

Load Estimation for Vehicles

SIVARANJANI.T

Pervasive computing Technology,
Kings College of Engineering,
Punalkulam,
srkings07@gmail.com

MOHAN BAPU.T

Assitant Professor,
Computer Science Dept,
Kings College of Engineering,
Punalkulam,

GAYATHRI.P.G

Pervasive computing Technology,
Kings College of Engineering,
Punalkulam,
gayupg05@gmail.com

Abstract — The main objective is to monitor and control the load. By load management, it is meant to capture or enable the distribution of loads or to aid in the installation of load cells for the distribution of loads. To achieve this in the first phase of the problem the load recognition process involving the weight sensors (load cells) for installing or used in the load distribution of loads. The methods of interface have included wirelessness transfer through GSM & GPRS available in driver's cabin, and a remote control terminal able until to receive and process the information from the load cells. The system tries to provide an effective approach in the developing of an effective load distribution and for load balancing. This framework identifies the challenges and benefits to implement interface with the consideration towards both individual and fleets of vehicles. The load cells characteristics of low cost, lightweight, small volume and high accuracy are evaluated. Repeatability, sources of error, weight accuracy and calibration values are discussed. The experimental results of the framework support the feasibility of its part in the smart transport systems. It helps to build a successful framework in Smart Transport System.

Index Terms— load, monitor, distribute, balancing, remote control.

1 INTRODUCTION

Pervasive computing technology exists anywhere, anytime with the help of any device. Pervasive computing will require a revolution in human-computer interaction and information access technologies for interacting with small, distributed devices which must present a unified interface to users and satisfied user comfort. The smart transport system improves the user interaction.

Overload of transport system is a main problem in many countries. Presently, they are using WIM Sensor, bar sensor to detect the load on trucks. The load can be verified in particular places like out of town, highways, toll free etc., so the load cannot be controlled completely some fraudulent also happened in that.

When framework is proposed to handle the part of smart transport system. It is done by computing numerous applications emerges when computing intersect transportation, such as load sensing, balancing, distribution, vehicle safety, and communication system and data collection for maintenance. The process is performed automatically and updated every time.

2 INVESTIGATION OF OVERLOAD PROBLEM

The India bus industry forms an important part of the automobile industry in the country. Past few years, the bus industry has grown to a great extent and new types of buses with better facilities. Due to the development of transport industry more people from the rural areas are also availing of bus services. One side development gradually increased other side disadvantages also increased. Most habitants use buses in day today life regularly. They face many problems in their traveling time. The main issue is due to overload. In many of them introduced some other concepts to overcome this problem but they also having some more demerits.

The intelligent system that monitors the load information involving weight sensor, GPS and remote control terminals to receive the information. This approach to prevent overload problem in trucks. [1] Automatic overload detection is calculated using weight sensor and the software system is used to monitor, analyze all the sequences. The weight sensor controls the tire pressure and calibration also performed. [2] To estimate the overload and calculate the exact number of persons available in the bus. This operation performed only in the highways using bar sensor (weight sensor). If overloaded, it locked the bus engine it starts again only the extra passengers are all go off. [3] Pavement monitoring system based on frequencies and sensing technology. This system is integrated with monitoring system such as bridge monitoring, weight-in-motion (WIM) & traffic classification. WIM calculated the static weight of the vehicle while in motion. [4]

The major demerits of the system problem is inaccurate axle counting when truck and bus volumes are high, temperature sensitivity of the air switch, at the time Single vehicle only monitor, commonly used for short-term traffic counting, covers small area/zone, road pavement structures are designed to carry a given number of standard axle load repetitions, overload reduces the design life of the structures.

3 SYSTEM SCHEME

The system scheme shown in the Fig.1, is a load cell (weight sensor) performance as a main component of the schema. The loads can be applied to the load cells; it performed the process in the operation. First sensing process allowed sensing the load & measuring how much load is applied in the load cell. After it completes the sensing process, the load cell monitors the load available in the cells. The load maintained at minimum of capacity level, it monitors the process. If the load is

maximum then the capacity level, it defined as overload and produces the alarm signal and transfer messages to administration office involving GPS/GSM. These overload process can be balanced and continue the systematic function. The balancing load function is the main step for distributing the load and carry easy, flexible & comfort drive. The load distribution is observed and monitored by the load cells. The load cells interact with the user comfort and satisfied them involving the distribution. The loads can be distributed by the nearby load cells within the coverage area and balanced the overload. The overload can be balanced and distributed in the

