Physics through Teaching Lab XXIII

LabVIEW Based Weighing Machine

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Abstract

LabVIEW is used in the development of dedicated instruments for laboratory and industrial applications. This paper presents the implementation of Lab VIEW for weights measurement using load cell. Virtual instruments are presently used in scientific and industrial applications. Aim of this paper is to build a simple weighing machine implementing the Lab VIEW. The hardware, software details are presented in this paper. The results are satisfactory. This paper helps the students to understand and build a basic instrumentation system.

Key words: LabVIEW, Weights measurement.

Introduction

Weight is generally used as a measurement in many situations as a measure of quantity. It is commonly used for batching out quantities. Many types of methods are available for weight measurement, one of the methods to measure the weight by using a load cell. It is a passive transducer which can convert a force (strain) into electrical signal. It has a strain gauge as a sensing element. Strain gauges are two types; one is semiconductor strain gauge and anther one metallic strain gauge. In the metallic type gauge is resistance varies linearly with strain. In this Experiment, the metallic type strain gauges are used.

A load cell usually consists of four strain gauges in a Wheatstone bridge configuration (Full Bridge). This load cell has a cantilever, one end of which is fixed firmly to a rigid support and the other end, where the unknown force is applied, is free. At the free end of the cantilever beam, applied force cause bending moment, develops the strain on the strain gauges, which is proportional to the applied force [1]. When the cantilever beam is stretched, the resistance of the strain gauges is increased due to which, its resistance changes in a definite manner. The force is applied through the different weights. In this experiment a load cell having linear response is used. The Wheatstone bridge consisting of four resistive arms with a DC excitation source acts as sensing element in the load cell. Measurements can be carried out either by balancing the bridge or by determining the magnitude of imbalance [4].

Instrumentation:

The weight measurement achieved by using labVIEW is shown in fig 1. The block diagram consists of the following blocks 1. DC Excitation Source, 2. Load cell, 3. Signal conditioner, 4. NI DAQ 6009, 5. Personal Computer.

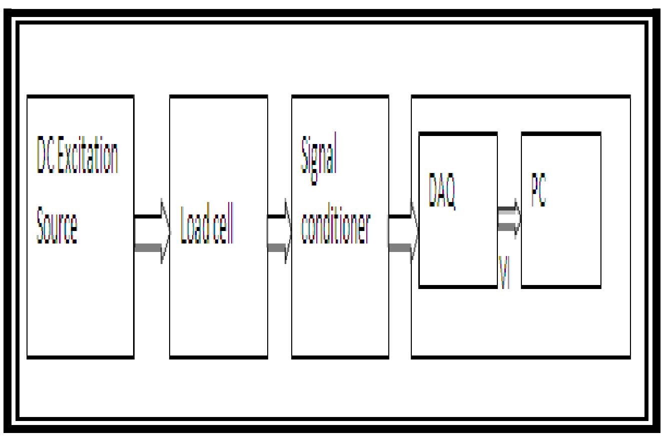

Fig. 1 Block diagram for measurement weights by load cell.

Basically load cell is a passive transducer. Excitation is needed for passive transducers because these transducers do not generate their own voltage or current. The excitation source may be an alternating current or D.C voltage source. The D.C system is comparatively simple and generally used for resistance transducers such as strain gauge. In load cell, the strain gauges are in Wheatstone bridge configuration (Full Bridge). It is the most commonly used Bridge for measurement of resistance. There are two ways in which a Wheatstone bridge can be used. They are Null Type Bridge and Deflection Type Bridge. For measurement of rapidly changing input quantities, the Deflection type is used. The output of Deflection Type Bridge is the result of imbalance caused by the strain on the strain gauge. The output of the bridge is directly proportional to the change in the input quantities; the output of the bridge is very low. Hence it needs a signal conditioning element. The signal conditioning element consists of an instrumentation amplifier and scaling amplifier. The instrumentation amplifier has high input impedance. This bridge is called the Voltage Sensitive Bridge [1]. The bridge output is applied to the differential inputs of the Instrumentation amplifier. The output of an instrumentation amplifier is applied to the scaling amplifier. The scaling amplifier is configured in non-inverting configuration with adjustable gain.

The output of the scaling amplifier is applied to the Data acquisition device **NI DAQ 6009** [6] from National Instruments. It has eight analog input channels and two 12 bit DAC channels, The ADC can be configured for either 12bit/14bit, the ADC can be used for single ended input or Differential input mode [7]. In this experiment the output of the scaling amplifier is read from A0 of the ADC of the NI DAQ 6009. The data is processed and the weight is displayed in Gms.

