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IOT Based Bridge Health Monitoring System

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ABSTRACT

Bridge monitoring system is significant to health diagnosis of bridges and flyovers. This project is proposed and developed a novel architecture for large span bridge monitoring. A-3 level distributed structure is adopted in the monitoring system, which includes central server, intelligent acquisition node and local controller. Acquisition nodes are located across the bridge. One local controller manages all the acquisition nodes. Every acquisition node has 8 channels, which can sample displacement, line of site and vibration of bridge. To get high precision data, a 10 bits A/D converter. Compare to the traditional method, the proposed architecture has two features. First, the acquisition node is a smart device based on powerful controller. Signals of field sensors are analysed and real time compressed in the acquisition node. Only the processing results are sent to local controller through IEEE 802.11 wireless network. This operation can relieve load of central server. The intelligent monitoring system has run on a large span bridge. Running results show that the proposed system is stable and effective. Keywords: IOT, Arduino, IR Sensor, Water Sensor, Wireless Sensor Network, Bridge Health Safety Monitoring, Alert Generation, Bridge Tracking Gadget (BMS), Harm Detection, Bridge Maintenance, Data Analysis.

1. INTRODUCTION

1.1 Introduction:

The mishaphappened on TheColonial-eraBridgeon the Mumbai-GoaHighway cavedin around Tuesday midnightowing to an incessantdownpour, which lashed the Konkan, causingthe riverto swell andmaul theweather-beaten bridge. Two State Transport buses, and a number of private vehicles,unable to seethe rupturedspan, plunged intothe raging floodwatersbelow.

To overcome such incidentwe canhave data-acquisitionsystemsare used in structuraland seismicmonitoring projectsrangingfrom simplebeam-fatigueanalysis,to structuralmechanics research, tocontinuous monitoringof large, complex structures.Our systemsprovide remote, unattended,portable monitoring*f*or and bridges. They arecompatiblewith awide varietyof sensors and peripheralsto fityour exact needs.This reportaims tosimplify theprocess of selectingbridge healthmonitoringsystems for thebridge engineer. Hundreds of bridges in the state on Maharashtraareobsoleteor structurallydeficient.To safely extend the lifeof these bridges, rigorous inspectionwould benecessary. These inspectionsare both costlyand time consuming. However, the field of bridge healthmonitoringmay beable to relievesomeof the cost and burden on thebridge engineer. Bridge engineers havemany responsibilitiesand it is impossibleto expectone to know. Our system willsense thewater levelangleif crackin the bridge willme sensed andsignal willbe givento the vehiclesto stopand will automaticallygive red signal andwill closethe gateand willsend detailsof sensor to controlroom. Bridge is one of the most important transportation infrastructures for social and economic activities of country which has long rivers.

Internet of Things (IOT): The Internet of Thing is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enable these things to connect and exchange data, creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions.

1.2 Necessity :

Bridge monitoring system (BMS) provides real time indication to us where we can easily save too many lives and we can avoid the loss.BMS is a tool to improve the safety and maintainability of bridge.

BMS provides real time and accurate information about the structural health condition of bridge. It is a process of non-destructive evaluations to detect location and extent of damage, calculate the remaining life, and predict upcoming accident.

1.3 Objective:

The system gathered data from sensors and the status is collected by the controller and is transferred through wireless network. This data is sent to the server and is analysed by the Arduino. Analysed data is sent to the management centre and an alert message is sent to the operator device. We will use sensors like IR sensor, water level point contact sensor as sensing devices. 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 sensory data will get converted into an digital signal. The devices which generate output are generally called as actuators (sound buzzer). Both sensor and actuator are collectively called as a transducer. The electrical signal will get transmitted to the Arduino. 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**.**

