

Level Control Liquids and Pump Temperature Monitoring by Using Labview

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Abstract: This article presents a prototype with an innovative design for temperature control, as well as level control of a liquid tank through the association of the Arduino-one and LabView software. The purpose of this work is to construct a liquid level control through the use of a microcontroller as well as the acquisition of data with the LabView interface software obtained with an ultrasonic sensor. The sensor is used for better accuracy and stability under different conditions, in this case to determine the exact filling and emptying of the tank. A display in LabView shows the liquid level in the tank and the ON / OFF state depending on of the state of the liquid. The developed system is highly flexible and easy to control to operate the pump.

Keywords: Ultrasonic sensor, Temperature monitoring, Data acquisition, Level control

1. Introduction

Currently the demand for level and temperature control is indispensable in any industry, as the temperature and the level is of great help in the industrial sectors. The storage area of liquids has been affected by not having precise control in level and temperature, thus it is intended to implement a monitor of these parameters.

One of the most used programs in automatic control is LabView because it allows the acquisition of data such as temperature, flows and other variables in real time and allows to obtain profiles of these variables. The objective of this work is to create an interactive temperature automatic control in the filling / emptying pump, as well as a liquid level control system in order to control the level of the tank. The circuit keeps the system pump temperature at a

standardized level. The pump will be turned on / off according to the conditions set in the parameters defined in the LabView software.

Palabras Clave:

Sensor Ultrasónico, Monitoreo de temperatura, Adquisición de datos, Control de nivel.

2. Materials and Methods

The ultrasonic sensor used to measure the level of the water tank provides information about the depth for the minimum and maximum level and sends data to the Arduino. The relay connected to the Arduino control the pump. The block diagram and the proposed liquid level control system are shown in Fig. 1.

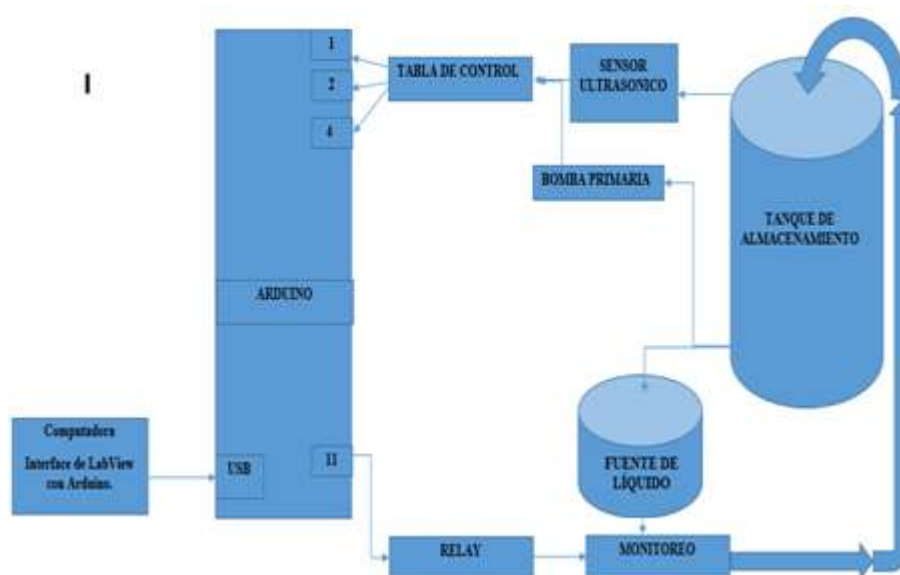


Figure 1: Block diagram of the liquid level control system

Ultrasonic sensor to measure level

The sensor used to measure the level is an ultrasonic sensor that was chosen to be non-invasive to the tank.

