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Design And Development Of Novel Weighing Scale System

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Abstract

The Measurement of load is a fundamental part of the several industries. So design a new a system that is capable for this type of measurement with advanced technology. This research work introduced a new method of weight measurements. The load cell, Analog to digital Converter /Amplifier/digitizer board is used in this research work are available in market on commercial basis. This paper gives the general idea about choosing load cell for load measurements and shows new implementation of weight measurements system based on Amplifier/ADC/Digitizer board. This research work has advantage of simple design and errorless, high accuracy measuring systems. The main theme of this paper is implementation of simple method for measurement of load with the help of load cell and advanced instrumentation.

Keywords: *load cell strain gauge, load measurement, analog to digital converter, personal computer.*

1. Introduction

Measuring weight is a vital and essential part of many industrial and commercial purposes. It is very difficult to measure weight with proper accuracy because of errors, so that it causes many losses like customers revenue.

For accurate and errorless weight measurements are to use load cell. A load cell is a transducer that is used to convert a force into electrical signal. The sensor used in weighing scale which gives out digital output is load cell. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire. 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 load cell provides an output voltage depending on the load placed on it. This cell is one of the most important applications of a strain gauge (SG) in an industrial environment.

The main theme of this research work is to display how much load is placed on the cell with accuracy and with a new technique. The figure1. Shows the overall schematic idea of the load measurement system.

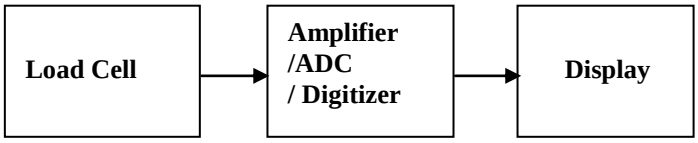

Figure 1 Schematics Diagram of Load Measurement

2. Load cell

The load cell is the heart of weighing system. Load cells are used for detection of weight or force; it is transducers with highest accuracy in very difficult conditions. Load cells are gives information according to user requirement. Load cell are classified according to their weight measuring technique and output generated signal, then there are fallowing types of load cell: Mechanical cells, strain gauge cells and fibre optic, piezoresistive etc. In this research work strain gauge load cell C3 class IP65is used, because, it is low cost and gives output with accuracy. So that it is used in large scale in industries. Strain Gauges normally are of two types: Semiconductor and Metallic. In semiconductor strain gauge resistance changes in large amount as compared to metallic strain gauge, it is small in size and semiconductor strain gauge have large gauge factor. In semiconductor strain gauge normally silicon material are used. But semiconductor strain gauge have non-linear response problem at output so that it should be solved by some documentation of gauge factor and signal conditioning circuit.

In this research work metallic strain gauge are used, its input resistance is 405 ohm and output resistance is 350 ohm configured in four arm bridge structure .A load cell is normally consist of 4 strain gauges, this arrangement is called Wheatstone Bridge arrangement . Some load cell consist of one strain gauge is known as quarter bridge and load cell construct with two strain gauge is called as half bridge. The figure 2 shows the arrangement of Wheatstone bridge. Strain gauge is act as sensing element; with the mechanical arrangements whatever force applied that will be sensed deforms strain gauge. This deformation measures by strain gauge as electrical signal .This electrical signal is in milli Volt so it is amplified by Instrumentation Amplifier .This output is send to program code to calculate how much force applied to the load cell.