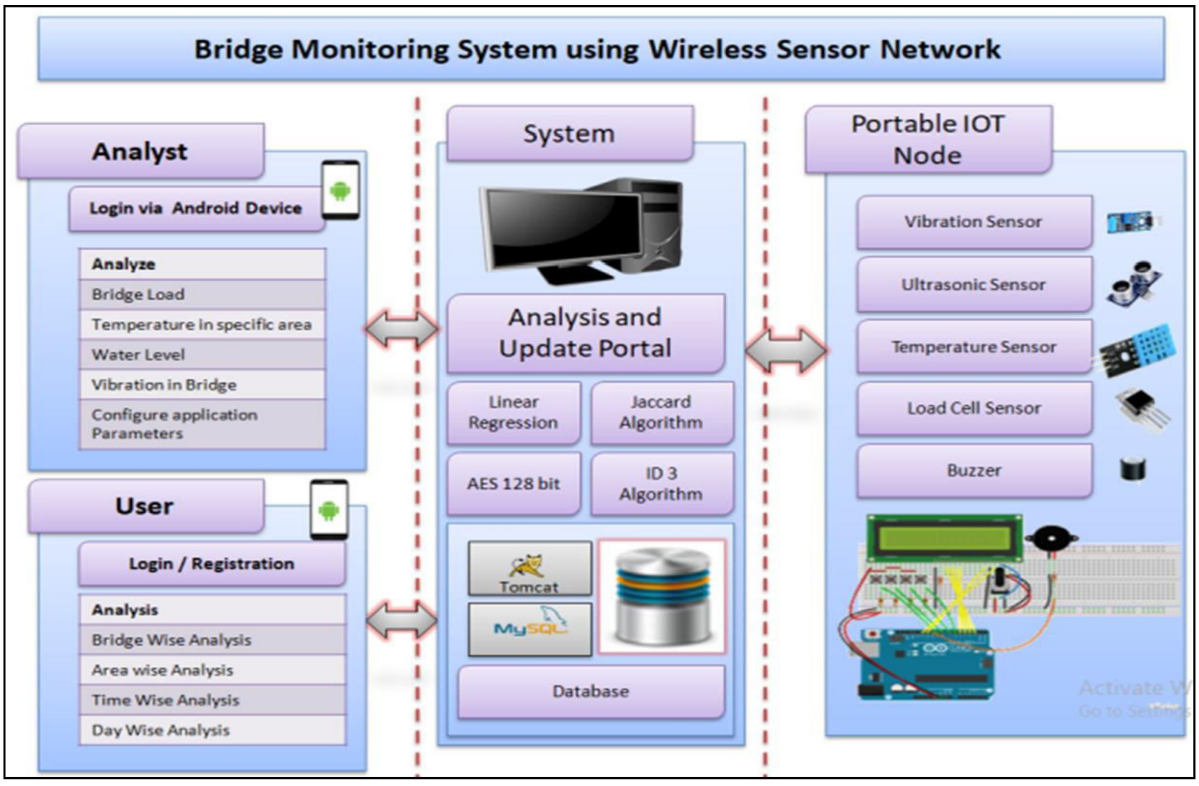
2. LITERATURE SURVEY

The bridge safety monitoring system which monitors and analyzes in real time the conditions of a bridge and its environmental condition , including the waters levels nearby, pipelines, air and other safety conditions. This project aims to simplify the system for selecting bridge tracking devices. Many bridges within India are obsolete or structurally deficient to safely increase the life of those bridges, inspection would be vital. Bridge engineers have many duties and it's far not possible to expect one to know. Our device will sense the crack inside the bridge and signal might be given to govern room immediately to stop traffic. The sensors and the LCD are interfaced with the Atmega(Microcontroller). The sensors used are Flex and Water level. The value is set so that if there is any sort of tilt or little crack and if it crosses our set value then the crack is detected. [1]
For developing bridge Health Monitoring System a 3level distributed structure is adopted in this system which includes central server, intelligent acquisition node and local controller. Acquisition nodes are located across the bridge.
All the acquisition nodes are managed by one local controller. Every acquisition node has 8 channels which can sample displacement, acceleration and strain of bridge. Compared to the traditional method, the proposed architecture has two features. The acquisition node is a smart device based on powerful ARM processor. Signals of various sensors are analysed and real time the data is compressed in the acquisition node. Only the processing results are sent to local controller through wireless networks. This operation can relive load of central server and decrease demand of communication bandwidth.

3. SYSTEM DEVELOPMENT

3.1 System Architecture:

The proposed system is the development of bridge monitoring system using IOT. The system continuously monitors the bridge condition. They use a different sensor to get the bridge information like ultrasonic sensor, load cell sensor, vibration sensor, and temperaturesensor.Thebridgeloadisgettingthroughtheloadcellsensorandthevibrationisgettingusingavibrationsensor.By usingtheultrasonicsensorsystemgetthewaterlevelunderthebridge.Allsensorsgetthereal-timevalueandsenditto theserver and android. The analyst login the android device and analyze the data that was sent by the system. It sends the data to the user. Usercanseethedatawhicharealreadyregisteredinthedatabasethesedatawillhelptheusertoseethedetailsofthebridge.These data can be helpful to avoid accident and all that data will display on the lcd. If the sensor value is above then the limit then the systemwillplaythebuzzerandnotifythepeoples.Thedetaildescriptionofproposedsystemisasfollows.

