International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN(P): 2249-6890; ISSN(E): 2249-8001
Vol. 9, Special Issue 1, Jan 2019, 130-135
© TJPRC Pvt. Ltd.

TRANS STELLAR
•Journal Publications •Research Consultancy

DESIGN AND DEVELOPMENT OF PROTOTYPE FOR INBUILT WEIGHING MACHINE

K. YUVARAJ[1], M. BALASUBRAMANIAM[2], K. BOOPATHI RAJA[3] & P. DINESH KUMAR[4]

[1]*Assistant Professor,Department of Mechatronics, Bannari Amman Institute of Technology Sathyamangalam, Erode, India*

[2,3,4]*UG Scholar, Department of Mechatronics, Bannari Amman Institute of Technology Sathyamangalam, Erode, India*

ABSTRACT

The aim of this project is to fabricate the weight bridge on moving vehicle. The recent survey suggests that, weighing at particular places makes unwanted time and travel. The project is used to measure the weight of vehicle in the loading and unloading conditions by using the sensors while on running condition. The work is carried out by using load cell based on the load. The load cell gives the value of the load that is carried, displayed through LED display to the driver. The load measured through load cell is proportional to the voltage displayed by the controller. This is mainly used in Lorries, trucks and containers for measuring the weight before and after the load is applied on the vehicle. The project just works like a portable weight bridge.

KEYWORDS: Loadcell, Voltage, Controller& Portable

Original Article

INTRODUCTION

The Embedded Technology is now in its prime and wealth of knowledge available in mind-blowing. An Embedded system is a special purpose computer system designed to perform a dedicated function. Embedded system is fast growing technology in various fields like industrial automation, home appliances, automobiles, aeronautics etc. Embedded technology uses pc or a controller to do the specified task and the programming is done using assembly language programming or Embedded C**.** Overloaded vehicle is a challenging issue in public transport systems and is one of the major causes of road accidents. Vehicle which carry heavy load pose threat to human life expectancy, and also cause excessive wear and damage to road, bridges, pavements and make the vehicle less stable. According to Motor Vehicle's Act, overloading vehicle is an illegal offence, which carries with fine and prison sentence. Even then, our community is least bothered about the same. Hence, the need to address this problem is relevant in the present scenario. The large volume of vehicle on roads has been a challenge to authorities and manually monitoring them is practically not possible. There arises the need for an entirely automated surveillance system.

LITERATURE SURVEY

Many inventions have done and lots of people have worked on different weighing methods for in-motion vehicles till now.

- **Sarah et al,** investigated the principle of measurement is developed and the estimation is done for measuring uncertainty by Grey Error Theory.Theoretical analysis and experimental research are given by

them to show that the method could be used to solve the weighing problem for in-motion vehicles with higher accuracy.The evaluation is also done by new mass-estimation method for axle weights of In-motion vehicles using vehicle model. The models are used for estimation are two-axle model,three axle model and five axle model. The trial is done on three types of vehicles and their result is used to improve the WIM output.

- **Grakovski et al.,** explained thatApart from these weight estimation methods, an advance algorithm for estimating axle weights of in-motion vehicle has also been taken into practice. A signal processing method has been implemented to improve the accuracy of measured axle weights of an in-motion vehicle. There is also some change in the platform i.e., the length of the platform is increased approximately three times than the regular conventional type.
- **Andrew et al.,** proposed an idea of using a bridge as a scale for the Weigh-InMotion (WIM) of trucks has been explored and investigation is done using the least amount of above-deck mounted sensors so as to make system installation and maintenanceeasier and cost effective.Various techniques are there for increasing the accuracy and performance of the WIM system along with reducing thecost. Different techniques are applied to the WIM weights,which are being measured to reduce or minimize the effects of dynamics of vehicle, but it cannot be totally eliminated. Inbuilt weighing machine is determined to be most effective system in all aspects like accuracy and expected life.

EXPERIMENTAL SETUP

Load Cell

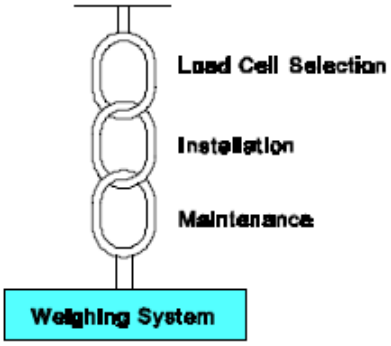

Figure 1: Load Cell Weighing System

The heart of any weighing system is the load cell. Load cells are designed to sense force or weight under a wide range of adverse conditions; they are not only the most essential part of an electronic weighing system, but also the most vulnerable.Here, we are using strain gauge load cell. The sensing or spring element is the main structural component of the load cell. The element is designed in such a way that it develops a strain, directly proportional to the load applied. Sensing elements are normally made of high strength alloy steels (nickel plated for environmental protection), precipitation - hardened stainless steels, heat treated aluminium alloys, or beryllium copper alloys. By bonding strain gages to a precisely machined element, the force applied can be identified in terms of resistance change. The strain gages, usually four or a multiple of four, are connected into a Wheatstone bridge configuration, in order to convert the very small change in resistance into a usable electrical signal. Passive components such as resistors and temperature depending wires are used to compensate and calibrate the bridge output signal.

