

LABVIEW based Specific Gravity Measurement

G. Shivakumar
Department of E&I
Engg
M.C.E., Hassan

Dr.H.S. Mohana
Department of E&I
Engg. M.C.E.,
Hassan

H.S. Murali
Department of E&I
Engg. M.C.E
Hassan

C.M. Naveen
Kumar
Department of E&I
Engg M.C.E.,
Hassan

ABSTRACT

Specific gravity or relative density of liquid is the main parameter of interest for chemists, gemologists and aquarists to know the reactions of chemical solutions, to check the purity of gem and to know the salinity of water respectively. Hydrometer is the most widely used device to measure specific gravity. But the draw back with this instrument is that, there is typically more wastage of the liquid sample under test and a longer cleaning time. Virtual Instrumentation based specific gravity measurement resolves this issue.

A virtual instrument for estimation of specific gravity of liquid under test is developed. A signal processing circuit comprising of instrumentation amplifier is designed to amplify the signal received from the load cell and this signal is interfaced to a personal computer with the aid of PIC microcontroller and MAX232. The virtual instrument design is completed using LabVIEW software. The results obtained are inline with the actual values and are found to be repetitive.

Keywords

Specific gravity (SG), Load cell, Virtual Instrumentation, PIC microcontroller.

1. INTRODUCTION

Specific gravity(SG) or relative density of a fluid is defined as the ratio of density of a substance to the density of a reference material, usually water. It is a dimensionless quantity. Specific gravity varies with temperature and pressure. Substances with specific gravity of 1 are neutrally buoyant in water. Those with specific gravity greater than 1 are denser than water, and hence they sink in water. And the substances with specific gravity less than 1 are less dense than water and hence they float .The principle use of specific gravity measurement in industry is determination of concentrations of the substances in aqueous solutions.

Virtual instrumentation is the use of customizable software and modular measurement hardware to create user defined measurement systems, called virtual instruments. Virtual instruments offer a wide range of data acquisition capabilities at a significantly lower cost than that of dedicated devices. Table 1 gives SG of few liquids

Table 1: Density and specific gravity of liquids

Liquid	Temp(°C)	Density(Kg/m ³)	Density of Water(Kg/m ³)	Specific Gravity
Benzene	25	837.800	997.073	0.8402
Water	20	998.200	998.200	1
Water	25	997.073	997.073	1
Water	26	996.811	996.811	1
Chloroform	20	1489.00	998.200	1.4916
Chloroform	25	1465.00	997.073	1.4693
Chloro Benzene	20	1106.00	999.200	1.1079

2. SYSTEM BLOCK DIAGRAM

Fig.2.1 shows the block diagram of the system. Load cell is used to find the mass of the liquid under test. The output voltage of the load cell is directly proportional to the mass of container with the liquid. This signal is amplified by an instrumentation amplifier. The amplified signal is interfaced to a personal computer using micro controller. Data acquisition software at the back end and interactive GUI control panel screen is designed using LabVIEW software.

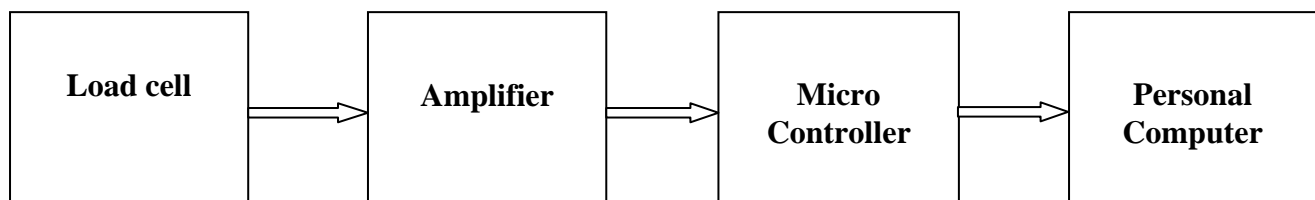


Fig 1. Block Diagram of the System

3. HARDWARE DESCRIPTION

3.1 LOADCELL

A load cell is a device that transduces an electrical signal whose magnitude is directly proportional to the force being measured. In a strain gauge type of load cell, through mechanical arrangement the force being sensed deforms a strain gauge. The strain gauge measures the deformation as a

change in electrical resistance, which is a measure of strain and hence the applied forces. Strain gauge load cell consists of four strain gauges in a Wheatstone bridge configuration. It converts the load acting on them into electrical signal. The electrical output is typically in the order of few millivolts.

3.2 INA 122

The INA 122 is a precision instrumentation amplifier for

accurate, low noise differential signal acquisition. Its two op-amp design provides excellent performance with very low quiescent current and is ideal for portable instrumentation and data acquisition systems. The INA 122 can be operated with single power supplies from 2.2V to 36V.