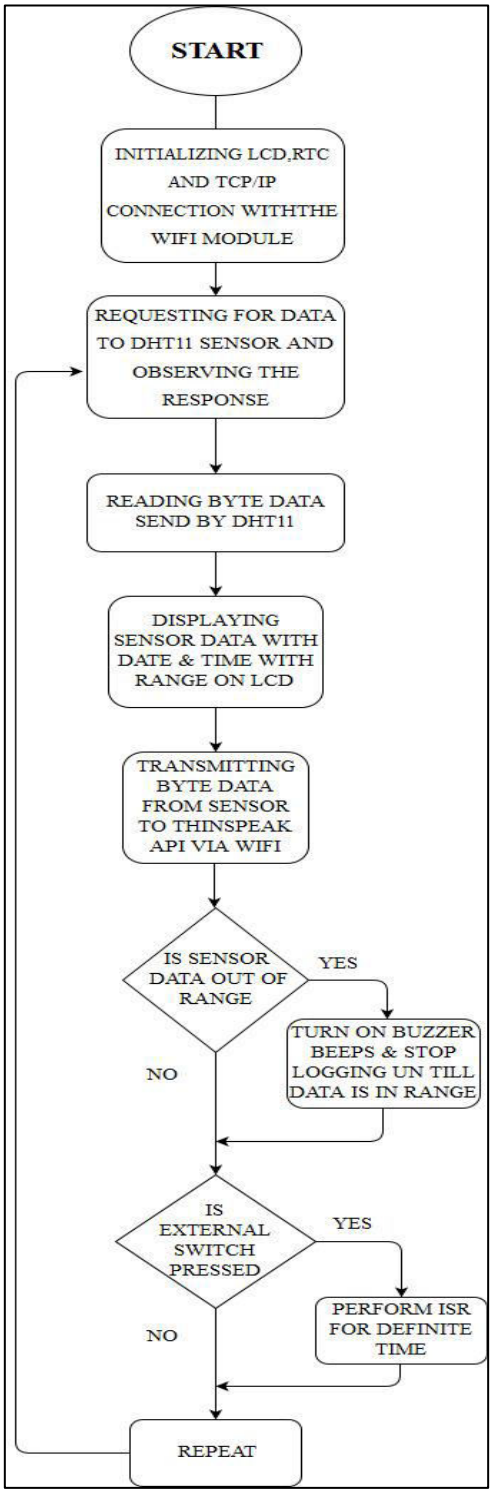


4. PERFORMANCE ANALYSIS

4.1Hardware Specifications:

COMPONENT	VALUE	QUANTITY
Resistors	10kΩ network	1
	2kΩ	1
	5kΩ	1
	10kΩ	1
Capacitors	33pf	2
Crystal	11.0592MHz	1
Microcontroller	89V51RD2	1
Switches	Push button	2
LED	3mm	2
Display	20x4 LCD	1
Buzzer	Beeper	1
RTC	DS12887+	1
Temp & Humidity sensor	DHT11	1
WiFi Module	ESP8266	1

