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Labview Based Liquid Level Control System

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ABSTRACT

Most of the traditional measuring systems were designed and implemented by complicated circuitry which made the product expensive, with low functionality. Using this LabVIEW based liquid level control system, the cheaper and more versatile measurement system can be developed. This paper demonstrates an innovative approach for industrial low cost liquid level monitoring based on virtual instrumentation. With virtual measurement technology, more of the instrument can be substituted by software. The development of virtual and open architecture monitoring systems shift the focus of automation from being hardware centric to software centric, providing further flexibility

Keywords: LabVIEW, level measurement

I. INTRODUCTION

Many industrial and scientific processes require knowledge of the quantity of content of tanks and other containers. In many instances it is not possible or not practical to directly view the interior. The more obvious industrial applications include: tank level gauging of milk, beer or wine in food and beverage industry; level gauging of acid, oil and solvent vessels in chemical plants; level monitoring of water in reservoirs. Level measurement for liquids can be accomplished with over 20 different technologies being offered on the market today. With the wide variety of approaches identifying the right one for specific application can be very difficult. Many applications require a single tank to process multiple environments with different densities or they have a media that changes density with temperature. This is very common in the food and beverage industry where different ingredients are blended and mixed in the same tanks. An accurate liquid level measurement in these conditions utilizing a gage type instrument mounted in the base of the tank is impossible. Continuous liquid level measurement and the detection of both density and temperature of liquids with dissimilar properties are classical topics in level sensor research. Several solutions have been developed that rely on a variety of working principles.

II. LITERATURE SURVEY

Praseed Kumar, Shamim S Pathan and Bipin Mashilkar [1] has demonstrated a prototype of a liquid level monitoring system based on float sensors, electromagnetic valve, Matlab and LabVIEW environment is developed for measuring liquid level accurately and accordingly maintaining the level of liquid close to the reference level. Georgi NIKOLOV and Boyanka NIKOLOVA[2] developed a prototype of a liquid level monitoring system based on integrated differential pressure sensors, multifunction data acquisition board and LabVIEW environment. Also discussed an appropriate method for liquid level monitoring based on comparative analysis of more popular technologies. The method for obtaining both liquid density and liquid level with two differential pressure sensors are considered.

James D. Wagoner and N. F. Macia [3] designed a liquid level control system to control the level of a liquid in a water tank that had a randomly varying inlet. Control of the water level was accomplished by adjusting a gate valve in the drainpipe located at the bottom of the tank. A solenoid actuator, operated in a continuous mode, controlled the gate valve opening and a pressure sensor provided liquid level feedback to the controller.The liquid level control system was implemented with a PC running National Instruments LabVIEW software.

III. METHODOLOGY

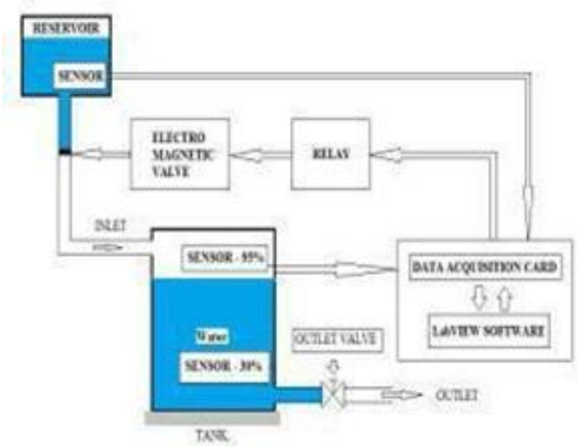

Figure 1. Block diagram of LabVIEW based liquid level control system

The setup consists of a water tank which receives water from a reservoir under a suitable head. A water pump is located at the inlet of the tank. A float sensor (5V) located at a suitable height in the tank is used to sense the level of water. The float sensor senses the water level and sends a signal to the NI DAQ 6008/6009 (input module) in the form of voltage. The DAQ card is used to interface with the hardware. The LabVIEW software will process the data and sends a voltage of 5V as a signal to the output module, i.e. NI DAQ 6008/6009. This voltage actuates water pump via relay. This will turn on or off the water pump depending upon the signal from DAQ 6008/6009.

IV. HARDWARE IMPLEMENTATION

A. POWER SUPPLY:

A DC power supply system, which maintains constant voltage irrespective of fluctuations in the main supply or variation in the load, is known as Regulated Power Supply.

