BRIDGE MONITERING SYSTEM

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ABSTRACT - A bridge monitoring system is significant to the structural health monitoring of both old/new bridges and flyovers an infrastructure daily used by citizens of their respective countries. The following report is proposed and developed an architecture for bridge monitoring on a more secure level taking into consideration the various parameters that are involved in the structural health of bridges. A 3-level distributed structure is adopted in the monitoring system, which includes a 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 easily and approximately sample the deviation of the line of sight, the vibration of the bridge due to a load of various transports and as well the water level which when cross a threshold lead to a flood. To get high precision data, a 10 bits A/D converter is being used. Compared to the traditional method, the proposed architecture has two features. The acquisition node is a smart device based on a powerful controller. Signals of field sensors are analyzed and real-time compressed in the acquisition node. Only the processing results are sent to the local controller through the IEEE 802.11 wireless network. This operation can relieve the load of a central server. The intelligent monitoring system has run on a large span bridge. Running results show that the proposed system is stable and effective

1. INTRODUCTION

With the rapid development of the economy in our country, the transportation has made great progress, and the highway mileage has been increasing fast. However, the increasing vehicles which exceed the weight limits have done great damage to the pavements and bridges. According to the experience in highway construction in other countries, if this situation can't be controlled effectively as soon as possible, the lifespan of these roads and bridges will be greatly shortened, which will cause a huge waste in investment.The overweight transportation, so-called "Killer of the Highways" can cause destructive damage to the roads and bridges, furthermore the great loss in the state's regulation fees and tax income. It brings about a sharp increase in the traffic accidents and the disorder in the road transportation. In order to improve the Bridge maintenance, it has become a very important task to develop an accurate, complete and practical weigh-in-motion as well as crack detection system to meet the needs of the bridge safety &traffic controllers. It has a technology called MBM (Monitoring Based Maintenance) that enables the bridge Maintenance engineers to monitor the condition of the bridge in Real time. The sensors installed on main cables, hangers, Decks, towers, etc. Detect the strain and crack of the bridge. The sensory inputs are process to represent the condition of the bridge against seismic loads. Sensor technologies have made the monitoring process more Accurate and fast. GSM technology is suggested to send the data to the remote location in which the maintenance office is located. However, regardless the advancements

of the sensor and sensor data processing technologies, there is one thing that has not been changed: data communication is through wires and optical cables. The advancement in wireless technology has provided motives to the authors to develop the wireless network based bridge health monitoring system.

2 LITERATURE SURVEY

1. **Title:** Structural Health Monitoring of Bridges Using Wireless Sensor Networks.

   Authors: Tyler Harms, Sahra Sedigh, and Filippo Bastianini.

Year: Dec 2010.

Comment: Aging and degradation of transportation infrastructure pose significant safety concerns, especially in light of increased use of these structures. The economic downturn further exacerbates such concerns, especially for critical structures such as bridges, where replacement is infeasible and maintenance and repair are expensive. The US Federal Highway Administration has classified over 25% of the bridges in the United States as either structurally deficient or functionally obsolete, underscoring the importance of structural health monitoring (SHM) to ensure public safety. In this given an overview of emerging wireless sensor networks (WSN) for autonomous SHM systems, their application, the power use and sources needed to support autonomy, and the type of communication that allows remote monitoring**.**

2. **Title:** Design of a wireless sensor network for structural Health monitoring of bridges.

Authors: M. Reyer, S. Hurlebausa, J. Mander, O. E. Ozbulut.

Year: 2011.

Comment: Bridges are bottlenecks in the railroad net, because of their limiting characteristics. To achieve a high load of the railroads old bridges especially are being pushed to their physical limit, regarding transfer speed, schedule, axle load and train length. Therefore monitoring of these strategic structures is getting more and more important. Installation costs of conventional sensors are expensive and time intensive. New wireless sensor platforms and distributed processing algorithms, going hand in hand with new or enhanced monitoring methods, promise an early damage detection and damage estimation. This paper designs a wireless sensor network for Structural Health Monitoring using commercially available wireless sensors to measure and extract vibration characteristics of bridges. The functionality of the network is verified in a laboratory experiment.