ARDUINO

Figure 2: Arduino Board

Arduino is a single-board microcontroller to make using electronics in multidisciplinary projects more accessible. **[4]. Fujimoto et al**, proposed an idea about the hardware which consists of an open-source hardware board designed around an 8-bit AtmelAVR microcontroller, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller. Arduino boards can be purchased pre-assembled or as do-it-yourself kits. Hardware design information is available for those, who would like to assemble an Arduino by hand. An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components to facilitate programming and incorporation into other circuits. **[5]. Fukuda et al**, explained animportant aspect of the Arduino is the standard way that connectors are exposed, allowing the CPU board to be connected to a variety of interchangeable add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²Cserial bus, allowing many shields to be stacked and used in parallel.

Power Supply

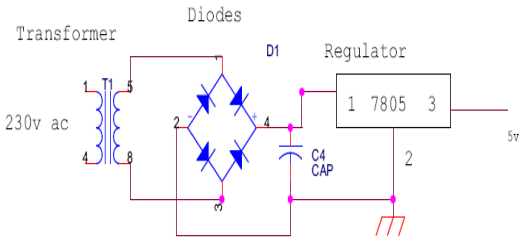

Figure 3: Power Supply

Transformer

The Step down Transformer is used to step down the main supply voltage from 230V AC to lower value. This 230 AC voltage cannot be used directly, thus it is stepped down. The step down voltage is consists of 12V.The Transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The output from the secondary coil is also AC waveform. Thus, the conversion from AC to DC is essential. This conversion is achieved by using the Rectifier Circuit/Unit.

Filter

The Rectifier circuit is used to convert the AC voltage into its corresponding DC voltage.The most important and simple device used in Rectifier circuit is the diode. This project uses bridge rectifier. A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.The circuit used for removing the ripples is called Filter circuit.

The simple capacitor filter is the most basic type of power supply filter. The application of the simple capacitor filter is very limited.Here, we used 1000µF capacitor. So, it allows only AC voltage and does not allow the DC voltage. This filter is fixed before the regulator. Thus, the output is free from ripples.

Regulator

Regulator regulates the output voltage to be always constant. The output voltage is maintained, irrespective of the fluctuations in the input AC voltage. As and then the AC voltage changes, the DC voltage also changes. Thus to avoid this, Regulators are used. Here, we used 7805 positive regulator. It reduces the 12V dc voltage to 5V dc.Here, we used 0.1µF capacitor. The output at this stage is 5V and is given to the Microcontroller.

Working Principle

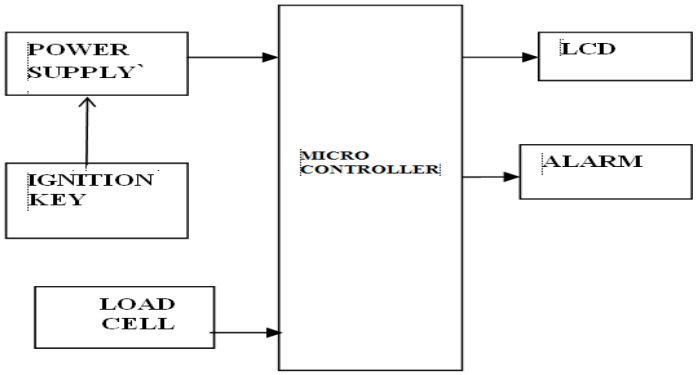

Figure 5: Block Diagram

The load cell is fixed under the leaf spring.Here, we use Strain gauge load cell.Strain gauge load cells are the most common in industry. These load cells are particularly stiff, have very good resonance values, and tend to have long life cycles in application. Strain gauge load cells work on the principle that the strain gauge (a planar resistor) deforms when the material of the load cells deforms appropriately. Deformation of the strain gauge changes its electrical resistance, by an amount that is proportional to the strain. The change in resistance of the strain gauge provides an electrical value change that is calibrated to the load placed on the load cell.

