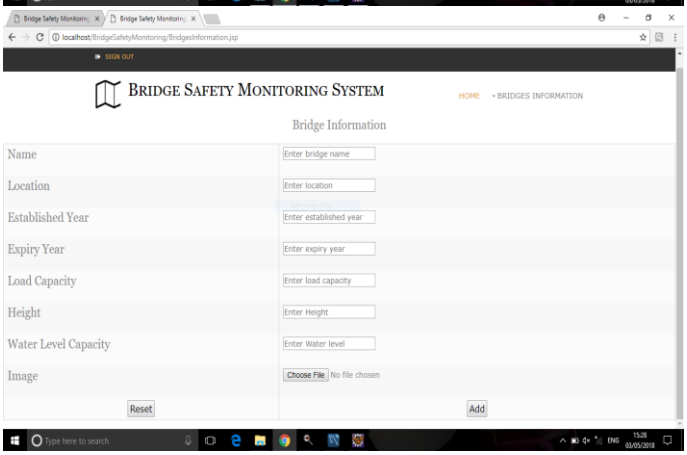
Figure 5 Schematic diagram of implementation model

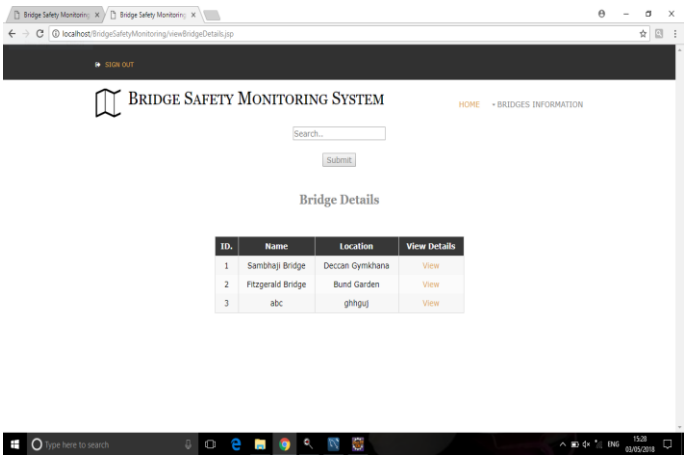
In this implementation model we used Arduino Microcontroller board, Sensors and ESP8266 Wi-Fi module as an embedded device for sensing and storing the data. Arduino board consist of 12 analog input pins (A0- A5), The Arduino UNO board has 14 digital I/O pins (15). Wi-Fi module connects the embedded device to internet. Sensors are connected to Arduino UNO board. Its read the sensors and on chip ADC converted the corresponding sensor reading to its digital value and from that values the corresponding environmental parameter are evaluated. Here we are connected ESP8266module to 19 (Rx1) and 18 (Tx1) pins of Arduino UNO. An embedded system designed for environmental monitoring and its components are shown in figure . The load sensor detects load on bridge and water level point contact sensor detects the water level if the threshold limit is crossed the corresponding controlling action is taken (like barrier get fall down and buzzer).All the sensor devices are connected to internet through Wi-Fi module. After sensing the data from different sensor devices, The sensed data automatically sent to the server, when a proper connection is established with server.

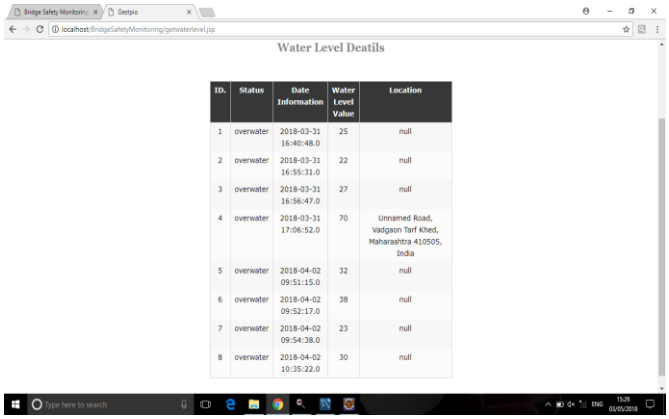
VI SIMULATION RESULT











VI MATHEMATICAL MODEL

Let Assume S be the system which is Real time Bridge Monitoring and Alert Generation System Using IOT.

S=Sw,Wv,Sp,Wl,Sb,Ab,Ad,Tw,Tl

S(System) = Is our proposed system which includes following tuple. Where,

Sw=weight sensor

Wv=weight of vehicle

Sp=water level point contact sensor

Wl=water level

Sb=sound buzzer

Ab=auto barrier

Ad=admin

Tw=threshold value of weight

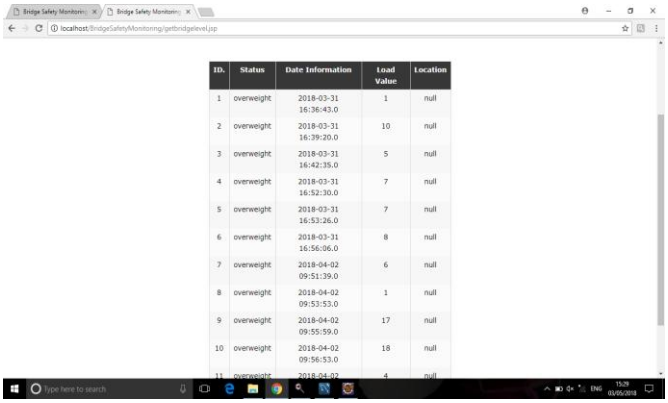
Tl=threshold value of water level

if(Tw¡Wv) or (Tl¡Wl) Then,

Sb(sound buzzer)Ab(auto barrier)

VIII 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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