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SMART BRIDGE

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Abstract - *This paper gives a brief idea about the historical background about the development of bridges. Bridges are the foundation of a country's transport network but they are expensive to build and maintain. So, care should be taken for the bridges. For that purpose, sensors are used. The idea of controlling different parameters through proper functioning, monitoring and analysis of data is effective for preventing the bridge from damages. This project predominantly focuses about monitoring and evaluation of bridge condition through various sensors used. We have also developed a smart control for the movement of vehicles on the bridge through toll gates on either side. Auto opening and closing of bridge is implemented to allow the ships to pass through. Sensors are used to detect ship movement; the toll gates are interlinked with these sensors to maintain safety of the vehicles on the bridge. And to conserve electric power, we have introduced smart streetlights on the bridge to auto on/off by detecting vehicle movement during night times.*

1. INTRODUCTION

A bridge is a construction made for carrying the road traffic or other moving loads in order to pass through an obstacle or constructions. The required passage may be for pedestrians a road, a railway, a canal, a pipeline etc. Bridges are important structures in modern highway and railway transportation systems and generally serving as lifelines in the social infrastructure systems.

Design of bridges vary depending upon the function of the bridge, the nature of the terrain where the bridge is constructed and anchored, the material used to make it, and the funds available to build it. Most likely the earliest bridges were fallen trees and stepping stones, while Neolithic people built broad walk bridges across marsh land.

Bridge maintenance consisting of a combination of structural health monitoring and testing. This is regulated in country specific engineer standards and includes e.g. an ongoing monitoring every 3-6 minutes, a simple test or inspection. Every 2-3 years and an inspection every 6-10 years. In Europe, the cost of maintenance is considerable is higher in some countries then spending on new bridges. The lifetime of the welded steel bridges can be significantly extended by after treatment of the weld transitions. This results in high potential benefit, using existing bridges far beyond the planed lifetime.

It is critical to have a system to monitor the health of the bridges and report when and where maintenance operations are needed. Advancement in sensor technology have brought the automated real-time bridge health monitoring system. Many long spam 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 the management center which increase the overall cost of installation and maintenance cost of health monitoring system. The complicated wiring also makes the installation and replacement process difficult and expensive.

1.1 Blueprint of Tower Bridge

A more absurd structure than the Tower Bridge was never thrown across a strategic river," wrote artist Sir Frank Brangwyn, referring to the most famous bascule bridge in the world..

Fig -1: Tower Bridge

In fact, Tower Bridge is a fusion of three bridges, two of the suspension categories emerging from the north and south banks of London's River Thames, with a central span comprising two leaves, or 'bascules', which can be raised to allow high- masted ships to pass.

2. BLOCK DIAGRAM

In the below block diagram, we have used Ultrasonic sensor, IR sensor, Flex sensor, Water level indicator, Vibration sensor. A load cell is a type of transducer which is used to convert mechanical force into measurable electrical output. Motors are used to open and close the bridge and for tollgates.

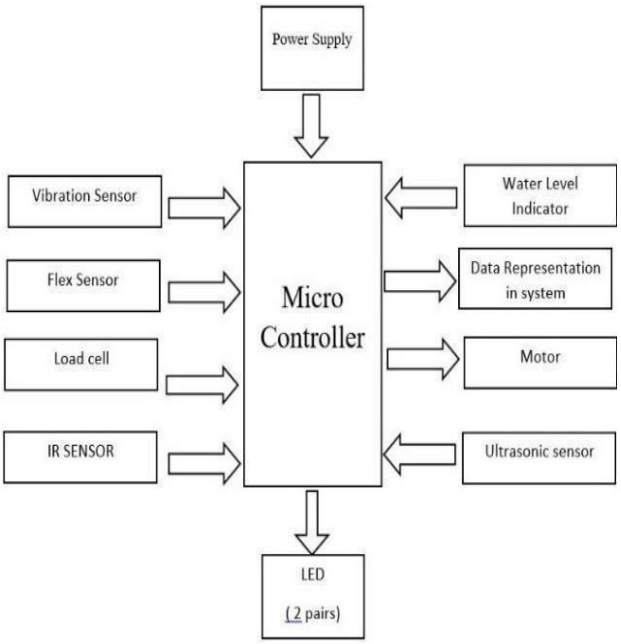

Fig -2: Components Used



Fig -3 Fig -4 Fig -5

Fig -6 **Fig -7**

- Ultra-sonic sensor (Fig 3) is a device that can measure the distance to an object by using sound waves.
- IR sensor (Fig 4) is used to sense certain characteristics of its surroundings
- Flex sensor (Fig 5) is a sensor that measures the amount of deflection or bending.
- Vibration sensors (Fig 6) are used for measuring, displaying, and analyzing linear velocity, displacement.
- Water level indicator (Fig 7), the purpose of water level indicator is to gauge and manage water levels.