3. **Title:** Weigh-in-Motion Systems for Bridge Protection and Bridge Traffic Data.

Authors: International Road Dynamics Inc. (IRD).

Year: AUG 2013.

Comment: Prevent damage to bridges from over-loaded vehicles using IRD's WIM (Weigh-in-Motion) systems. WIM technology plays a vital role by monitoring truck weights in advance of bridges and on the structures themselves. This is especially the case for bridges that are under a load restriction due to distress. Continual monitoring by enforcement agencies enables the rerouting of overweight vehicles before they can do damage to bridges that are compromised, or that were built to support lighter vehicles.

4. **Title:** Semi-Supervised Multiresolution Classification Using Adaptive Graph Filtering with Application to Indirect Bridge structural Health Monitoring.

Authors: Siheng Chen, Fernando Cerda, Piervincenzo Rizzo, Jacobo Bielak.

Year: JUNE 2014.

Comment: It present a multiresolution classification framework with semi-supervised learning on graphs with application to the indirect bridge structural health monitoring. Classification in real-world applications faces two main challenges: reliable features can be hard to extract and few labeled signals are available for training. It propose a novel classification framework to address these problems: It uses a multiresolution framework to deal with non-stationarities in the signals and extract features in each localized time-frequency region and semi-supervised learning to train on both labeled and unlabeled signals. Also further propose an adaptive graph filter for semi-supervised classification that allows for classifying unlabeled as well as unseen signals and for correcting mislabeled signals. It validate the proposed framework on indirect bridge structural health monitoring.

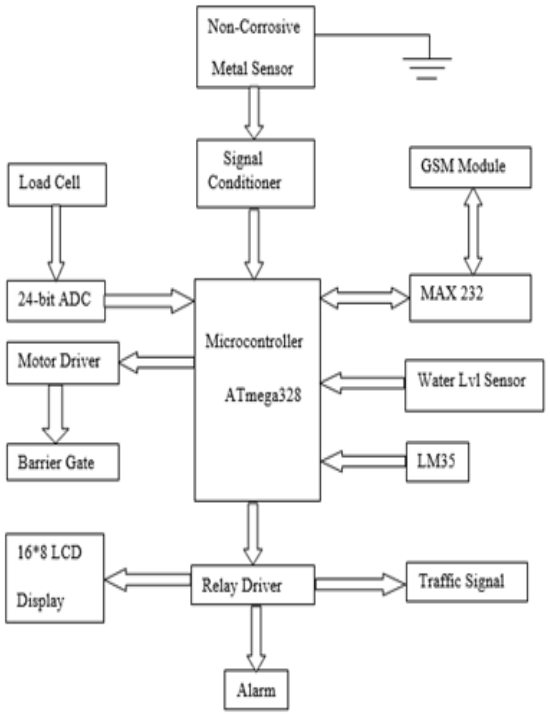
5. **Title:** Bridge Condition Monitoring System Using PIC Microcontroller

Authors: Mr.M.V.N.R.P.Kumar, Ms.B.Hombal, Miss. J.D. Kadam, Mr. A. B. Yadav, Mr. B.M. Pawar.

Year: MAY 2015.

Comment: Advancements in sensor technology have brought the automated real-time bridge health monitoring system. Many long span bridges in Korea and in Japan have adopted this real-time health monitoring system. However, current system uses complicated and high cost wired network amongst sensors in the bridge and high cost optical cable between the bridge and the management center, which increases the overall cost of installation and maintenance cost of health monitoring system. The complicated wiring also makes the installation and repair/replacement process difficult and expensive. In this paper, a new idea of bridge health monitoring systems suggested GSM for long distance (between the bridge and the management center) data communication is tested.

