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# Mixing of solvents in chemical industries using Ratio Control

**Vinutha S [1], H. Prasanna Kumar[2]**

PG Scholar (C&I), Department of EEE, University Visvesvaraya College of Engineering, Bangalore[1]
*vinutha0507@gmail.com*

Assistant Professor, Department of EEE, University Visvesvaraya College of Engineering,Bangalore[2] *uvcehpk@gmail.com*

## ABSTRACT

*The goal of this project is to give an insight to the performance of Ratio controller in mixing two liquids in a required proportion. It is important in chemical industries to mix the solvents in a fixed proportion. This leads to the requirement of automation. There are conventional methods which uses man power to switch on and off valves manually for mixing. Since conventional method consumes time and man power, it is essential to jump into an automatic method which overcomes lags in conventional method. Automation needs a controller to control the given task automatically. This paper in specific gives an overview of ratio controller. It includes ArduinoUnowhich takes input from sensors and actuates valves automatically. LABVIEW is used as a GUI.*

**Keyword: Ratio control, Arduino, LABVIEW, flow sensor, solenoid valve.**

## 1.INTRODUCTION

It is essential in chemical industries to mix solvents in a required proportion. There are two methods to achieve this task and they are manual method and automatic method. Manual or conventional methods include labourers to manually switch on and switch off the valves when the solvents are reached a required proportion. Manual method of controlling consumes time and it also increases the labour cost. Every time the person has to check whether the fixed amount has been filled or not. This gives rise to a problem of time consumption.

Hence it is important for industries to move on to automation. There are several advantages of automatic methods over manual methods. It includes lowered man power, lesser time consumption, and human interruption, less chances of damage as well. The paper explains ratio controlling system which continuously measures the flow rate of the solvents or liquids using flow sensor and compares the present flow data with the fixed values and finds the error. The error is fed to the controller which rectifies the error and controls the valve on/off. Since objective of the paper is automation, there comes a need of controller. Arduino Uno is used as a controller. Flow sensors are used to measure the continuous flow data. The measured flow is fed to the comparator which compares present value with the threshold value and difference value is generated. This difference value is given to the Arduino and hence the valves are operated automatically. Using the remote set point facility, the relationship between any two flows can be set and controlled automatically to minimise wastage. Automatic control of systems allows the plants to operate independently to maximise output. Regardless of how ratio control is implemented, the process variables must be scaled appropriately. LABVIEW is used as a graphical user interface. It is easy to design the system using LABVIEW and to display the measured values and the respective actuators operation.

## 2.METHODOLOGY

### 2.1Blockdiagram

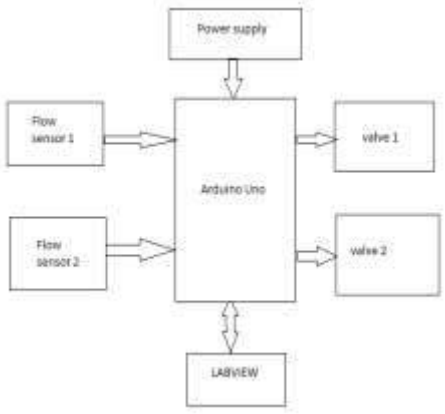


**Fig 1:block diagram**

*2.1.1Arduino UNO*

The Arduino UNO is a widely used open source microcontroller board based on the ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The board features 14 digital pins and 6 analog pins. It is programmable with arduino IDE via USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the arduino nano and Leonardo. UNO means one in Italian and was chosen to mark the release of arduino software. The ATmega328 on the arduino uno comes with a boot loader that allows uploading new code to it without the use of an external hardware programmer.

*2.1.2Flow sensor(YF-S201)*

Water flow sensor is of a plastic valve body, a water rotor, and a Hall Effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow. The Hall Effect sensor outputs the corresponding pulse signal. This one is suitable to detect flow in water dispenser.

Specifications

- Minimum working voltage: DC 4.5V
- Maximum working current: 15Ma
- Workingvoltage: DC 5V to 24V
- Flow rate range: 1 to 30L/min

The YF-S201 can measure a maximum of 30 litres of water per minute.