The chosen sensor was the model HC-SR04. This sensor model was chosen due to its low price in the market and the accuracy of 4 meters in length. This sensor contains a transmitter and a receiver of ultrasound waves, and works as a sound, in such a way that the emitter sends an ultrasonic

pulse and the receiver waits for the echo of said pulse in some object. The ultrasonic sensor with Arduino is used to calculate distances between objects. The Arduino provides 5V to connect the sensor, the ultrasonic sensor is shown in Fig. 2.



Figure 2: Ultrasonic measurement module HC-SR04 Sensor

To start the detection range, first: you need a pulse with 10uS to activate the input. Segundo: an echo of 8 cycles at 40 kHz will be sent and its echo will increase. The pulse width is an object of distance, it can be calculated. The formula used to calculate the time interval between the sending of the activation signal and the reception of the cycle signaling of the ultrasonic sensor operation is shown in Fig.3.

• Rank = time * speed (340M / S) / 2

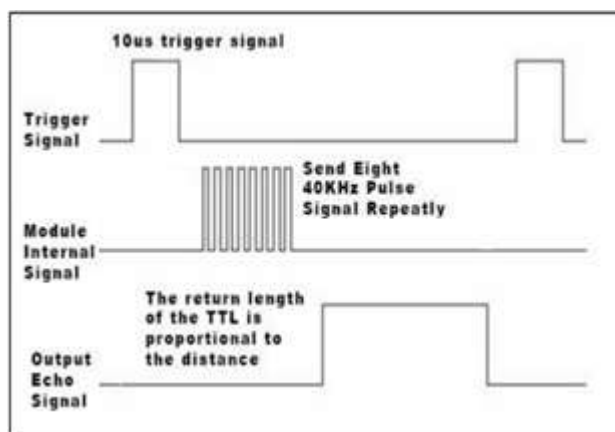


Figure 3: Timing Diagram.

Arduino Card

Arduino-uno is a physical computing platform, which is open source. It is a microcontroller that has six pins that can be used as PWM outputs and six analog inputs that can be controlled using the language (C). They are 16 MHz ceramic resonators, a power connector, a reset button, an ICSP header and USB connection. Is having a hardware, which consists of an Atmel AVR, present ease of use, low energy consumption and high level of integration, software that consists of a boot loader and a compiler. Arduino programmed hardware uses a language similar to (C++) with some integrated development and development environment based on information processing. Fig. 4.

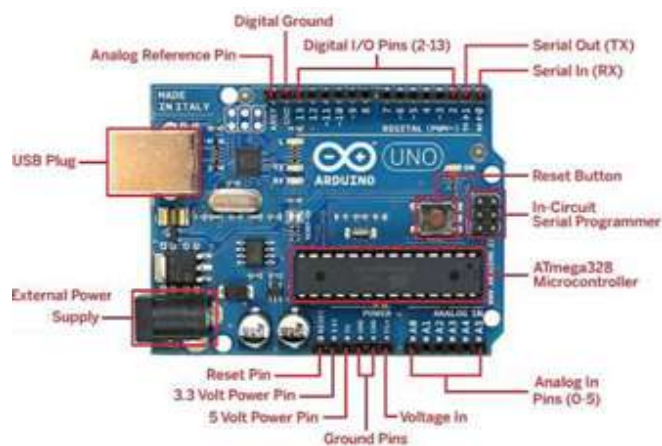


Figure 4: Arduino-uno.

Temperature sensor Lm35

The LM35 is a temperature sensor with calibration accuracy of 1 ° C. Its measuring range ranges from -55 ° C to 150 ° C. The output is linear and each degree Celsius equivalent to 10 mV, therefore:

$$150\text{ }^{\circ}\text{C} = 4230\text{ mV}$$

$$-55\text{ }^{\circ}\text{C} = -2180\text{ mV}^1$$

Operates from 4v to 30v.

Characteristics

- Its most relevant characteristics are:
- It is calibrated directly in degrees Celsius.
- The output voltage is proportional to the temperature.
- Guaranteed accuracy of 0.5 ° C to 25 ° C.
- Low output impedance.
- Low power supply current (60 µA).