Fig -8: Collapsed Bridge

When a bridge collapses or closes for repairs, it can cause massive traffic problems or strand people all together if they live on island.

Fig -9: Damaged Bridge

Fig 8 and Fig 9 represents the weak bridge monitoring system.

3. APPLICATIONS

A **moveable bridge**, or **movable bridge**, is a bridge that moves to allow passage for boats or barges. Movable bridges are used to provide both waterway for containers and ships to pass though the bridge and provide traffic way for cars, trains, and other forms of transportation on top of it

It opens the water way for ships and vessels with constant speed and it allows the passage of small size boats to pass through even if the passage is not opened completely. Traffic of cars or trains need not to be

blocked completely during the passage of small vessels that only the lower deck is to be lifted.

Car Traffic – This is the most common usage of the bridge, with two or more lanes designed to carry car and truck traffic of various loads. Modern large bridges usually feature multiple lanes that associate travel in a single direction, and while the majority of bridges have a single decking dedicated to car traffic, some can even have an additional deck, enabling each deck to be focused on providing travel in a single direction.

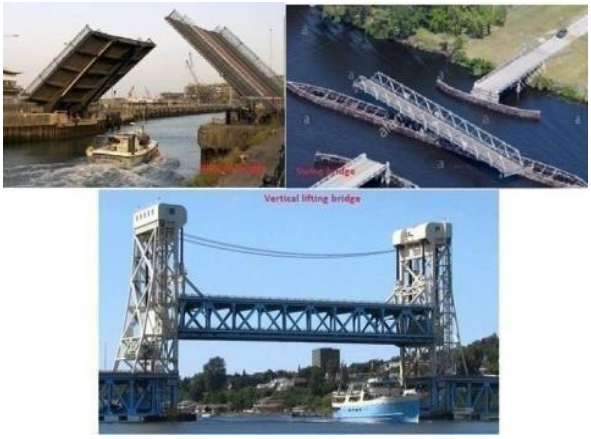

Fig -10: Movable Bridge

Arch bridges are used to transfer the weight of the bridge and its loads partially into a horizontal thrust restrained by the abutments at either side. A viaduct (a long bridge) may be constructed from a series of arches, although other or more economical structures are typically used today.

Fig -11: Arch Bridge

Multi-purpose bridges provide an advanced and enhanced flow of traffic across bodies of water or rough terrain. Most often they have a large number of car lanes, and sometimes have dedicated area for train tracks. For example, in addition to multiple car lanes on the main decking, famous Brooklyn Bridge in NYC features an isolated bicycle path ad civilian walking too.

Fig -12: Multi-Purpose Bridge

More or less as a standalone bridge type, pipeline bridges are constructed to carry pipelines across water or non-accessible regions. Pipelines can carry water, air, gas and communication cables. In modern times, pipeline networks are usually incorporated in the structure of existing or newly built bridges that also house regular decking that affiliates pedestrian, car or railway transport.

Purposes of BMS are detect structure damage, safety, disaster mitigation etc. Wireless sensors to monitor physical or natural environmental condition like pressure, level of water, acceleration, thrust etc. For bridges and dam's application, wireless sensor measures the acceleration, tilting angle of bridge pillar, the load base and water level

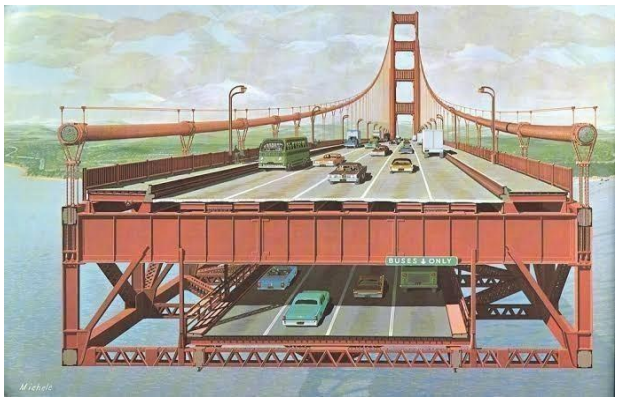

Fig -13: Pipeline Bridge

A typical suspension continuous girder suspended by suspension cables, which pass through the main towers with the aid of a special structure known as a saddle, and end on big anchorages that hold them.