Frequency=7.5*Flow Rate(L/min)

=7.5*30

=225 Hz

The sensor will output 450 pulses for a litre of water that will flow through it, hence if 1 litre of water will flow through the sensor in a minute, we would be getting 450 pulses a minute. Therefore, for 1 second there will be approximately 3.75 pulses per second per litre of water flow. Hence the calibration factor is set to 3.75. The sensor is connected to digital pin which uses an interrupt and this is configured to trigger on a falling edge. Since calibration factor over here is considered for every second, there are cases in which the loop will not execute in a second. Hence we calculate the number of milliseconds that have passed since the last execution and scale the output according to that. We also apply calibration factor to scale the output based on the number of pulses that the sensor outputs at that second.

*2.1.3Solenoid valve*

A solenoid valve is an electro mechanical device win which the solenoid uses an electric current to generate a magnetic field and thereby operate a mechanism which regulates the opening of fluid flow in a valve. A two way valve has two ports. If the valve is open, then the two ports are connected and fluid may flow between the ports. If the valve is closed, then ports are isolated. If the valve is open when the solenoid valve is not energised, then the valve is termed as normally open. Similarly, if the valve is closed when the solenoid is closed, then the valve is termed as normally closed.

*2.1.4LABVIEW*

LABVIEW is used for Graphical User Interface.

## 3.RATIO CONTROL METHOD

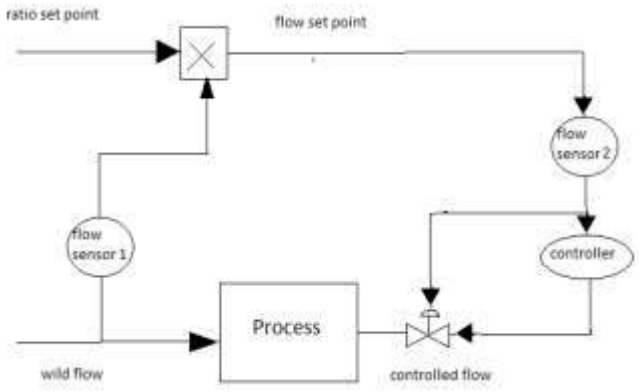


**Fig 2.Ratio control block diagram**

Ratio control system is a technique where in variable is manipulated to keep it as a ratio proportional to another. Ratio control system is a special type feed forward control system widely used in process industries. The objective of ratio control system is to maintain the ratio of two variables at a specified valve. Flow sensor 1 measures the flow of wild stream. Flow sensor valve is given to a multiplier which multiplies it with ratio set point. Flow set point is measured by flow sensor 2 which is fed to the controller. Controller controls the valve.

Typical applications of ratio control include:

1.Setting the relative amounts of components in blending operations.

2.Maintaining stoichiometric ratio of reactants to a reactor.

3.Keeping a specified reflux ratio for a distillation column.
4.Holding the fuel-air ratio to a furnace at the optimum value.
5.Paint mixing plant