The LM35 does not require additional circuits to calibrate it externally. The low output impedance, its linear output and its precise calibration make it possible to be incorporated into the sea, available in a control circuit. Due to its low feed current there is a very reduced self-heating effect. It is found in different types of encapsulation, The most common is TO-92, used by low power transistors. The data sheet is shown in the following image. Fig. 5. Temperature sensor.

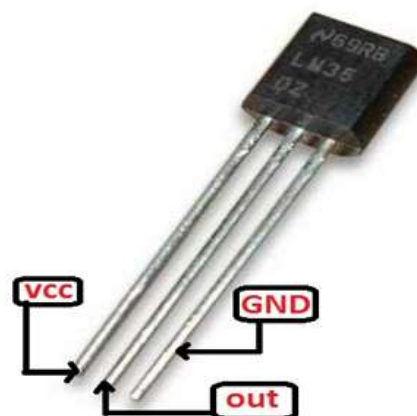


Figure 5: Temperature sensor

LabView

The Virtual Laboratory programs are a graphic programming language that uses icons to create applications such as instrumentation, data acquisition, communication and control with automation It is also called virtual

instruments. It is a software developed, as well as several programming languages such as C / C ++ and the graphic language offers an advantage for users who have the capacity to change the graphic representations of hardware by examining their dynamic link libraries or their controllers hardware. You can use a set of tools and objects to build a user interface called the front panel. By using a graphical representation of the functions, the code is added to control the objects on the front panel. In addition, a simulation with LabView software saves project development time. The LabView debugging tool is self-adapting and easy to implement, which saves a considerable amount of time.

Interface for Arduino and LabView

LINX is an open source project from Digilent and is designed to facilitate the development of embedded applications using LabView. LINX includes VIs for more than 30 of the most common embedded sensors.

3. Results

The final assembly of the ultrasonic sensor, Arduino and the project structure are shown in Figures 6 and 7.



Figure 6: Location and physical assembly of the ultrasonic sensor in the structure.



Figure 7: Final assembly of the structure with the ultrasonic sensor and Arduino UNO.

Data visualization and graphing

For the monitoring of the variables sent from the Arduino to the PC, which in this case is the water level and the

temperature of the drain pump, it was carried out in a virtual instrument in LabView.

The serial visa block was used to obtain the data that is sent from Arduino. The data is saved for the second time on the PC and graphed in a virtual instrument made in LabView. The front panel of the application was shown in the Figure. 8

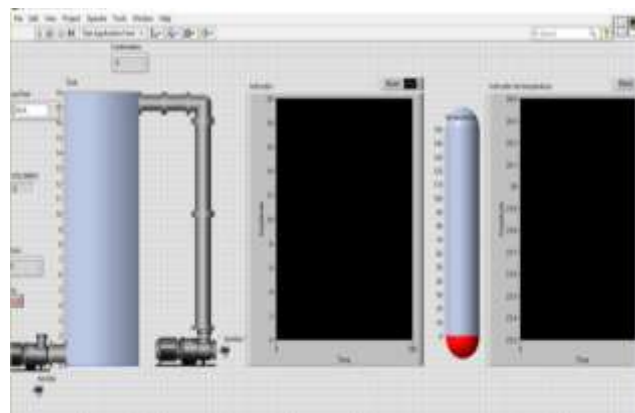


Figure 8: Front panel of the application in LabView.

The block diagram (Fig. 9) of the data acquisition process is shown where the digital voltage is fed from the pins of the Arduino board. The microcontroller reads the digital inputs.

