SMART DATA ACQUISITION TECHNIQUE FOR LEVEL PROCESS USING LIFA

T. Sivaranjani, P. Malarvizhi and S. Manoharan
Department of Electronics and Instrumentation Engineering, Karpagam College of Engineering, Coimbatore, India

ABSTRACT

Level monitoring plays an important role in the industrial production, automotive, oil, petroleum and natural gas industries whose measurement should be continuous and accurate throughout the process. Hence the importance of measurement and data acquisition is very much increased in industry. This paper is proposed for measuring and monitoring the level of the tank using LabVIEW software and Arduino board is used for interfacing the hardware and the LabVIEW software. The proposed method is of low cost, easy to use and has wide range of applications in industries and laboratories.

Keywords: arduino UNO, data acquisition, LabVIEW, LIFA.

1. INTRODUCTION

Measurement of levels in tanks is important across many industrial applications. There are many tank monitoring applications, for example water level monitoring, mining process liquids monitoring, Boiler level detection and pipeline corrosion inhibitor liquid monitoring, etc. The monitoring is required for two purposes. One is to make sure that the tank does not run dry or over flow during the process, another purpose is to ensure the liquid is being drawn from the tank is of prescribed value , for these requirement we are continuously monitoring the level of the tank using a level sensor.

In most of the industrial applications the level measurement is carried out in terms of pressure, in which pressure can be calibrated to the level of the tank. Level transmitters are familiar and well understood technology for liquid level measurement. They are straight forward, easy to use and install and work in a high variety of applications and wide range of conditions. The measured value should be monitored and suitable action should be carried out to rectify the deviation in the process.

Technological advances have made computers an important part of every workplace. Many companies store their processed data with the help of the computer systems, databases and networks, and in most of the industries communication is done using computers and networks. DAQ (Data AcQuisition) is simply the process of bringing a sensor or transducers output into the computer, for signal processing, analysis, storage or other data management [1]. A physical phenomenon represents the real-world signal that we are trying to measure and stored in the computer. In order to optimize the characteristics of a system in terms of performance, managing capacity and cost, the equivalent subsystem can be combined together. Analog data is generally acquired from the sensor and converted into the digital form for the purpose of processing, transmission and display. Rapid improvement in Personal Computer (PC) hardware and software, technologies have resulted in easy and efficient adoption of PCs in various precise measurement and complex control applications. A PC based data acquistion or control application requires conversion of real world analog signal into digital format and transfer of digitized data into the PC. A data acquisition system that performs conversion of analog signal to digital data and the digital data to analog signal which is interfaced to a PC to implement the functions of a measurement and control instrumentation applications.

This paper proposes for a smart data acquisition method using LabVIEW [2]. In this paper Arduino board is used to interface the level sensor output to a PC in order to monitor the level of the process tank using LabVIEW software. LabVIEW Interface for Arduino (LIFA) based monitoring is economical and can be implemented in any small scale industries. This proposed method will overcome the disadvantages of the existing monitoring method.

In this paper Section 2 deals with proposed system block diagram in which it explains how data is acquired and monitored using LabVIEW via Arduino board. Section 3 deals with the Results and Discussion and Section 4 ends with Conclusion.

2. PROPOSED SYSTEM DESIGN

To assure the safety and productivity of the process, it is essential to be equipped with instruments providing consistent and precise measurements of level. At the source of level measurement, it is simply about determining the position of the surface inside a tank, reactor or other vessel. Precise control of the level of the liquid in a reactor, or vessel is significant in many process applications.

Level measurement is frequently used for inventory management. The main reason for maintaining the level is to keep track of inventory in terms of volume or weight. Level measurement is one of the key components in the tank gauging system for consistent and precise inventory control.