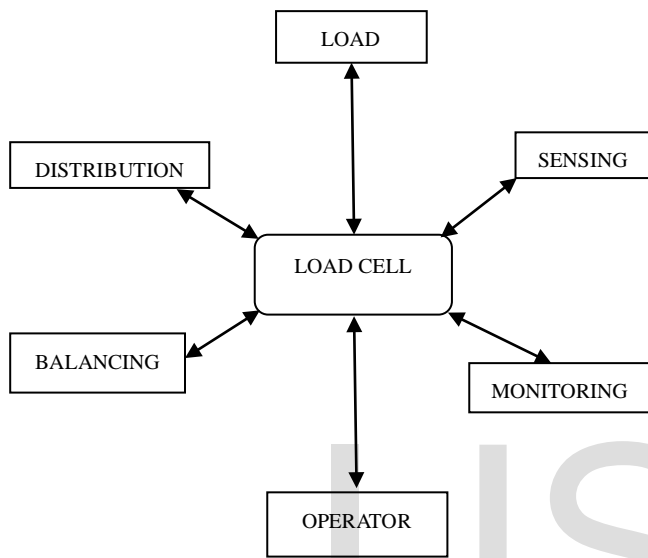


Fig1. System framework

secured manner. All data's stored in the database and sent it to the administrative system (server) through wireless network technology. The process can take place within fraction of seconds. The retrieving data should be more accuracy, comfort and user interaction. Sending data also more secured.

4 OVERLOAD CONTROL FRAMEWORK

The systematic operation performed overload control and monitor involving load cells. Much kind of load cells are available in the market. The main objective of the load cells are high sensitivity, stability, more coverage area, accuracy, low cost, long life. The load cells are nothing but weight sensor, calculate the load without any calibrated values.

The control framework involves Integrate the load cells in the vehicles, calculate load involving weight and space, balance the load, maintain & monitoring the vehicle damage, communication process. To achieve the control framework, overcome many problems. The main problem is selection of load cell, because all kind of load cells are having individual merits and demerits. So choosing load cell to achieve and satisfy related problem mentioned above. In the Experiment, the evaluation of load cells is the first part of system. In this two type of calculation are made up constant values. One is involving single load cell and evaluate the coverage load cells value.

The load cell evaluation process give successful results to proceeds all other operation.

In single load cell evaluation Fig 2, a load (weight) applied to a particular load cell and the load can be sensed and produced the original load output value. The rest of load cells are constant value. Monitor the output values are more accuracy, speed and reliability.

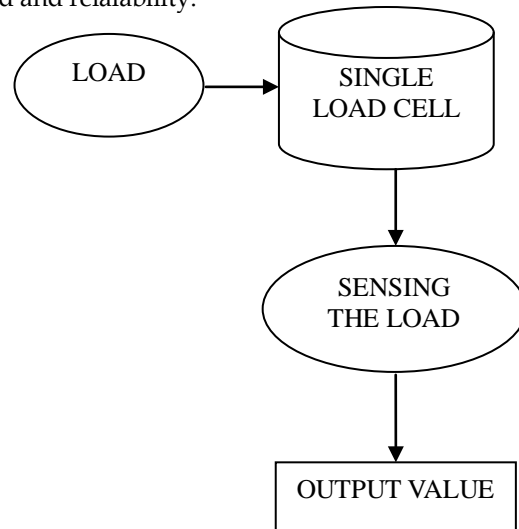


Fig2. Evaluation of single load cell

In load cell, coverage area verification Fig.3 can be evaluated involving multiple load cells. A load (weight) can be applied to a platform of the load cell and the load can be sensed and split the load to multiple load cells near in the platform (coverage cells). Finally it produced the original load output value. The rest of load cells are produced a constant value.

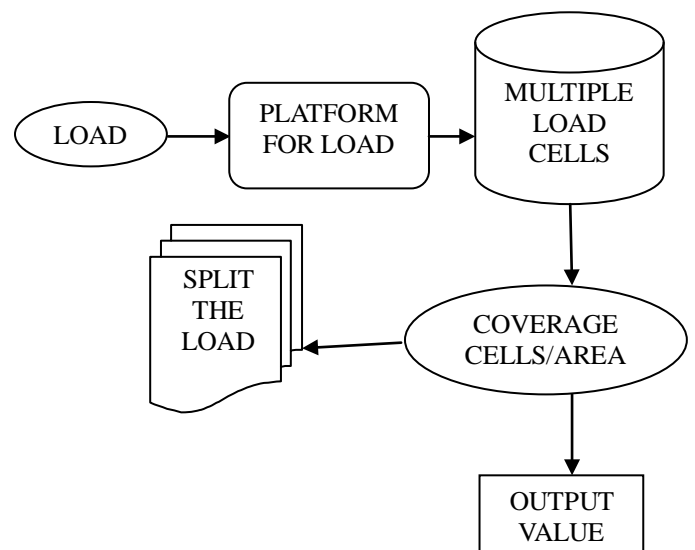


Fig3. Verification of coverage area

A load (weight) can be applied to a load cells in the platform. The platform evaluates the load involving single load cell & multiple (coverage) load cells, decides the location of the load to be placed and identifies the coverage area. That

