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Flow measurement

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ABSTRACT
The Flowmeter is a measuring instrument that is not mentioned every day, but is widely used and r<regularly by many people in various environments. Thanks to it we can determine the flow rate of a liquid that is transported through a pipe or system, as well as the speed. The use of these can help in any process in which it is required to probe the fluid that is being used during the manufacture of a product in which the measurement of the amount of liquid is necessary. By using flow sensors, a measurement is made through a flow rate or volumetric flow rate of a fluid. These instruments tend to be placed directly in the pipes that transport a raw material. Also, they are usually used to quantify other low viscosity liquids, such as: Carbonated beverages, alcoholic beverages, fuel, cleaning products, etc. This type of flow is compatible with some digital systems, in which we can visualize the net quantity that passes through them. This type of sensor is placed in a pipe through which a non-corrosive liquid flows and measures the amount of raw material.

Keywords: flow measurement; microcontroller; volumetric expenditure

INTRODUCTION

The Flowmeter is a measuring instrument that is not mentioned every day, but is widely used and regularly by many people in various environments. Thanks to it we can determine the flow rate of a liquid that is transported through a pipe or system, as well as the speed.

The flowmeter arose thanks to the research of a great physicist, Giovanni Battista Venturi. An Italian priest born in 1746, who has, among his achievements, having been a professor of physics, philosophy and geometry, and a state engineer.

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Also, they are usually used to quantify other low viscosity liquids, such as: Carbonated beverages, alcoholic beverages, fuel, cleaning products, etc.

This type of flow is compatible with some digital systems, in which we can visualize the net quantity that passes through them. This type of sensor is placed in a pipe through which a non-corrosive liquid flows and measures the amount of raw material. The YF-S201 flowmeter has 3 connection cables: Red, 5 to 24-volt power supply, black, ground or circuit common, and yellow, for the output signal. By counting these pulses, the volume of liquids passing through the flowmeter can be calculated in the simplest way.

The operation of this sensor is as follows: the fluid flow enters through the sensor and that rotates a small turbine, which is attached to a magnet that activates a detector, which in turn emits an electrical pulse that can be read by the input of some digital system.

Carrying out an analysis of the manufacturing process of the liquid products used for cleaning within the technological university of Tlaxcala,

the result was that, in the manufacturing procedure, there is a deficiency in the way in which the concentrates are supplied to get a more accurate formula.

Based on the results of the analysis, we defined that our objective was to optimize the operation of this device, which produces the cleaning supplies used for cleaning at the technological university of Tlaxcala. We implement the use of 3 flowmeters connected to a processor and an LCD screen (Liquid Crystal Display), in order to control the amount of a specific fluid used in the manufacturing development of our products.

METHODOLOGY

A flowmeter is a measuring instrument for measuring the flow rate or volumetric flow rate of a fluid or for measuring mass flow rate and is usually placed in line with the pipe that transports the fluid. Within water meters, a distinction is made between mechanical and non-mechanical meters.

HYDRAULIC DISTRIBUTION

It is made up of two areas.

First zone: Material content

FIGURE 1: Material Content.
Source: Own, year 2023.

It has three tanks that allow the raw material to be stored, which passes through the pipe area and can be controlled manually and automatically. This area has a manual valve to block the product and thus be able to clean the deposits.

Second zone: Pipe zone

Through this optimization of the process, a considerable improvement in manufacturing times was achieved, significantly increasing the control and use of floor cleaning products within the educational institution, improving the quality of the final elements.

FIGURE 2: Pipe zone.
Source: Own, year 2023.

The pipe area has a manual control zone stage that has a set of manual valves, which have to exchange positions to block the automatic zone, in this zone the flow is regulated manually through the valves. You can also view the flow measurement with the help of the flowmeters, however this control requires a lot of experience from the operator for an adequate mixture.

This pipe area also has automatic control through three solenoid valves at 12V-200mA with a capacity of 0.02-0.8Mpa which are activated by the ATMETL 328p microcontroller that sends an activation signal through a power stage of a JQC-3FF-S-Z relay that is activated by means of an opto-coupled transistor in a cut-saturation configuration, this stage also allows it to be measured through the flow meters of the manual pipe area.

Third zone: Mixing zone

FIGURE 3: Mixing area.
Source: Own, year 2023.

The mixing area is made up of a 200 L plastic container, which is useful for the process of dissolving the different substances that will give the final product.

Inside the container there is a fan blade to agitate the product, this in turn is controlled by a three-phase motor connected in star, with a voltage of 440V (3/4 Hp), through a Power Flex De brand inverter. 40-2.2kw Allen-Bradley 22A-D4P0N104, which allows the output voltage to be regulated by frequency and thus control the motor speed, since it is necessary to avoid foam in the manufacturing of the product.

FOURTH AREA: PACKAGING AREA

The packaging area has a 373 W (1/2 Hp) peripheral pump, this is useful for the container filling process, this in turn has a control system manipulated by means of two buttons, which allows the exit of the final liquid that passes through three pipes with different filling capacities which are 1L, 1.5L and 20 L.

FIGURE 4: Packaging area.
Source: own, year 2023.

CONTROL PANEL

The control board has an LCD screen (LIQUID CRYSTAL DISPLAY), measuring 4x16 centimeters. Which serves to display the amount of fluid that passes through the 3 flowmeters, it has a selector button to choose manual or automatic mode.

It also has an on and off button for filling the main container.

To make all the interconnection of the equipment, a pair of electrical terminals were used which allow a correct distribution of the electronic wiring.

FIGURE 5: Control panel.
Source: Own, year 2023.