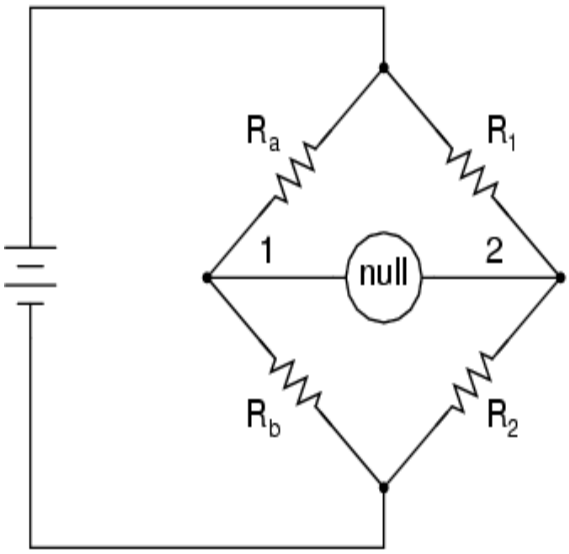

Figure 2.Whetstone Bridge

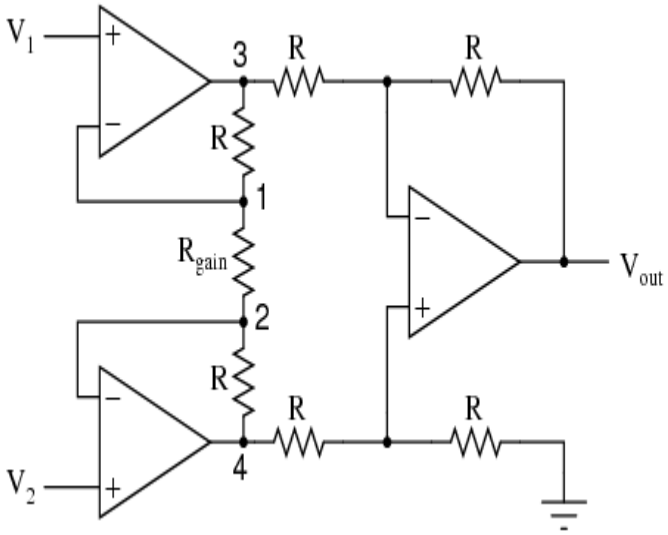

Figure 3. Instrumentation Amplifier

In market there are more number of load cell types ,some of are single point load cells , miniature ,bending beam, shear beam rectangular, shear beam round, canister, low profile, and 's' or 'z' beam.

In automotive industry, there are seat belt, gear stick, steering wheel, pedal force and in-line suspension load cells.

In this research work a load cell used is a single point load cell, protection is IP65 and rated load capacity is 40kg max and rated output is 2mv

3. Amplifier /ADC/Digitizer

1. This block as shown in fig.1 consist of three circuits that are
1. Instrumentation amplifier
2. Analog to digital converter
3. Digitizer

3.1 Instrumentation Amplifier

It is a combination of differential amplifier and input buffers. Due to this arrangement, matching of input impedance problem can be solved. This is biggest advantage instrumentation amplifier, so that instrumentations amplifier used in measurements and testing systems. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short- and long-term are required .The electronic instrumentation amplifier is shown in fig.3

The Instrumentation amplifier is consist of three operational amplifier ,in which one operational amplifier is used to buffer the each input and other operational amplifier produces required output with property of impedance matching .Operational Amplifier schematically similar to instrumentation amplifier. This can be differentiating by a feedback resister. In the circuit if feedback is absent then it is instrumentation amplifier ; and feedback is present then it is operational amplifier .The Characteristics of Instrumentation amplifier are low drift, very high open-loop gain, very low DC offset, low noise, very high common-mode rejection ratio, very high input impedances etc.

3.2 Analog to Digital converter:

Analog-to-Digital Converter (ADC) is a mixed-signal device, has both analog and digital functions. It is considered as an instrument which provides digital output that represents input voltage or current An ADC has an analog reference voltage or current against which the analog input is compared. The Resolution is a property of ADC, can be defined as the number of output bits of ADC. The analog input signal is converted to quantised output form by Analog-to-Digital Converter. The accuracy of ADC is depending on Quantization Error, but Quantization is a term that refers to subdividing a range into small but measurable increments. Quantization error is a difference between actual signal and digitised signal. These errors are measured in a unit called the least significant bit (LSB)It is 24-bit analog-to-digital converters (ADCs),consist of an onboard, low-noise programmable gain amplifier (PGA), precision delta-sigma ADC and internal oscillator, it provide a complete front-end solution for bridge sensor applications including strain gauges, weighing scales and pressure sensors. The onboard, low-noise PGA has a selectable gain .The clock is given

externally to ADC by an oscillator or crystal, an internal oscillator is also present in it, it does not require any external components. The delta-sigma ADC has 23.5-bit effective resolution. This ADC supported by two data rates 10(Sample Per second) SPS and 80SPS.

3.3.Digitizer : This is last block in above figure1. It takes input from ADC and gives outputs serial data of 9600 bps (Bits per second).This is a direct reading in kilograms. This output is directly connected to the microcontroller for display purpose in display unit. In this research work for display of reading , the output from digitizer block can be directly interface to the PC using RS-232 serial port with MAX-232 driver.

4. Display: For display purpose, Light Emitting Diodes (LEDs), Seven –segment display, Liquid Crystal Display (LCDs) can be used. In this research work, PC can be used for readings display purpose via serial port techniques. In the computer software, with the help hyper terminal mechanism it can easily showings readings in kilograms whatever load can be placed on the load cell.

5. Conclusions: It is a new technique for measuring weight with the help of load cell and without using microcontroller. In this technique, it does not require any software programming, adjusting or initialization of any display. This research work was a part of design of weighing scale measurement system for purity and cost standardisations. This work gives the acceptably readings from load cell and Amplifier /ADC/digitizer systems without going for classy precision electronics Instrumentation This paper gives out a new technique for new researchers for measuring weight on load cell. This weight measurement method with load cell platform gives proper accurate readings as compared to other methods.

6. References

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