location can be modified by the users comfort. The load cells sensed the load to be placed and split the load to multiple load cells Fig.4 near in the platform (coverage cells). If the load exist above the load cells capacity & coverage range, it intimate/send as an error message. The error message is monitored by the system. Finally the load cells produced the original load output value. The rest of load cells are produced a constant value.

5 EXPERIMENTAL METHODS & SIMULATION

The design of Load cell that can be used, in conjunction with an electronic data acquisition system, for static thrust measurement of a vehicle.

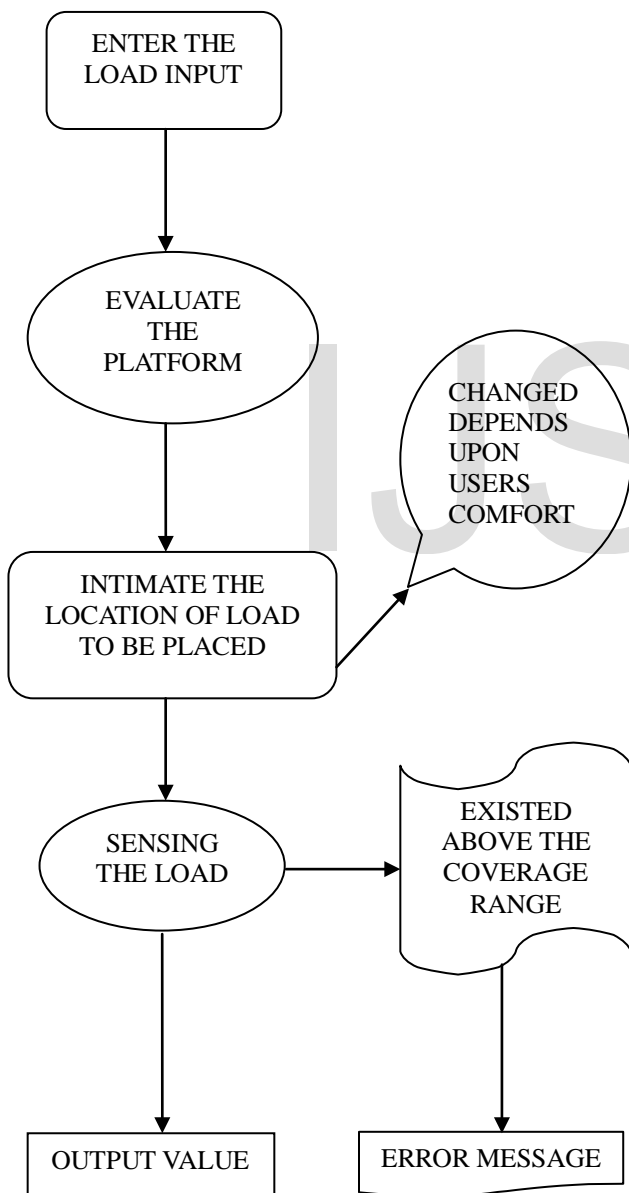


Fig4. Development of load cell simulation

The load cell described here is meant to be relatively simple to make, versatile to design with regard to load capacity, sufficiently accurate for its intended use, and inexpensive. I have made a

number of vehicles, with excellent results. An important feature of the load cell is that displacement under load is very small. This is significant, as it nearly eliminates unwanted dynamic effort associated with mass and large displacement system.

Load cell evaluation process is tremendous in experimental part. The first module is about how the evaluation of load cells and development of load cell simulation experiment has been done using this VB .NET. The VB .NET using C# .NET language to develop the simulation. The evaluation of load cell takes place two verification process involving single load cell and multiple load cell performance and coverage area of the load cells (weight sensor). Next, the development of load cell simulation process has been performed. The load (weight) applied to the load cell it sensed the load and verify the output value. The load cells platform interact with the user and satisfy the users comfort.