2. BlOCK DIAGRAM

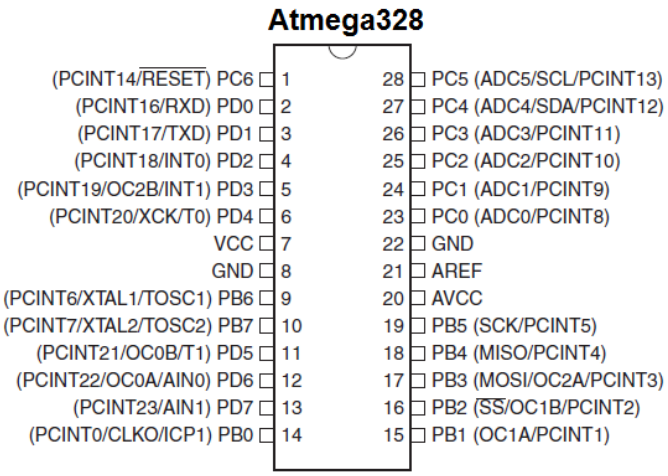


Working of the project:

Block diagram of the weight in motion over weight protection system is shown in Above Fig. In which we see 'BRIDGE PROTECTION' is automatic maintenance system. In this system there are several blocks namely Driver, Controller, Sensors, LCD.When car enters on a bridge the weight of car or vehicle is measured by load cells, after that the load cell will continuously measure & adds the weights of each vehicle, as we are setting a threshold for maximum capacity of bridge. If the

threshold of maximum capacity is crossed then controller will take action as actuating the barrier gates for controlling the traffic over the bridge. Collapse detector is used for detection of bridge collapse, Also RED signal is used for indication. As well as GSM technique is used to alert the control room.

CONTROLLER: ATMEGA328



Features:

1) High Performance, Low Power AVR® 8-Bit Microcontroller
2) Advanced RISC Architecture:

a) 131 Powerful Instructions – Most Single Clock Cycle Execution
b) 32 x 8 General Purpose Working Registers
c) Fully Static Operation
d) Up to 20 MIPS Throughput at 20 MHz
e) On-chip 2-cycle Multiplier

3) High Endurance Non-volatile Memory Segments:

CONCLUSIONS

- The overweight transportation, so-called "Killer of the Highways" can cause destructive damage to the roads and bridges, furthermore the great loss in the state's regulation fees and tax income.
- This system is capable of monitoring and detection of Bridge Collapse, and avoids human mortalities successfully with most of possibilities.

APPLICATION

- Protect your bridge infrastructure: by using the collapse detection and load cells this system protect bridge infrastructure.
- Identify over-weight vehicles approaching bridges.
- Live load monitoring by using load cells.
- To Read surrounding temperature by using LM35.
- To control the bridge traffic using barrier gates and traffic signals.

FUTURE SCOPE :

- **We can use steel corrosion detectors.**

  We can use steel corrosion detector to detect the corrosion takes place in the bridge. So we can identify health and status of the bridge. Also we can get the information about the structural health of the bridge.

- **Crack detection system can be implemented.**

  Here we can implement the crack detection system to detect crack over the bridge. It can help us to avoid measure accident on the bridge. Also it helps to maintain the bridge health & safety.

- **Accelerometer to check the vibrations of the bridge.**

As vibration over the bridge is also important factor of the bridge health. So here we can use accelerometer sensor to sense the vibrations of the bridge.

- **Earth-quake detection system.**

  Earth-quake is the natural disaster. And we can't predict losses or damages due to this factor. So Earth-quake detection is one of the important factor for bridge safety.

- **Speedometer to control the speed limit of vehicle.**

  As on any highway or any roads there is speed limit to reduce the accidents and mortalities. And accident will also cause the measure damages to the roads. And this rule is also applicable for the bridges. Due to over speed vehicles, chances of accidents increases highly. So to control the speed limit of vehicles, we can use the speedometer.

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