1. A step down transformer converts the 220 ac voltage to the lower ac voltage and gives alternating current at output.

2. The process of conversion of ac to dc is known as rectification. Here a bridge rectifier made up of p-n junction diodes is used to perform this operation.

3. The output of the rectifier contains some ripples or distortion so filtering is carried out.

4. By using a voltage regulator IC LM 7809, 9V dc output is generated. The power supply of 9V is used to run the water pump to pump water from sump to tank.

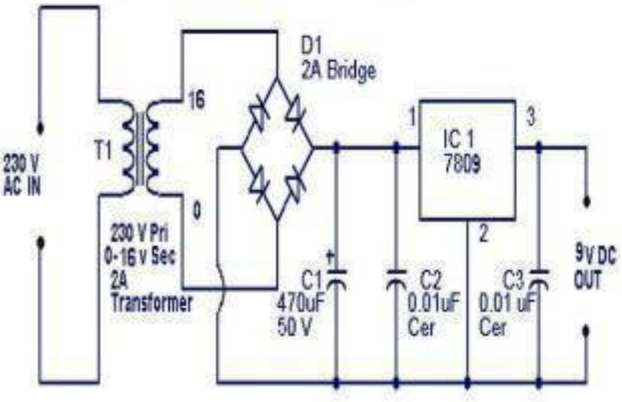

Figure 2. 9V DC regulator using 7809

B. FLOAT SENSOR:

Properly used, float switches can deliver millions of on/off cycles, for years of dependable operation. Failures are normally due to overloading, frequently caused by spiking voltage. The project consists of three float sensors, one is placed at the bottom of the sump and other two are placed at minimum (30%) and maximum (95%) position of the tank. The floating sensor placed in the sump indicates the presence of minimum water required to turn ON the water pump when there is a request from DAQ 6008/6009 card. When the level of liquid goes below the minimum position of the tank, the float sensor placed at 30% of the tank sends a signal to turn ON the water pump to fill it. When it reaches maximum position, the float sensor placed at 95% of the tank sends a signal to turn OFF the water pump.

V. SOFTWARE IMPLEMENTATION

A. FLOW CHART

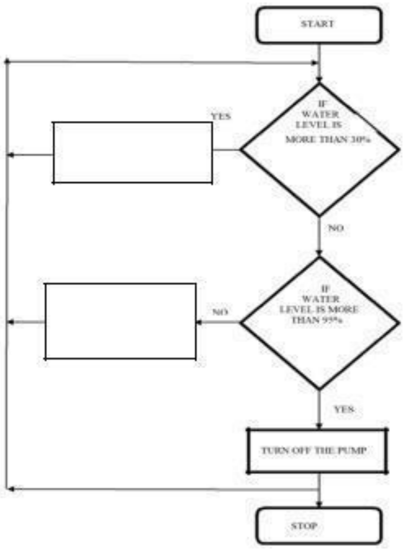

Figure 3. Flowchart for monitoring and controlling of liquid system

B. LabVIEW Program for Monitoring and Controlling of Liquid Level System

Initially a task is created and virtual channels are selected depending on the input and output i.e. analog or digital and add them to task. Later task is started and it reads the data from three sensors located at sump and tank. The sensors in the tank are located at 30% (minimum level) and 95% (maximum level).

1. If the water level in the tank is below 30% (both sensors are at false condition) signal is sent from DAQ card to turn ON the water pump. Water is pumped till it reaches 95% of the tank and turned OFF.
2. If the water level in the tank is above 30% and below 95% it sends feedback value, i.e., while incrementing motor is turned on and while decrementing motor is turned off.
3. If both the sensors are at true condition, the signal is send to turn off the water pump.
4. The sump will pump water only if the sensor placed in it is at true condition, else pump won't turn on.

An additional option is provided for manually controlling the system which will grave out in case of automatic conditions. The signal from the DAQ card writes the data as output and stops the task and clears it for next cycle.

