

Implementation of Bridge Strength Detection and Accident Prevention System using Raspberry pi

Abhishek R. Sonar, Husain K. Bhaladar, Rohit S. Ranaware, Tanjim M. Sayyad



Abstract:-In today's era, there is a huge advancement in the field of sensors and computing systems which make real-time monitoring of Bridges much easier and cheaper. There is a need for real-time bridge strength monitoring to avoid crisis scenarios. Currently available systems use a much more complicated wired network, sensors, and controller, this results in a high cost of installation resulting in an increase in the cost of a bridge. The wired network increases complexity which makes it complicated to install. This paper proposes the use of Raspberry pi which has a longer life span which reduces complications in-network and uses advanced sensors.

Keywords: - Raspberry pi, flex sensor, GSM, Vibration sensor.

I. INTRODUCTION

Monitoring based maintenance system enables the maintenance engineer to monitor real-time situation and parameter of the bridge to schedule its maintenance time slot. The reason behind that crisis scenarios related to bridges due to poor maintenance and structural audit. On 3rd Aug 2016, a bridge collapsed on Savitri River due to poor structural audit nearly about 41 people died.

To prevent this crisis scenarios system can be developed with the help of advanced sensors such as flex sensor, vibration sensor and IR sensor the data of the sensors are precise and accurate. This data needs to be processed. The changes detected by the sensors are further processed by Raspberry pi to get the condition of the bridges. Only getting the status of the bridge is not sufficient here Communication plays an important role. There are multiple options are available for communication. In both wired and wireless communication. The wired communication system makes the system complex and costly. So instead of that, we are using the wireless communication method. In wireless communication, we are using GSM communication.

The GSM communication is a cost-effective way for communication with the help of GSM technology, we can send real-time data to the maintenance office located in any remote area and emergency alert message to the respective authorities and near by police station in case of any dangers zone.

Advantages:

- Avoid accidents and life loss.
- Improve disaster management capability.
- Early damage detection.
- Assurance of a structure's strength and serviceability.

The flex sensors are used to check the deformation in the bridge which gives the information about the dead load bridge. More the deformation more the dead loads. When dead load crosses the dead load limit it becomes dangerous to use. The vibration sensor is used to measure the vibration of bridges when any accident happens on the bridge, we get the intimation. It also gives the intimation of earthquakes. The IR sensor help in the case of bridge failure scenarios it gives quick intimation to the raspberry pi.

II. LITERATURE SURVEY

Branko Glisic proposed the use of optical fiber cables in the concrete bridges while manufacturing the bridges which are used to get the value of the deformation present in the bridges which are the main reason behind the increase in dead load. Depending upon the bending loss deformation is calculated.[1] Prateek Prasanna proposed the Automated Crack Detection on Concrete Bridges. This paper proposed the use of Machine Learning and Image Processing technology to identify the cracks on the bridges. Based on the image processing algorithms and techniques it finds out the cracks in the bridges and with the help of machine learning. It compares the image of that particular bridge with its previously available bridge images.[2] Ms. Shital Nandkishor Vitekar proposed the Automatic Bridge Monitoring Using Wireless Network. In this paper, the author mentioned the use of Ultrasonic sensor, Accelerometer, Humidity sensor, and WAN. These sensors monitor the different parameters and predict the bridge condition.[3] C. C. Ren- Guey Lee proposed the A Backup Routing with Wireless Sensor Network for Bridge Monitoring System in this author mentioned efficient and reliable use of WAN networks to access the remote bridge sensors for monitoring the bridge-related parameters alongside wired network for communication.

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* Correspondence Author

Mr. Abhishek R Sonar*, Student at SVERI's COE Pandharpur, India,

E-mail: abhishekrsonar@coep.sveri.ac.in

Mr. Husain K Bhaladar, Research scholar, BKIT, Bhalki, VTU Belgavi & Asst Prof. SVERI's COE, Pandharpur, India, E-mail: hkbhaladar@coe.sveri.ac.in

Mr. Rohit S Ranaware, Student at SVERI's COE Pandharpur, India, E-mail: rohitrnanawaew@coep.sveri.ac.in

Mr. Tanjim M Sayyad, Student at SVERI's COE Pandharpur, India, E-mail: tanjimmsayyad@coep.sveri.ac.in

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Whereas WAN networks are Backup Routing Network.[4]

Yan Yu1, Hang Liu1 proposed the Bridge Deflection Measurement Using Wireless MEMS Inclination Sensor Systems In this paper, they planned the use of MEMS Inclination Sensor for detecting the inclination in the bridges which are causing dangerous effects on the bridges that make the bridges insecure to travel.[5]

Prof. Y. R. Risodkar, Mr. Ankush S. Pawar, planned the Structural Health Monitoring of Bridge Using WSN. In this paper, the author mentioned the use of WSN with the help of sensors and the global system for mobile, which helps the authorities to check all parameters related to bridges from any remote location. That is leading to a fine structural audit. [6]