5.1 Evaluation of Load cell

i. Single load cell

The goal of the load cell technique is to control and monitor the loads and to achieve a balanced state in terms overall coverage. By analyzing the deployment region as a virtual graph, the load cells capacities are modeled as vertices and the distances/coverage between the cells as edges. In our Experiment, the evaluation of load cells is the first part of system. In this we measured in two kinds. One is involving single load cell and evaluate the coverage load cells value. In single load cell evaluation, a load (weight) can be applied to a particular load cell and the load can be sensed and produced the original load output value. The rest of load cells are a constant value that was tested and verified in the laboratory condition.

Assume the number of load cells is $x_1, x_2, x_3, x_4 \dots x_n$. The single load cell capacity is α , applied load to the cell is β . The load cell satisfy the condition $\beta < \alpha$. The original output is \sum , it limits to $1 \leq \beta \leq \infty$.

$$\sum \beta = 1 = \alpha - \beta \dots \dots \dots (1) \quad \text{if } \beta < \alpha$$

The value of β is greater than capacity of cell α ($\beta > \alpha$), it go for the evaluation of multiple load cell/coverage zone.

ii. Multiple load cell

The coverage area verification can be evaluated involving multiple load cells. A load (weight) can be applied to a platform of the load cell and the load can be sensed and split the load to multiple load cells near in the platform (coverage cells). Finally it produced the original load output value. The rest of load cells are produced a constant value.

The objective is to derive a maximum capacity between the vertices, while minimizing the coverage (total edge weight). The coverage problem can be represented mathematically [5] with X_{ij} ($i, j=1 \dots n$) being the set of variables, n is the number of nodes in the vertices set of the complete bipartite graph $A = (V, U, E)$, where V, U form the sets of vertices and E the set of edges. $X_{ij}=1$ means the edge v_i, u_j is included in the coverage whereas $X_{ij}=0$ means the edge is not included. Hence, the best coverage can be found by solving the optimization problem:

$$\text{Coverage} \quad \sum_{ij} a_{ij} X_{ij} \quad \dots\dots(2)$$

$$\text{Subject to} \quad \sum_{ij} = 1, X_i = 1, \quad i = 1, 2, \dots, n$$

$$\sum_{ij} = 1, X_j = 1, \quad j = 1, 2, \dots, n$$

This converts the bipartite graph based matching into a matrix representation with a_{ij} being the assignment capacity with the rows of the matrix being vertices in V and the columns being vertices in U . Considering the constrained load the assignments in the form of unique row and column combination which are within the permissible coverage as per the load distance constraint are taken into account and the rest are discarded.

5.2 Simulation Process

A uniform deployment region (load cells) of 100×100 is considered with 100 cells each of size 10×10 . A load cell is considered covered if at least one node is within its area. The loads are assumed to be at the center of the load cell as the precise location of the load is not taken into consideration. The Euclidean distance between the centers of the load cells is used to populate the capacity matrix, α , in (2).

The experiment is conducted with the variation in number of loads from 50 to 500 with increments of 5 & 10. The experimental results are mean values for all parameters calculated over 100 runs of the simulation. In constrained mobility, the maximum covered distance is considered as 7.5, 5.0 and 2.5 units respectively. The number of covered load cells considered available is varied from 10% to 100 %. The coverage attained, the total and highest distance moved by nodes are observed for change in the input parameters.

The evaluation of single load cell, load is vertices and capacity of the load cell is edges. The capacity changes and loads also changed similarly and verified the accuracy of the cells. In this taking the load cell capacity 50 and applied the load also 50. It shows the accurate value in the Fig 5. The capacity changes randomly as 55, 60, 65....the load also changed.

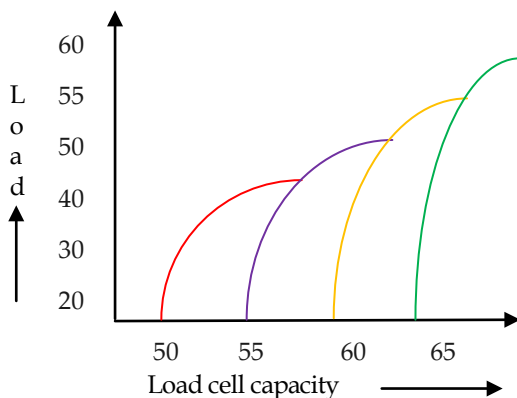


Fig.5 Evaluation of single load cell capacity

As can be observed from the Fig 6, the number of load cells required to achieve a single load cell used in different variety load cell capacity. In that process also it has same features and accuracy of the values.