Level measurement indicators enable an onsite level check. Indicators require the operator to interrupt the measurement and take the suitable action. Systems with level monitoring systems are referred to as an open loop control system. Indicators are also frequently used to help standardize the automatic control loop.
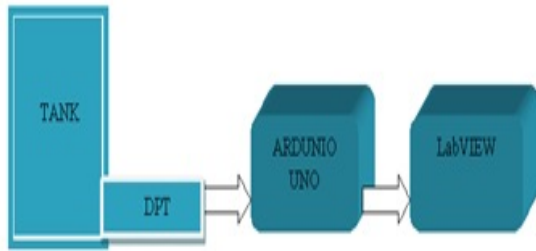
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Figure-1. General design for level monitoring system.

Level transmitters are used inside the plants. The level measurement is usually a self-determining input to a control system. Level process that use pressure transmitters are called as bottom up measurement systems. A bottom up measurement typically contacts the process fluid for e.g. DP level.

Indirect measurement also well-known as inferred measurement indicates that a variable other than level is first measured and then used to determine a level measurement. For example pressure transmitters use fluid specific gravity and mass to analyze level.

If a level measurement is being made on an open vessel, a gauge or differential pressure transmitter is required. If the tank is closed or pressurized a DP measurement must be made to compensate for the vessel pressure.

In general pressure transmitters are economical, easy to use and well understood. In addition, pressure transmitters can handle nearly any tank and liquid, including slurries. They function in a wide pressure and temperature range as well as in foam and turbulence.

a) Differential pressure transmitter

A Differential pressure Transmitter (DPT) for level measurement is normally mounted at or below the tank connection as shown in the Figure-2 in order to measure the pressure of the liquid.
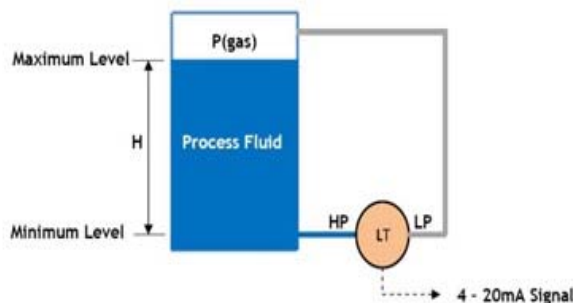

Figure-2. Tank with a DPT setup which produce (4-20) mA output.

The most common and useful industrial pressure measuring instrument is the differential pressure transmitter. This equipment will measure the difference in pressure between two ports and produce an output signal with reference to a calibrated pressure range. The majority of industrial DP Transmitters are fitted with diaphragm an elastic material act as a pressure sensing element. This diaphragm is an elastic mechanical device which is placed in between the two pressure inlet ports. The diaphragm will produce deflection for the applied pressure.

DC output current is generated which is directly proportional to the pressure range of the Differential Pressure Transmitter. The lower range which is calibrated to 4mA and the upper range to 20mA. This controlled output current is not affected by load impedance variation and supply voltage fluctuations. The corresponding voltage of the DPT is given to LabVIEW software via Ardunio board for monitoring the system.

Advantages of Differential pressure transmitters are Differential pressure based level sensors can be easily mounted or fitted to the surface of the vessel. To carry out maintenance and testing, DPT can be provided with block values for isolating them carefully from the process liquid. They can be easily applied in level measurement applications such as total level in separator vessels where other level measurement devices are not feasible owing to the extensive changes in material formation experienced in the upper state.

b) Ardunio

The Arduino UNO is a microcontroller board based on the ATmega328.It has 14 digital I/O pins out of which 6 pin can be used for Pulse width modulation outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, an ICSP header, a power jack, and a reset button. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that usually need an external programmer [3].

Arduino is an open-source single-board microcontroller, easy to use for the open-source Wiring platform, developed to make the process of using electronics in multiple projects more easily and economically. The hardware consists of a simple design for the Arduino board with an Atmel AVR processor and on-board input and output support. The software contains standard programming language that are easy to the user to work on the platform. Arduino hardware is programmed with some small simplifications and modifications than the conventional method that the user can easily understand. The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects [4].

