RESEARCH ARTICLE OPEN ACCESS

IoT Based WeighBridge Management System

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Abstract:

Weighbridges play a vital role across a diverse range of industries. They provide valuable weight data for incoming and outgoing vehicles at quarries, recycling plants, energy from waste sites, ports & terminals, cement works and processing plant the software used is user-friendly, peripheral control equipment and communication technology is rapidly increasing the scope of weighbridges, thereby expanding their operational, data collection and connectivity capabilities. The main part of the project is Microcontroller; it is used for automatically controlling the device. In this project the microcontroller is interfaced with GPRS and buzzer. The weight is measured using a load cell and this value up dated on internet using network of IoT and a GPRS module.

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1. INTRODUCTION

India is a country which is very heavily populated. Hence, everyday traffic is heavy in the major cities of the country. Due to such bad traffic conditions everyday commuters prefer to reduce their travel time from one place to another and hence use flyovers. In recent times we have seen a number of flyovers collapse. A good fraction of this can be accounted for the everyday movement of overloaded trucks over them. The movement of these overloaded trucks cause a lot of vibration over the flyover which in turn causes the bonded materials, which make up the flyover, to move apart. With passage of time this activity continues and makes the flyover fragile and prone to collapsing.

Fig.1 Collapsed Flyover due to overloaded truck.

In India, due to the negligence of the legal systems, transporters load the goods transportation vehicles with weights far above the permissible limit. This causes a lot of vibration on the ground when the vehicle is moving and when these vehicles traverse on the flyovers, they cause the bonded materials (sand,

cement, iron rods) to move apart, which in turn make the flyovers fragile and prone to collapsing. Figure 3. shows the number of collapses in recent years owing to negligence of transporters.

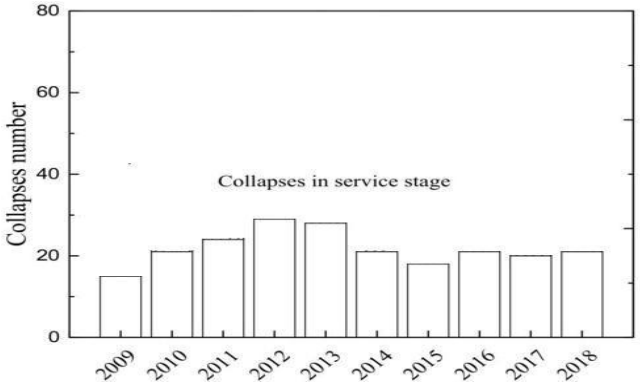

Fig.2. Graph showing the number of flyovers that collapsed from 2009-2018

This work proposes a system in which there can be drastic reduction in the movement of overloaded trucks over flyovers, which in turn will increase the longevity of flyovers in India. Moreover, this system will be an asset to an economy which cannot afford a lot of loss to its public wealth.

Bridge Design

The monitoring and control system is built from several components, including loadcell sensor as the weight sensor of vehicles passing through the bridge. Accelerometer sensor as a sensor to detect the vehicle's position when the bridge, the portal as a bridge safety actuator when the total weight of the vehicle exceeds the specified capacity, microcomputer as a control center, micro-SD as data storage or logger and power supply with the appropriate voltage. The design of the bridge monitoring and control system shown in figure 1 as

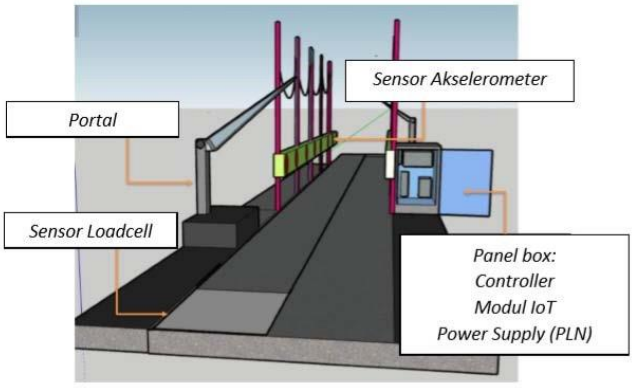

Fig.3. Design of Bridge

It is assumed that the maximum vehicle length is 16.5 meters and the safe distance between vehicles is 5 meters. Whereas the distance for placing the accelerometer sensor is shown in figure 4 as follows:

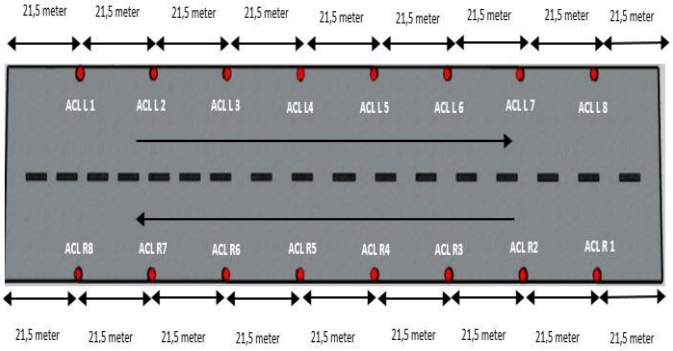

Fig.4. Accelerometer Sensor Placement Design

2. Objective

The goal of this project is to monitor each vehicle in weighbridges and sending data to the IoT server.

The main objectives of the Bridge Monitoring System are :

- To provide safety for bridges.
- To avoid future accident due to over weight of vehicles.
- To overcome the technical and cost obstacles.

3. BASIC WORKING FLOW DIAGRAM

A weighing station is set up before the entrance to a flyover. A floor load cell is used to measure the weight of an overloaded truck. It is a transducer which uses the principle of converting a load or weight acting on it into an electrical signal which is done using the principle of balanced Wheatstone Bridge. Whenever the resistance on any branch of the Wheatstone Bridge changes, then current starts flowing through the central resistance joining the two end points of the bridge network. The current in the central branch provides a potential drop across the central resistance which keeps on increasing along with the increase in load.

In the weighing station a horizontal floor like load cell will be used, upon which the whole weight of the truck will act when the vehicle rests on it. The arrangement of a truck resting on a floored load cell is shown in figure below, Figure 4.

Fig.5. Truck resting upon floored load cell

Each weighing station is provided with two gates, one inlet gate and the other an outlet gate. Along with this a diversion road is also present beside the outlet gate, such that when the overloaded truck is not allowed to take the route towards the flyover, it can take the diversion as shown by the GPS towards its pre-planned destination. When there is no vehicle in the weighing station, the outlet gate of the station remains closed. We have placed a load cell before the outlet gate (gateway to the flyover) of the station. As and when a truck enters, it stops before the closed gate and over the load cell. The load cell gives an electrical signal proportional to the weight present over it as output and this is fed to a microcontroller present in the system. It compares the weight of the vehicle to the prescribed limit of the weight allowed over the flyover. If the weight is below the threshold, then the outlet gate opens and the truck is permitted to move towards the flyover. If the weight is above the permissible limit, then the outlet gate remains closed and the GPS present in the vehicle is triggered to show an alternate route to the truck other than the flyover. The truck takes a diversion and the gate again closes after the truck moves out of the weighing station. The basic flow diagram of the system is shown in the figure below. Let us consider the prescribed limit of load on the flyover to be 10 metric tons.

Suppose the weight of the truck, stationed over the load cell, is found to be above 10 metric tons, then the GPS is triggered. The outlet gate before the flyover stays closed and the truck is forced to take the diversion. On the other hand, if a truck stationed on the load cell weighs less than 10 metric tons, then the outlet gate opens and the truck is then allowed to move towards the flyover.