2.3 PIC MICROCONTROLLER

Microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and a programmable I/O peripheral. PIC (Programmable Interface Controller) is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics division.

3.3 MAX232

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs into 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, hysteresis of 0.5 V and can accept 30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASIC library.

4. SOFTWARE DESCRIPTION

Flowchart of the interface program is as shown in the fig.4. Microcontroller is initialized at first, followed by the initialization of UART module for baud rate 9600. Further, ADC module is configured. I/O ports are configured next. Using an finite loop, while (1), voltage from the loadcell is continuously read from the channel and are loaded on to a variable. This value of the voltage is then sent to PC through Tx pin of UART.

3.1 LabVIEW

LabVIEW is a system design software that provides engineers and scientists with the tools needed to create and deploy measurement and control systems through unprecedented hardware integration. LabVIEW inspires to solve problems, accelerates productivity, and gives the confidence to continually innovate. LabVIEW which is the short for Laboratory Virtual Instrument Engineering Workbench is a graphical programming language that is more flexible than the standard laboratory instrument because it is software based. It is much more than a programming language which has interactive programming development and execution for the use of people. LabVIEW development environment works on computers running with WINDOWS, MAC-OSX or LINUX. LabVIEW consists of one or more virtual VIs (Virtual Instruments). Virtual Instruments are called so because their appearance and operations imitate actual physical instruments. However, behind the scenes they are analogous to the main program.

A VI has three main parts:

1. A front panel
2. Block diagram
3. An icon

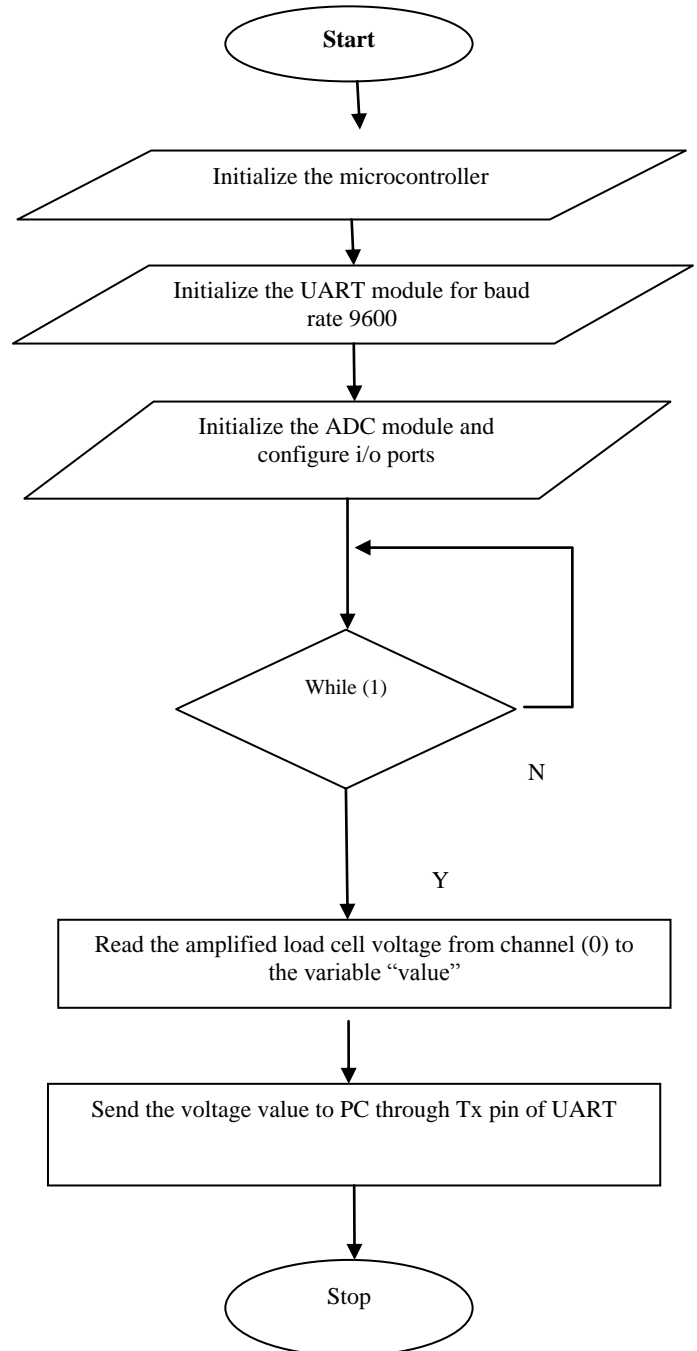


Fig 2. Flowchart of the interfacing program