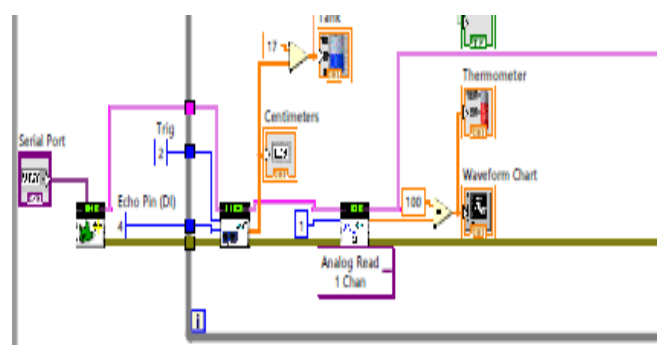


Figure 9: Program for filling the tank and temperature of the pump in LabView block diagram.

Capture at the time of tank filling and pump temperature is shown in Fig. 10

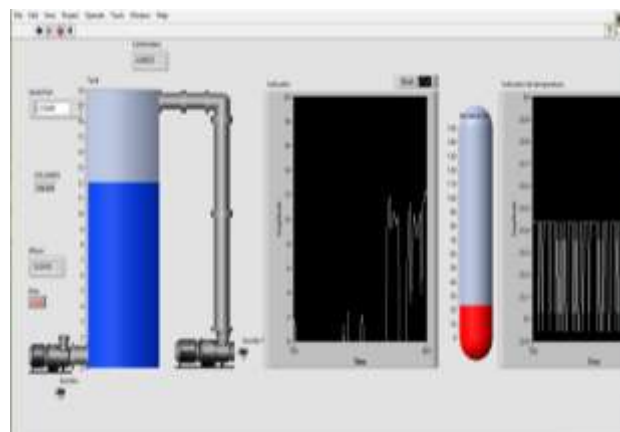


Figure 10: Display of tank filling and pump temperature.

It was observed that after 40 minutes of continuous work, the pump starts to increase the temperature and we have to be careful in its use. Fig. 11

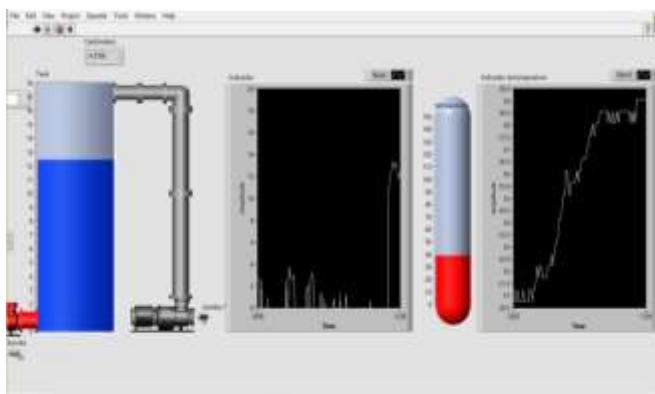


Figure 11: Pump temperature increase.

4. Conclusions

Automation is presented for level monitoring in a tank for later industrial use. The heart of the prototype is an ultrasonic sensor to measure the level. The modeling of the tank and the calculations for the correct measurement of the level by the ultrasonic sensor were carried out. The data is saved and is plotted in a LabView virtual instrument for later use in the analysis of tank filling and pump temperature. It is worth mentioning that the present project is the first stage for the automation of an industrial tank.

References

- [1] Smith C. y Corripio A. (1991). *Control Automático de Procesos Teoría y Práctica*, Editorial Limusa – John Wiley&Sons, México.
- [2] Pallás, R. (2004). *Sensores y acondicionadores de señal*, Editorial Marcombo, Cuarta edición, México.
- [3] Muñoz, G. y Garduño M. (2010). *Manual de cultivo de Tilapia*, Editorial CONACYT.
- [4] Egna H. y Boyd C. (1997) *Dynamics of Pond Aquaculture*, Editorial CRC PRESS.

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- [5] Arduino, Creative Commons Attribution Share a Like **3.0**, (2014).
<http://arduino.cc/en/Tutorial/HomePage>
- [6] Arduino, Creative Commons Attribution Share a Like **3.0**, (2014).
<http://playground.arduino.cc/Code/time>