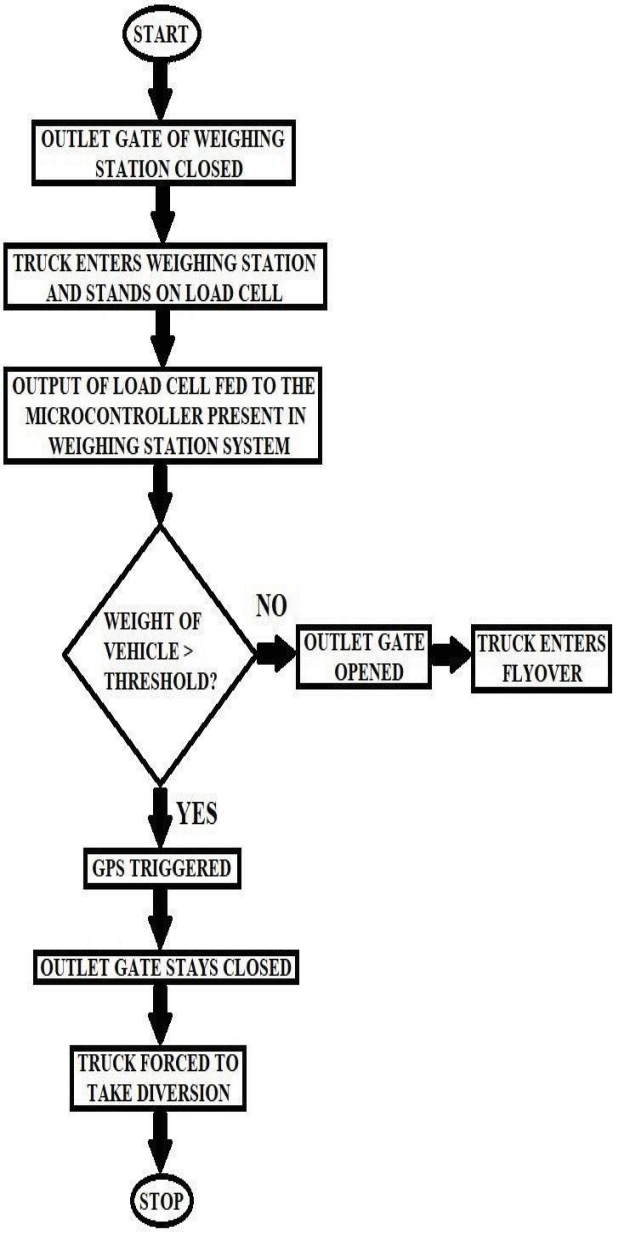

Fig :5 Basic Flowchart to demonstrate the working of the system

4. CIRCUIT DIAGRAM

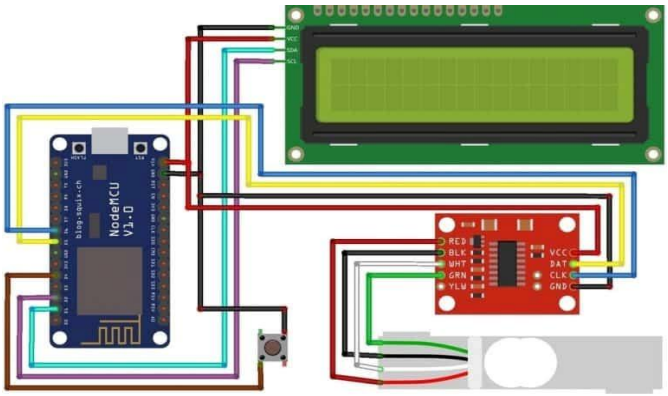

Fig 6 : Circuit Diagram

5. CONCLUSION

Modern weighbridge systems can offer considerably more than weight information and their integration with other technologies is bringing dramatic changes to a wide range of industries. However the quality of the data they provide is still totally dependent on the load cells design principles and well defined installation procedures.

With the ever-rising figures of bridge collapses, this system of overload detection will be an asset. Earlier work in this field has been done using the concepts of magneto- resistance sensors, measurement of inflation pressure on tires, and reluctance principle.But no one has used the concept of load cell and weighing station to ascertain the weight of the vehicle. The experimental analysis gives us a brief idea about the load and the serial output readings from the load cell which will be used to drive the microcontroller output connected with the gate of the weighing station. The experimental analysis was done using a 10kg load cell whose serial output have been tabulated in the adjacent table. The macroscopic system can be assumed to fetch proportional results, that is the output can be assumed to be a direct proportional output corresponding to the load present above the load cell. This system can be readily implemented in the existing economic structure where a weighing station has to be present in front of a flyover. This can be easily applied with the help of government intervention

6. ADVANTAGES AND DIS-ADVANTAGES

6 .1 ADVANTAGES

- Fully Automated
- Secure Vehicle Identification
- Save Time & Labor on Weighbridge Operations

6.2 DISADVANTAGE

- Load cell accuracy
- Environmental forces
- Interference with signal transmission

7. FUTURE WORK

- Only manager can read weigh data from IoT
- Works need to do in case of algorithm to make is more efficient and faster
- As per software used by manager will be more user friendly
- Will be planning to implement this algorithm using block chain and latest technology should be implemented in the system
- The system scope will increase throughout not only for trucks but for all types of vehicles.
- More realistic and real time functionality should be added

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