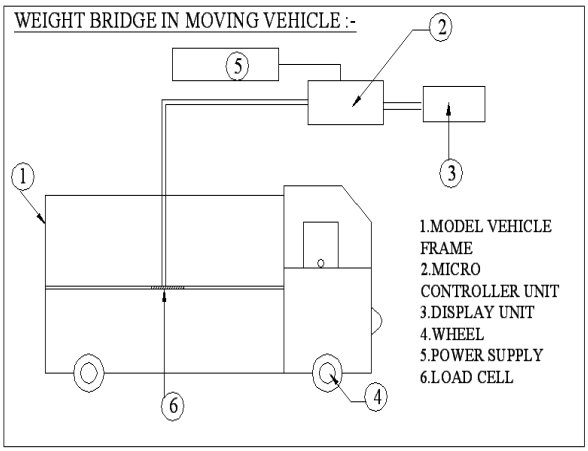

Figure 4: Overload Indicator

A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one strain gauge (Quarter Bridge) or two strain gauges (half bridge) are also available. The electrical signal output is typically in the

order of a few millivolts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer can be scaled to calculate the force applied to the transducer. Sometimes, a high resolution ADC, typically 24-bit, can be used directly.

The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gauges are used to obtain maximum sensitivity and temperature compensation. Two of the gauges are usually in tension can be represented as T1 and T2,and two in compression can be represented as C1 and C2, and are wired with compensation adjustments. The strain gauge load cell is fundamentally a spring optimized for strain measurement. Gauges are mounted in areas that exhibit strain in compression or tension. When weight is applied to the load cell, gauges C1 and C2 compress and decrease their resistances. Simultaneously, gauges T1 and T2 are stretched increasing their resistances. The change in resistances causes more current to flow through C1 and C2 and less current to flow through T1 and T2. Thus, a potential difference is felt between the outputs or signal leads of the load cell. The gauges are mounted in a differential bridge to enhance measurement accuracy. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. Other load cells are fading into obscurity, as strain gauge load cells continue to increase their accuracy and lower their unit costs.The load cell and the display are connected through the microcontroller unit. The battery is providing the power supply to the control unit. The load cell is a device which is used to measure the load. The initial load of the vehicle is displayed in LCD. When the vehicles are in loaded condition,the load values are displayed in the digital display through the control unit with the help of the pulse generated in through the load cell. This is very useful in the heavy loaded vehicle like lorries trucks and container.

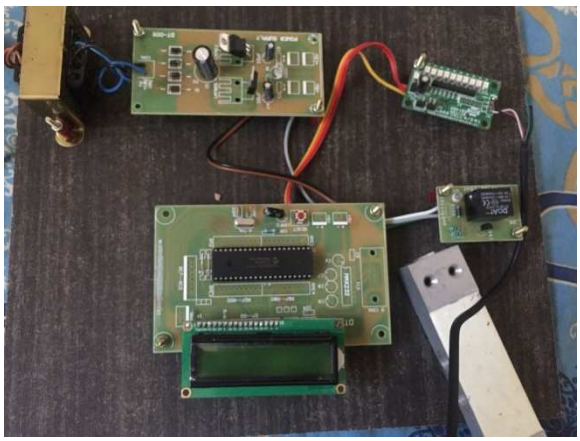

Figure 6: Setup

CONCLUSIONS

Overloading vehicles is one of the foremost reasons of road accidents. Although certain measures are taken to detect overloaded vehicle dynamically, authorities are giving least importance to this issue due to various reasons. The safety of school children going to their respective schools in vans and buses is a major concern to parents.With regards to overloaded vehicle, there must be stringent law enforcement to monitor the authorities who are violating traffic rules. Many researchers have contributed towards detection of overloaded vehicle and different techniques are reviewed in this paper. A comparison of different Weigh in motion sensors are assessed in this survey and reached to a conclusion that WIM sensors are effective in detecting overloaded vehicle in motion. The findings made by different researchers in this area are remarkable. A vehicle that poses abnormal behavior could be a reason for overloaded vehicle and the detailed

description of the same is reviewed in the survey. The techniquesuch as, counting the number of passengers inside the vehicle using camera installed at the door entrance andelliptical head detection method proposed by Boon Chong Chee overcomethe difficulty of manual checking, in case of excessive passenger.

REFERENCES

1. *Sarah K. Leming, Harold L. Stalford, "Bridge Weighin-Motion System Development Using Superposition of Dynamic Truck/ Static Bridge Interaction", Proceedings of the American Control Conference, Denver, Colorado June 4-6, 2003.*
2. *A. Grakovski. I. Kabashkin "Fiber Optic Sensor Applicaions For Automatic Measurement of vehicles in Motion" Computer Modelling and New Technologies,2012, vol. 16, no. 4, 7–9.*
3. *Andrew J. Pratt, Rob Bushman, "Weigh In Motion Technology Economics and Performance", Presented at NATMEC '98, Charlotte,North Carolina.21 May 2014.*
4. *S.Fujimoto,T.Ono,Z.ohsaka : Evaluation of an In-motion Vehicle Weighing Method via Grey EstimationModel,Pmc.of SICE Annual Conference 2002,Papa No. SICE02-0500(2002).*
5. *K.Fukuda, K.Yoshida,T.Ono,K.Kameoka, T.Hirata, "An advanced algorithm for estimating axle weights of in-motion vehicles".*