## 4.ALGORITHM AND FLOWCHART

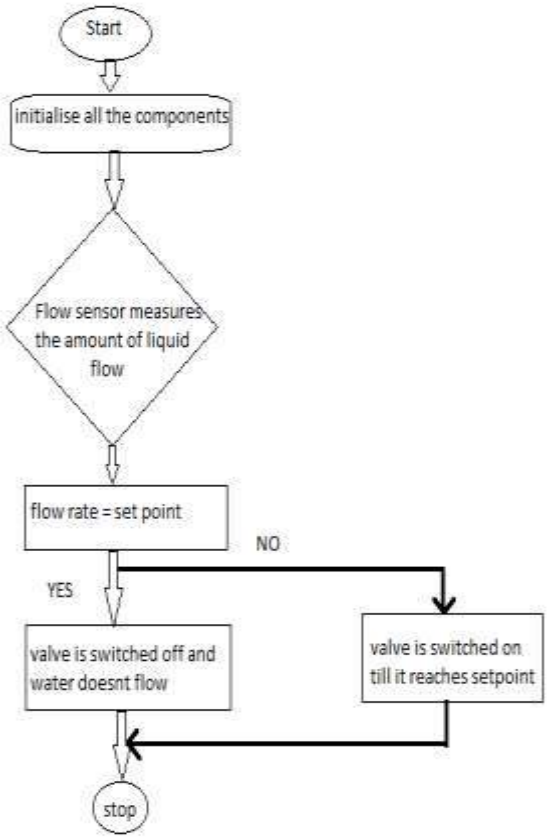


**Fig.3 flow diagram of proposed system**

1.Interfacing LABVIEW with arduino and checking the compatibility of flow sensor and valve.
2.Flow sensor measures the flow rate.
3.The valve is set on till the flow rate reaches the set point.
4.Valve is automatically switched off once the set point is reached

## 6.RESULT

Flow sensor works on the principle of hall effect. It has a water rotor which rotates when pressure is applied to it horizontally. The pressure to it can be given either by supplying air or water. With respect to this project, pressure is applied via supplying water. It tends the rotor to rotate continuously until the flow is stopped. This rotation is counted and it results in the frequency applied. As we know the relation between frequency and flow rate of the flow sensor, it is simple to calculate the flow rate once the applied frequency is known.

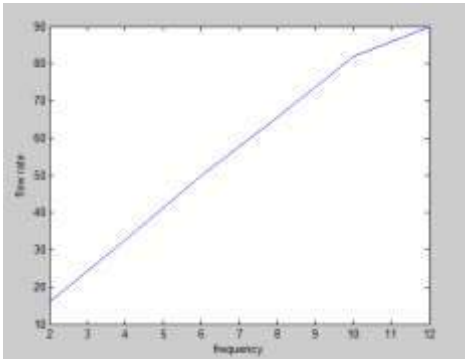

**Fig 4. Frequency versus flow rate of flow sensor**

Frequency= 7.5*flow rate
i.e., flow rate = frequency / 7.5

Practically, the different frequencies at which water is supplied is noted and the respective flow rates are calculated which is linear in nature. These values of frequency and flow rate are tabulated and plotted using MATLAB which is shown in the figure 4.

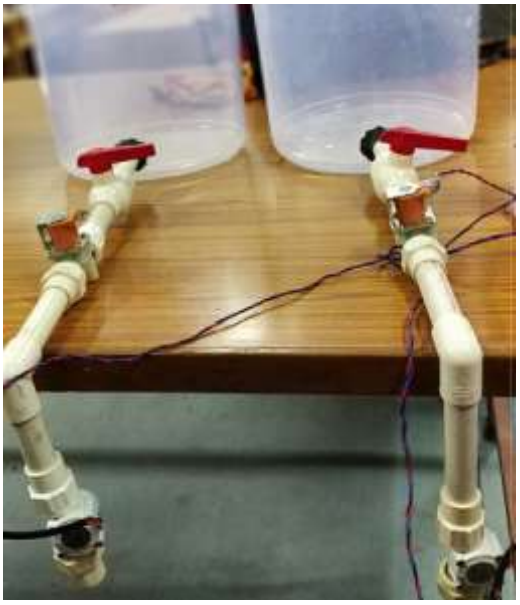

**Fig 5. Hardware implementation**

## 7.CONCLUSION

Automatic mixing of solvents for threshold values using ratio control is built successfully. The code has been built in LABVIEW and arduino as a controller. The prototype has been tested for different threshold values. Ratio control which is

special type of feedback control makes it a closed loop system and the complete system works automatically

**REFERENCES**

[1]. James D Wagoner, N F Macia, Automatic liquid level controller using a labview based PC, department of electronics and computer technology, Arizona state university east.Unpublished.

[2]. Tushar Mohan Shingade, Reena Sonkusare, S SRathod, P V Kasambe, Sardar Patel, Design and development of flow control system using labview. institute of technology, Andheri(W)-Mumbai, India.

[3]. Pushkar Singh, Arduino based smart irrigation using water flow sensor, soil moisture sensor, temperature sensor and ESP8266 wifi module, department of electronics and communication, JSS academy of technology education,Noida,India. Sanghamitrasaikia, department of physics, Tezpuruniversity, Tezpur, India.

 