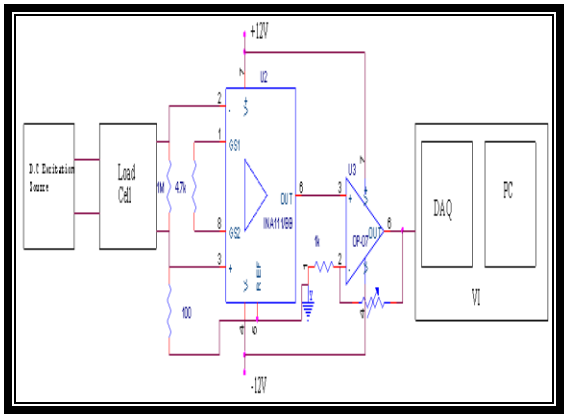

Fig2.Schematic Diagram of weights measurement

Fig. 2 shows the schematic diagram of weights measurement using lab VIEW. The external D.C excitation source is connected to two arms of the load cell and another two arms of load cell are applied to Load resistor of 1 MΩ. The output of the

bridge is applied to the differential inputs of an instrumentation amplifier. A small resistor is connected at the non inverting input of the instrumentation amplifier to the ground. The 100Ω resistor acts a ground point eliminating grounding errors. The output of the instrumentation amplifier is fed to scaling amplifier. The scaling amplifier has adjustable gain for suitable amplification for linear measurement. The output of the scaling amplifier is applied to National Instruments DAQ card NI DAQ 6009. In load cell, the strain gauges are in Wheatstone bridge configuration. In this experiment deflection type measurement is used. Due to the small variation in the resistors, there exists a small amount of DC voltage at the output of the bridge at no weights condition. Hence to offset the bridge voltages, the offset voltage is compensated through the lab view programming. The programming on LabVIEW measures the voltages and displays the weight on the front panel of the virtual instrument.

Software Development:

The following Algorithm is used for the software development in the present application.

1. Initialization of DAQ for data acquisition.
2. Enabling the function for the Amplitude and level measurements in VI (virtual instrumentation) for measurement of DC voltage.
3. Find out the offset voltage of NI DAQ.
4. Offset Nulling: The offset voltage is subtracted from the measured voltage obtained from the amplitude measurement function. The corrected output voltage value is applied to the Formula function for the exact voltage measurement.
5. A case loop is designed for tare weights function.
6. Weights are displayed with tare and without tare.

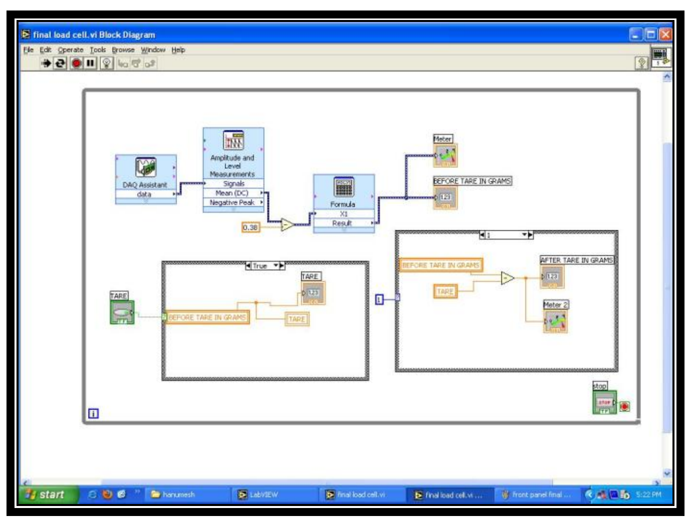

Fig.3. Block Diagram of the VI

Fig. 4.front panel of the weighing machine on VI

The experimental setup is shown, in plate 1.

Plate1. Experimental Setup of Lab VIEW based weighing machine

Results and Conclusions:

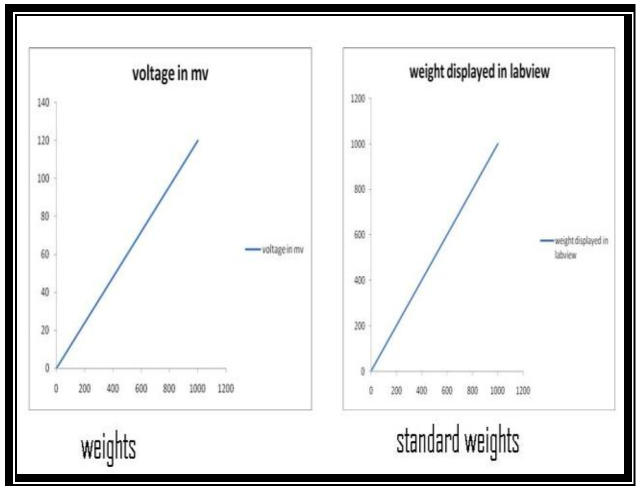

Fig. 5(a) Weight vs. Voltage, fig.5 (b) Standard weights vs. weights displayed in Lab VIEW

Weight measurements are achieved by implementing the load cell as sensor and LabVIEW as platform for the weighing machine.

The fig.5 (a) shows Weights vs. Voltage, 5(b) shows Standard Weights vs. weights displayed on LabVIEW. The weights are measured from 5 Gms to 5 Kg with this present unit. The experiment is done without any additional mechanical couplings. The results are satisfactory.

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