After installing LIFA the Arduino firmware can be found in <LabVIEW>\vi.lib\LabVIEW Interface for Arduino\Firmware\LIFA_Base\LIFA_Base.ino. syncLV() is called in the setup function and establishes the connection between the Arduino and LabVIEW. This function should only be called once when the Arduino boots. Check for Command () is called repeatedly inside the main loop of the Arduino sketch. This command scans the Arduino serial buffer for data from LabVIEW. If full

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packet is available this command will process the packet and send the appropriate response to LabVIEW.

Check For Command () is implemented in LabVIEW Interface.ino and simply checks to see if a full packet (15 bytes by default) is available in the Arduino serial buffer[5].

c) LabVIEW

NI LabVIEW system design software is at the center of the National Instruments platform. Providing complete tools that we need to build any measurement or control application in considerably less time, LabVIEW is the ideal development environment for improvement, detection, and provide good results. Combine the power of LabVIEW software with Arduino board it will overcome the difficultly of interfacing the hardware in very low cost and time.

NI LabVIEW software helps you acquire data from any standalone instrument over any bus and provides extensive libraries for signal processing and graphical visualization. Combine the power of LabVIEW software and IDNet instrument-specific drivers to automate third-party instruments to create reusable measurement solutions that you can program and reconfigure to meet your evolving needs.

LabVIEW is a graphical programming language for instrumentation, data-acquisition, analysis, automation & control and communication. LabVIEW is program development application software, much like various commercial C/C++, FORTRAN or BASIC development systems. On the other hand LabVIEW is the software that was used to interface the computer with the control device. It allows for easy interfacing and control because of the fundamental concept behind in which it has been developed for graphical programming [6].

The programs created are independent of the type of machine that they are created for that the programs can be transferred between different operating systems. Additionally LabVIEW has a large set of built-in mathematical functions and graphical data visualization and data input objects typically found in data acquisition and analysis applications.

The advantage of using graphical programming as in LabVIEW is that it avoids the user having to go into the programming aspect of the required action. Users can place graphical representations of hardware by examining their respective hardware drivers or dynamic link libraries (dll's). The main benefit of LabVIEW over other development environments is the extensive support for accessing instrumentation hardware [7].

d) Steps for installation

Firstly install VI Package Manager

1) Here for installation Internet should be available throughout the installation process.
2) After installing VI Package Manager, it searches various options.
3) Then we get an option of LabVIEW interface for Arduino, and install it.

4) After installation we get the icon of LabVIEW beside Arduino interface for Arduino.
5) Now, we have to open LabVIEW 2012, We get an icon of Arduino.
6) Then we have to open LabVIEW 2012 and connect the required circuit using Arduino inLabview2012 with proper input output (Read/write).

The LabVIEW Interface for Arduino (LIFA) provides an interface between LabVIEW and an Arduino. LIFA was developed and well experienced using an Arduino. The LabVIEW Interface for Arduino includes opens source firmware for the Arduino as well as over 100 Vis to access the Arduino functionality from within LabVIEW. LabVIEW for Arduino is a tethered solution and requires a data connection between LabVIEW and the Arduino at all times. This is typically interfaced via USB but can also be interfaced using Xbees or 5639luetooth.

The LabVIEW interface for Arduino is a VI based API that was written and distributed by national instruments [8]. The VI packet manager should be loaded in the device which is to be performed, the analog signal from the sensor or transducer is fed into the arduino board and this will sent to the LabVIEW software through the USB bus. The LabVIEW Vis provided, allow us to read the analog inputs, control the digital IO lines and use various other features of the Arduino hardware.

There are many reasons LabVIEW makes you more productive when using Arduino:

▪ Interfaced with your system through a graphical user interface.

▪ Streamline the design process with graphical programming.

▪ Improves the debugging process in an interactive way.