- To suspend the loads on one or more ropes anchored to the ground and configured as a catenary
- To realize the structure by laying a carrying cable from one side of the obstacle to the other and successively equipping it with secondary structures and elements.

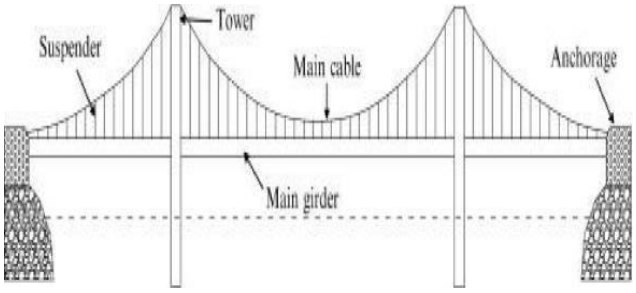

Fig -14: Suspension Bridge

4. METHODOLOGY

A bridge is a structure built to a span of physical obstacle, such as a body of water, valley or road without closing the way underneath. It is constructed for the purpose of providing passage over the obstacle, usually something that can be detrimental to cross otherwise. In our project, we are designing to ease road traffic while preserving access to main stretch of the canal. This project is only applicable for movable bridges. Here we use power supply to supply power. We use vibration sensor to sense any vibrations on the bridge. Flex sensor is used to find any bend in the bridge. Load cell converts the obtained data from the sensors to electrical data. Water level indicator indicates the water level in case of tsunami or floods. IR sensor is used to sense the movement of vehicles on the road. Ultrasonic sensor is used to sense the movement of ship in the canal. LED's are used to on/off by detecting the movement of vehicles on the road automatically. Light sensor detects whether it's daytime or night.

Motors are used to open and close the bridge and for toll gates. The ultrasonic sensors send the data of the movement of ship at a distance of 6 km from the bridge. Toll gates are closed and wait for an interval of time and then the bridge starts opening. After the ship crosses the bridge, the ultrasonic sensor sends the data of the crossed ship and the bridge closes. In case of any accidental incidents happen on the bridge, there will be red and green light signal control for the ship to slow down its speed from the top of the bridge.

5. RESULT

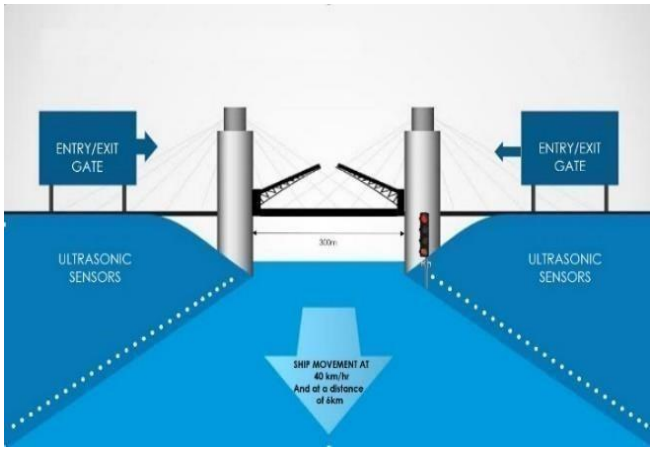

Fig -15: Working

The ultrasonic sensors send the data of the movement of ship at a distance of 6 km from the bridge. Toll gates are closed and wait for an interval of time and then the bridge starts opening. After the ship crosses the bridge, the ultrasonic sensor sends the data of the crossed ship and the bridge closes. In case of if any accidental incidents happen on the bridge, there will be red and green light signal control for the ship to slow down its speed from the top of the bridge. Hence the main idea was to monitor the system for evaluation of bride condition abs auto opening closing of the bridge.

6. CONCLUSION

The smart bridge is very advance type of bridge monitoring system. The main advantage of this bridge system is that it can extend a network by acting as a repeater. Bridges can reduce network traffic on a segment by subdividing network communications. It can provide safety during natural disasters. It helps in ship transportation. It helps in minimizing the accidents.

Bridges increase the available bandwidth to individual nodes because fewer nodes share collision domain. This also reduces collision.

Even though the quality of material used and components used are of good quality, the cost of the project is not so costly and it can be used and implemented in all movable bridges without much increment of cost. This smart bridge is best in its field and will be most widely used and advance system.

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