III. WORKING METHODOLOGY

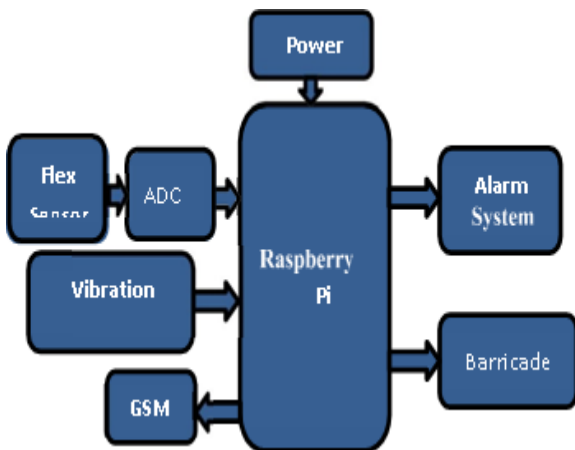


Fig 1: - Block Diagram

Flex Sensor:

The flex sensor is used to measure the deformation of the bridge. Over the period of time there are gradual deformation gets developed in the bridge. This deformation must be measured. Depending on the deformation or bend flex sensor changes its resistance. To convert this resistance, change in electrical parameter we are using the voltage divider circuit. The output of the flex sensor is resistance change. So, the output is taken across the voltage divider.

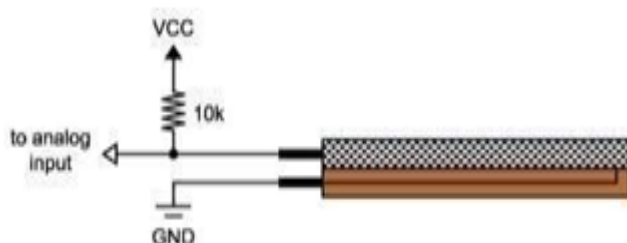


Fig 2: - Constructive view of Flex Sensor

ADC:

As the raspberry pi does not have any in built a log to digital converter. We need to use ADC PCF8591. It converts the output of the flex sensor in the digital signal format. This digital signal conveyed to the raspberry pi zero through the I2C communication protocol. The raspberry pi zero is the master device in this communication and ADC PCF8591 works as a slave device here the I2C communication is

initiated by the Raspberry pi zero.



Fig 3: - PCF8591 Module

Vibration Sensor:

The vibration sensor is also known as a piezoelectric sensor. It used to measure vibration. The vibration sensor is based on the principle of the piezoelectric effect. The vibration sensor is used to detect the earthquake. Whenever the vibration sensor detects high vibration signal it sends the intimation signal to the raspberry pi zero.



Fig 4: -Vibration Sensor

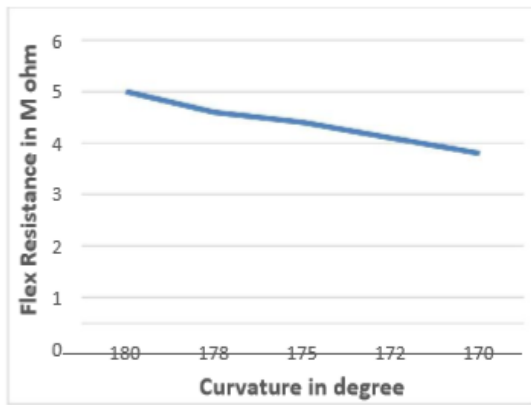
GSM:

GSM stands for Global System for Mobile Communication and it is mobile communication modem, GSM used TDMA technique for communication. This allows communication anywhere, anytime and with anyone. The GSM can make all the functionalities of mobile phones by using the computer system and perform the command like sending SMS, MMS, receiving calls. The GSM module sends the SMS to the nearby police station and the respective department officers about the critical scenario. Whenever the officers give the confirmation about these scenarios live earth quake then the system will shut the bridge off. The GSM works on the existing mobile communication channels there is no need to set up an additional network which makes it easier to implement this solution.



Fig 5: - GSM Module

IV. RESULTS



This figure shows the graphical representation of flex sensor resistance depending upon the curvature of the sensor. When there is no curvature then it shows 5M ohm and if the curvature is beyond the threshold level which is at 175 degrees then it shows 4.5M ohm at this stage the bridge is in critical condition and the alert message is sent to the respective department, and barricades gets closed which shows that bridge condition is not good for transportation. The vibration sensor detects the vibrations then intimation is received by the raspberry pi which displays the message on the LCD display. And start closing the barricades The SMS is sent on the predefined number. If the condition of the bridge is safe and due to some malfunction of the sensor it is closed in that case it can be reopened by sending the SMS to the raspberry pi zero through the GSM module.

V. CONCLUSION

This paper is effectively experimented & implemented for bridge strength monitoring and alert system to avoid crisis scenarios. Which helps for easy monitoring of bridge parameters.

FUTURE SCOPE

A further modification for this project can be the use of IoT which replaces the GSM communication system. AI will make the system smarter system which will work more efficiently.

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AUTHORSPROFILE



Mr. Abhishek R Sonar, Student atSVERI's COE, Pandharpur,India, Mob. No. +91-7028790808. E-mail:abhishekrsonar@coep.sveri.ac.in



Mr. Husain K. Bhaladar, Research Scholar, BKIT, Bhalki, VTU Belgavi & amp. Asst. Prof. at SVERI's COE, Pandharpur, India, Mob.No.+91-9096615501. E-mail:hkbhaladar@coe.sveri.ac.in



Mr. Rohit S Ranaware, Student at SVERI's COE, Pandharpur, India, Mob. No. +91-9146855915. E-mail:rohitsranaware@coep.sveri.ac.in



Mr. Tanjim M Sayyad, Student at SVER's COE, Pandharpur, India, Mob. No. +91-9021227665 Email:tanjimmsayyad@coep.sveri.ac.in