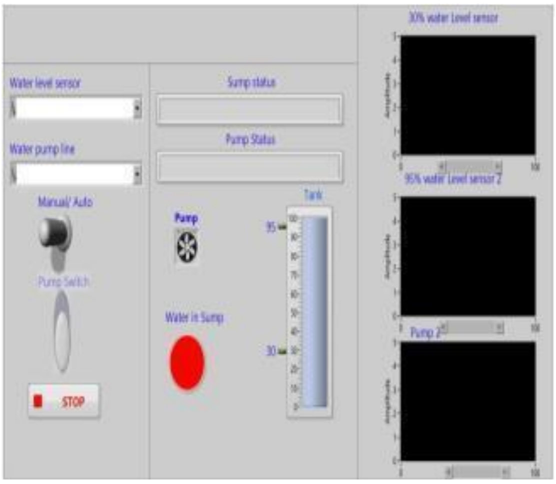

Figure 4. VI Front panel of the LabVIEW program for monitoring and controlling of liquid system

VI. RESULTS AND DISCUSSIONS

When the float sensor is in the ON condition, the relay completes the circuit where the water pump is connected and turns it on. When the water rises to the desired level the float sensor turns off and this in turns off the water pump.

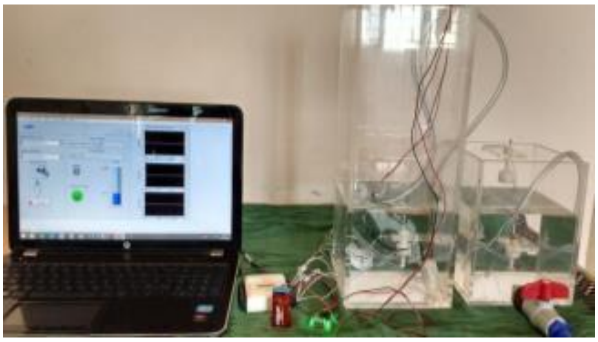

Figure 5. Prototype of a LabVIEW based liquid level control system

Random filling of the tank represents a real life unpredictable disturbance to the system. Automatic control is accomplished with the use of a personal computer operated with LabVIEW software and also by sensing the water level and then controlling the position of a gate valve that releases water from the tank. An option of manual control is also provided.

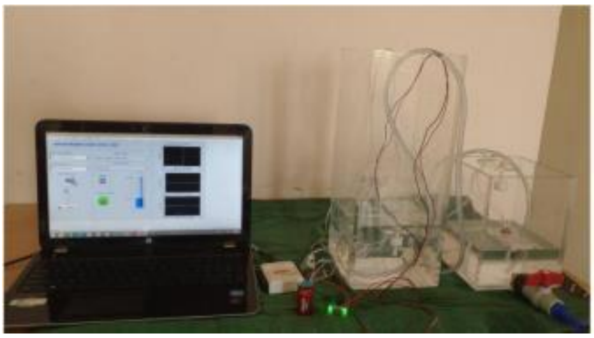

Figure 6. Image of the prototype when the level of liquid is at minimum position in the tank

When the level of liquid in the tank goes below minimum position (30%), it is sensed by the float sensor which in turn sends signal to DAQ 6008/6009 to turn ON the pump to fill the tank. Above figure shows the image of pumping the water from sump to fill the tank.

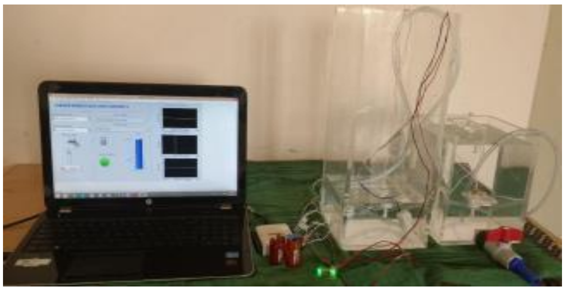

Figure 7. Image of the prototype when the level of liquid is at maximum position in the tank

When the level of liquid reaches maximum (95%) position of the tank, the float sensor sends a signal to turn OFF the pump through DAQ 6008/6009 card. Above figure shows that the liquid level in the tank has reached maximum position (95%).

VII. CONCLUSION

Detection of liquid level by float sensor and corresponding ON/OFF switching of water pump is achieved. The open loop control system is modeled in LabVIEW. This set up will further be used for testing and implementing an Ultrasonic sensor. This will enable to control the level of liquid at any height directly from LabVIEW. The implementation of virtual measurement technology for continuous liquid level is presented. This system design concept may be used to develop a various low cost liquid level measurement and monitoring systems. Interfacing of hardware components with LabVIEW software through NI hardware is carried out successfully. This will create a new era in the field of process automation.

VIII. REFERENCES

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