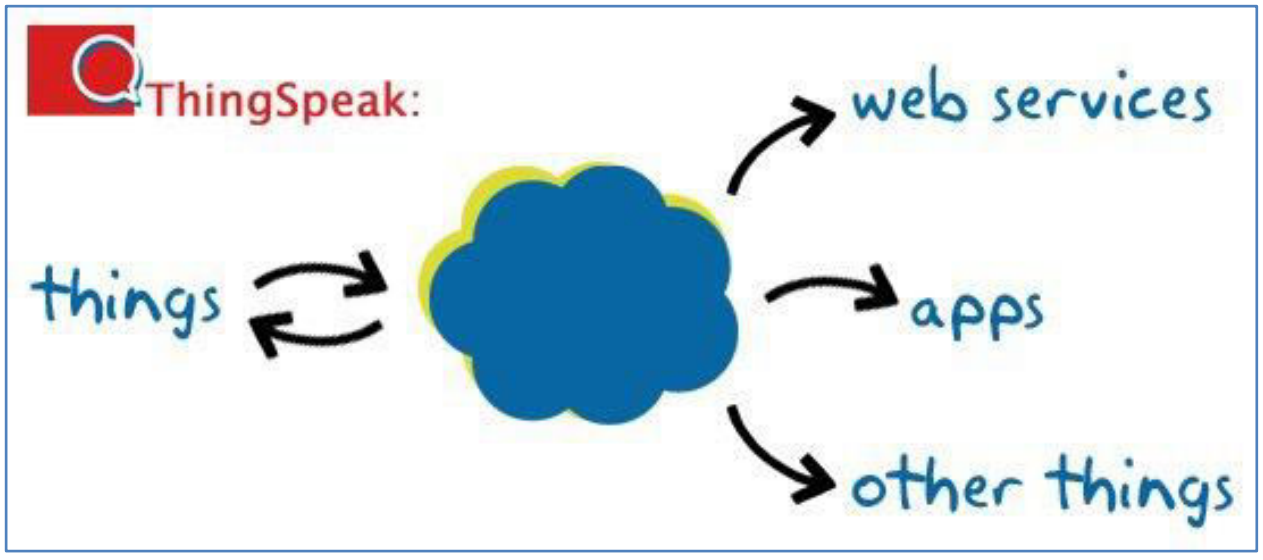
5. FLOW OF THE PROJECT



6. ABOUT THING SPEAK

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software.
- Automatically act on your data and communicate using third-party services like Twilio or Twitter.

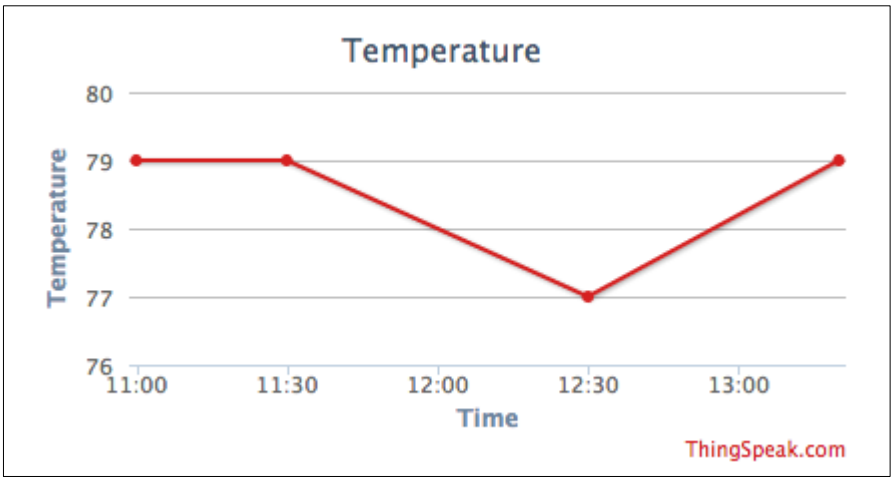


Send sensor data to the cloud.

There are sensors all around—in our homes, smart phones, automobiles, city infrastructure, and industrial equipment. Sensors detect and measure information on all sorts of things like temperature, humidity, and pressure. And they communicate that data in some form, such as a numerical value or electrical signal.

Why would you want to collect data in ThingSpeak?

Sensors, or things, sense data and typically act locally. ThingSpeak enables sensors, instruments, and websites to send data to the cloud to store in a channel. Once data is in a ThingSpeak channel, you can analyze and visualize it, calculate new data, or interact with social media, web services, and other devices.



Why would you want to analyze and visualize data in ThingSpeak?

ThingSpeak provides access to MATLAB to help you make sense of data. You can:

- Convert, combine, and calculate new data.
- Schedule calculations to run at certain times.
- Visually understand relationships in data using built-in plotting functions.
- Combine data from multiple channels to build a more sophisticated analysis.

Trigger a reaction.

Acting on data could be something as simple receiving a tweet when the temperature you are measuring goes above 70° F. Or you could set up a more intricate action such as turning on a motor when the water level in your water tank drops below a specified limit. You can even remotely control devices, such as battery-operated door locks, using the TalkBack app.

ADVANTAGES AND DISADVANTAGES

Advantages-

1. Measurements are always taken at the right time. Unlike a human, data logger will not forget to take a reading or take a reading too late or too early.

2. Mistakes are not made in reading the results.

3. Data can be accessed over internet.

4. Graphs and tables of results can be produced automatically by the online API oncomputers.

Disadvantages-

1. Needs a internet connection

2. High cost.

3. Need a skilled user to operate and control

4. It may possess cyber security threat.

CONCLUSION

Here we have discussed the different methods used by the researcher to monitor the bridge condition. Such a system will help to control the dynamic parameters of the bridge for preventing it from the disaster which can save them any lives and also wealth.This system is unique in its ability to monitor the bridge environment, transmit the environmental data through wireless communication and send alerts to the bridge management staff in real time for prompt reactions. This system can enable 24x7 bridge safety management as well as prompt andappropriate.Responses to emergency incidents.

The system continuously monitors the bridge parameter value and judges whether the bridge is safe or not for traveling. In case the parameter values are beyond the threshold values the nan alert sound is given to the people.