▪ Open API allows for complete customization, customize our programs to fit in the application

e) Liquid level monitor using LIFA

The LabVIEW interface for Arduino is a VI based API that was written and distributed by NI. The code also includes an Arduino embedded program which must be downloaded to the device. This program runs on the Arduino, responds to the commands given on the USB bus from the LabVIEW program. The digital data sends back data to the computer via the USB. The LabVIEW Vis provided, allow us to read the analog inputs, control the digital input output lines and use several other features of the Arduino hardware [9].
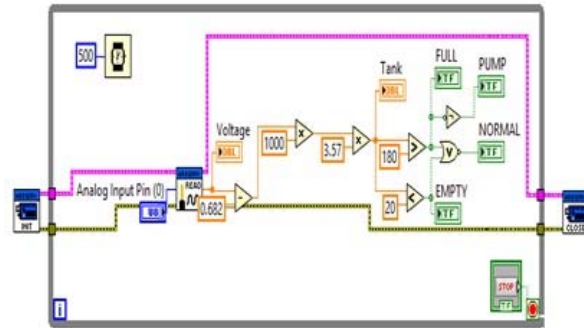
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Figure-3. Block diagram for monitoring of level process.

This paper is proposed for smart data acquisition of analog input from the DPT to LabVIEW software via Ardunio board. The block diagram for data acquisition process is shown in the Figure-3 in which analog voltage is fed into the A0 pin of the Ardunio board.

Once the Ardunio board is initialized it reads the analog signal and convert into digital signal and given to the microcontroller. The output voltage is viewed in the LabVIEW front panel and it is converted into corresponding level in terms of mm.

3. RESULTS AND DISCUSSIONS

With the help of LabVIEW we can monitor the process tank whether it is FULL, NORMAL or EMPTY and we can get the information whether the pump should be in ON and OFF condition. The front panel shows the results of the level monitoring system. Figure-4 and 5 shows the normal and full condition of the tank. The level is sensed by the level transmitter and the produced current is converted in to corresponding voltage which is fed into the A0 pin of Arduino and calibrated into level in terms of mm. When tank is empty the sensor will produce an equivalent output voltage of 0.68V and for full condition 0.74V have been produced.
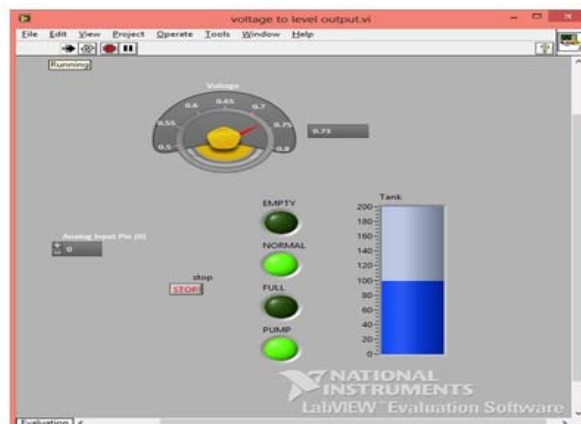

Figure-4. Front panel for level monitoring system when pump is on for normal condition.
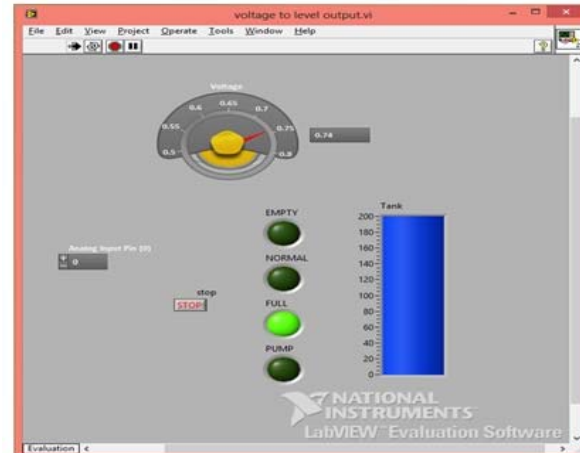

Figure-5. Front panel for level monitoring system when pump is off for full condition.

4. CONCLUSIONS

Ardunio based data acquisition system is used in small scale industries where the sampling instant is 1 sample for every 1sec.Most of the data acquisition can be monitored by using this sampling rate.

The presented work can be extended for various sensors and this setup is economical, cost effective and useful for studying the characteristics of different process. This method can use in small scale industries where the low sampling instant is required for monitoring process.

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