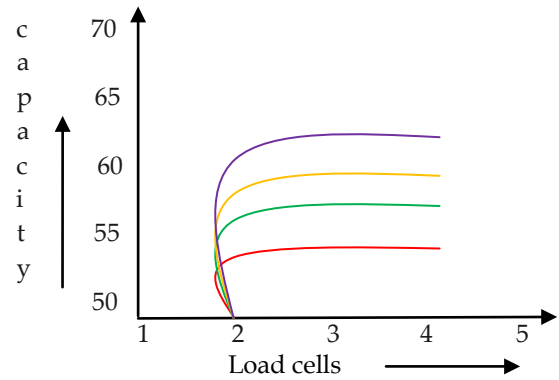


Fig6. Evaluation of single cell

As can be observed from the figure, the number of load required to achieve a full coverage (99%) is 460 for random deployment. Therefore in the particular load cells based deployment the excess loads required to achieve full coverage as 360. The total distance covered by the loads and the highest distance an individual load covered to attain the aforesaid coverage pattern is shown in Fig.7.

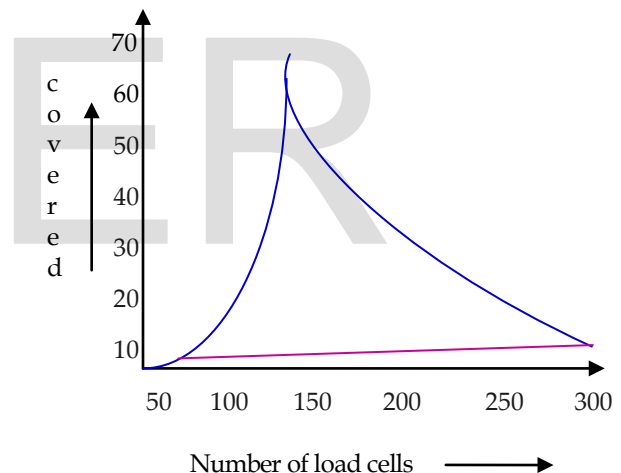


Fig7. Total and highest distance covered by cells

The total and highest distance moved by a node with the same constrained covered to achieve the coverage improvement is shown in Fig. 8. It can be observed that the loads reorganize to attain the full coverage at the minimum number of nodes required to attain the full coverage.

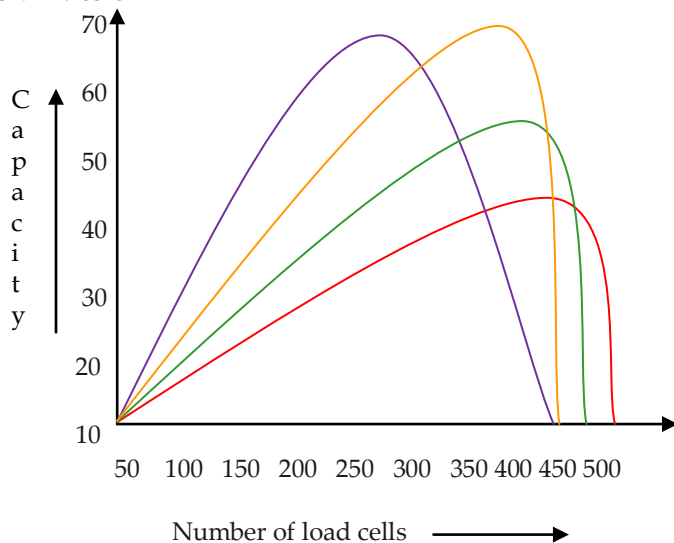


Fig8. Total distance covered by loads for coverage improvement

The platform having a number of load cells in the edge and the total coverage is calculated in the vertices. Here different loads are applied to the load cells and testing the load operation. It acquires highest coverage area and improves the performance of the cells. The variety of capacities also available and also tested to satisfied the coverage improvement. The resulted value is accurate, reliable and speed operation.

6 CONCLUSION

The objective is to control and monitor the load involving load cells (weight sensor). The estimation of load cells handles the load in much way. The experimental results present a precise relation between the various parameters for a particular deployment condition with respect to the coverage obtained and give the correct choice to choose the load cell. The real deployments based on the resources available and the constraints applicable (total number of load cells, proportion of coverage cells, highest covered distance and the number of loads available). All the parameters related with the deployment of a practical load cell/weight sensor for attaining a desired performance, based on the resources available. The tested values are satisfied comfort, accuracy, speed and reliability.

The next work of project is to take the handled load data for balancing and distribution in the vehicles and methods to monitor and manage the road and vehicles.

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