POWER SUPPLY

For the operation of the solenoid valves which consume 250 mA, it is required to use a 12V-5A Power Supply, since the standby flowmeters consume 20mA, plus the power consumption on the LCD screen is 5V and the microprocessor consumes a Voltage of 100 A- and 2 V, therefore a 12V-5A Power Supply was used.

FIGURE 6: Power supply.
Source: Own, year 2023.

FIGURE 7: Power supply.
Source: Own, year 2023.

CONNECTION OF FLOW METERS AND SOLENOID VALVES.

Flowmeters are input devices that only have 3 terminals, which are: positive, negative and signal.

FIGURE 8: Flowmeter yf-s201.
Source: Web browser.

The signal is analog type that is processed by the ATMEGA 328 microcontroller, which adjusts the signal in a range of 0-5V that allows decisions to be made to activate or deactivate the process solenoid valve.

These solenoid valves are activated by power stages with relay output, which are controlled by a transistor in its cut-off and saturation configuration, and protected by a DC817C Opto coupler.

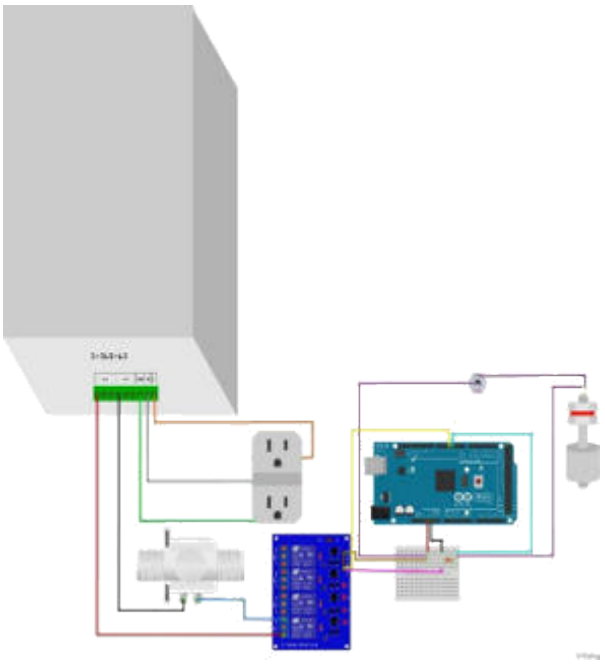

FIGURE 9: Connection of flow meters and solenoid valves.
Source: Own, year 2023.

PROGRAMMING (FLOW CHART)

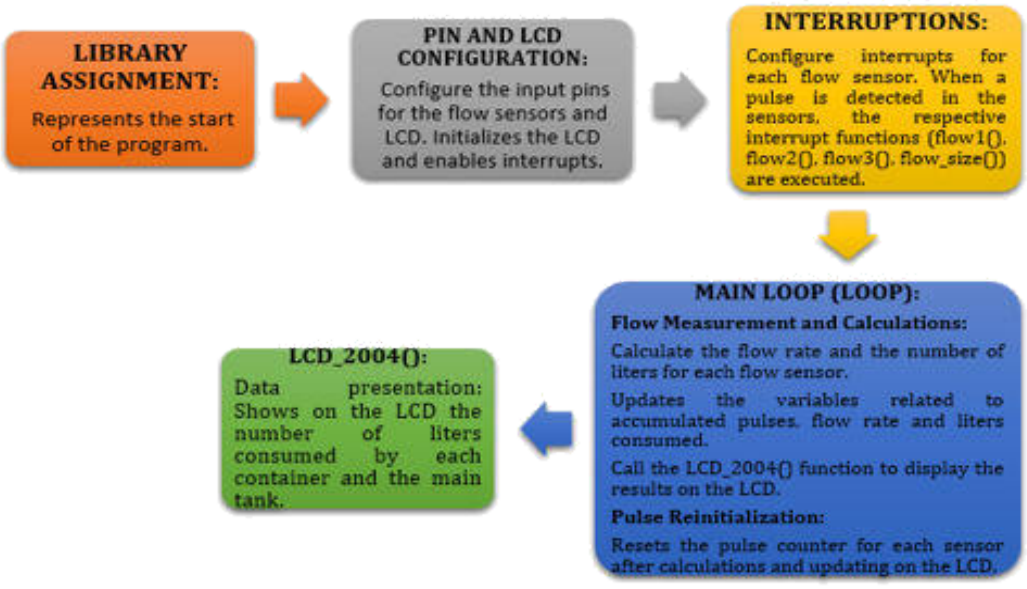

FIGURE 10: Programming (flow chart).
Source: Own, year 2023.

RESULTS

Measurement of liquids, using flowmeters.

TABLE 1: Results.

TESTS IN LITERS		
LITERS	**RESULT**	**FINAL SCORE**
100mL	95Ml	102ML
200mL	195ML	201ML
300mL	295ML	305ML
400mL	395ML	400ML
500mL	495ML	499ML
1L	995ML	1.3L
2L	1995ML	2L
3L	2995ML	3.1L
4L	3995ML	4.1L

CONCLUSION

A better alternative to perform measurements in liquid substances was achieved when using the flow meter. For this, the tests were carried out within the university laboratory, obtaining different measurement results, which were recorded in Table 1. (Results).

Based on the tests carried out, it was seen that with the implementation of the measurement system using flowmeters, better performance was obtained when taking measurements of the quantity of liquids. With these results, the amount of raw material used in the manufacturing process can be better controlled, thus avoiding adding extra quantities. Which will allow a more exact mix.

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