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Liquid Flow Control System Using Arduino Microcontroller

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***Abstract:** An automated system presented here is designed to control the flow of fluid or liquid. The system uses automated peristaltic Pump to control the liquid flow. The peristaltic pump used here is designed and developed by the author according to the requirement of the application. The stepper motor movement of pump is controlled by using Arduino Microcontroller. Liquid flow through the pump is controlled in two ways: Automatic and manual mode. Such systems can be used in small industries for fluid separation from slurry or slug. Also can used where pre described amount of liquid or fluid is required in application.*
***Keywords:** Arduino, Microcontroller, Peristaltic Pump, Slug, Slurry, Stepper Motor*

I. INTRODUCTION

An automated system presented here is for the control of flow of fluid/liquid using peristaltic pump. Arduino microcontroller is used for this purpose as the software and interface hardware of this microcontroller is easy to program reprogram and design.
In industries sometimes it's needed to separate fluid or gases or slurries from the mixture. This task can be easily done by using peristaltic pump. The amount of fluid to be separated or mixed is of specific amount. It is very difficult to separate or mix a particular amount of liquid hence, some sort of equipment is needed here to define the amount and accuracy. This problem can be solved by using this automated system. The peristaltic pump used here in this system is designed and built at very low cost.

II. LITERATURE SURVEY

Literature survey is done for the designing, fabrication of the Peristaltic Pump and Arduino Microcontroller interfacing with pump motor. Suhas Dhumal & S.S.Kadam presented a prototype and design of rotary Peristaltic Pump. They studied various designs of pump on the basis of theoretical calculations [1]. MdFayaz Ahemad et. al. analyzed fluid structure interaction of a peristaltic hose pump by using COMSOL multiphysics FSI Module [2]. R. Harisudhan et. al. has controlled the stepper motor rotations using microcontroller ATmega-328 [3]. Sanjeev Kr. Chaudhary et. al. designed and implemented a smart water sprinkler system based on Arduino Microcontroller. In this system servo motor is controlled for irrigation process [4].

III.THEROTICAL APPROACH

The Arduino Uno Microcontroller board used here is based on Atmega328P [4]. Arduino Uno consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. Software used for Arduino device is called Integrated Development Environment which can be programmed using C and C++ language. The reason behind choosing this controller is its programming and software.
Acrylic sheet and Silicon tube are used to develop peristaltic pump. Stepper motor with step-angle 1.8 degree is used to rotate pump. Stepper motor can be easily interfaced with Arduino Uno Microcontroller.

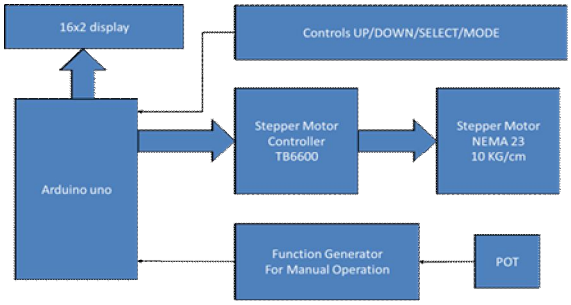

Fig. 1 A Block Diagram of Liquid Flow Control System

A 16x2LCD display is interfaced with microcontroller for indication of liquid measurements or flow. The pump operates in automatic mode as well as in manual mode. The speed of motor can be varied manually by using potentiometer.
Peristaltic pump works on the principle of peristalsis process [5]. It's a positive displacement type pump. The fluid is contained in flexible tube of pump which is opened and closed by the rollers, lobes attached to the rotor of pump. The fluid or liquid is trapped inside the tube between rollers and then transported to the outlet of pump. Each rotation of pump will transport certain amount of liquid or fluid at the pump outlet. Here this rotation of pump rotor is controlled by Arduino.

IV. EXPERIMENTAL

The Peristaltic pump was designed and developed by using Acrylic sheet. Pump is designed according to need using software.

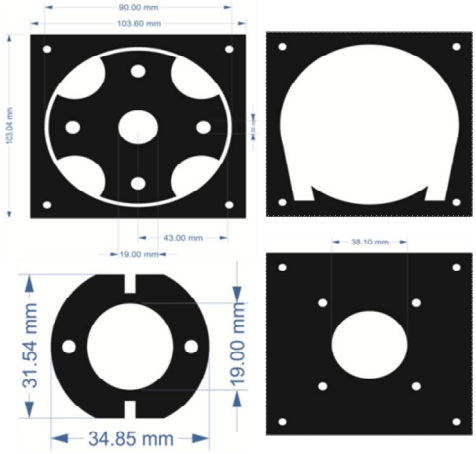

Fig. 2 Pump Plate Design

Tube Pump design is used here for making pump. In this design rollers creates pressure on flexible rubber tube and when released, it sucks the liquid or fluid. This continuous action pumps the fluid at outlet.
Stepper motor is used to move rollers. The speed and pulse of squeeze is controlled by Microcontroller programming.
Arduino Uno microcontroller is used for this purpose as it is easy to program and design the circuit than 8051 microcontroller family. Stepper motor driver TB6600 is used to drive the stepper motor. Functional circuit is used for manual control of speed of stepper motor. Mode selection circuit is used for selection of mode of operation. Trial and error method is used to set the speed and measurement of liquid flowing through the pump.

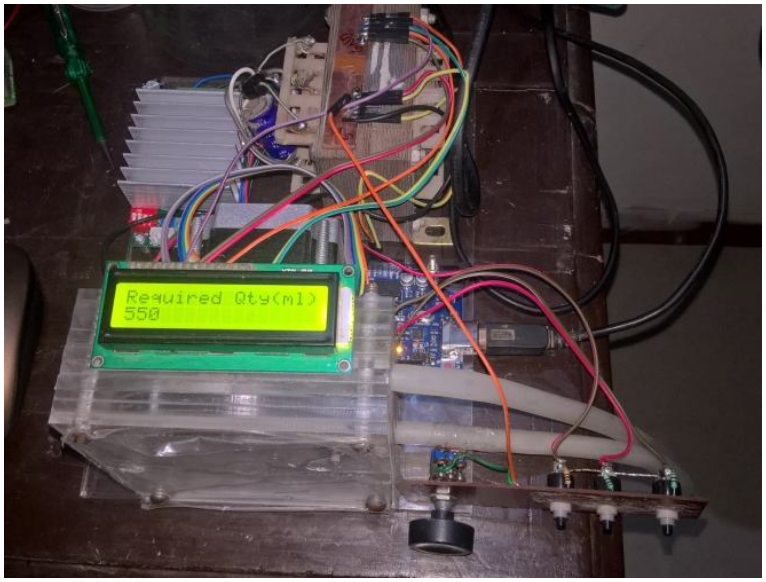

Fig. 3 Experimental Setup

The system is tested for different speeds of Stepper motor in both the operating modes. The program is set as 512 steps of stepper motor will give 10 ml of liquid at the outlet. It can be increased in multiple of 10 means for 20ml liquid at outlet 1024 steps are required to move by stepper motor and so on. Pump working can be switched in two different modes by using a switch. In manual mode speed of motor is controlled manually by using one rotary switch. This mode can be used for very slow operation of motor in cases where liquids have to be separated without disturbing slurry contained in a mixture. In Auto control only requirement of liquid in milliliter has to be entered using a keypad attached to the system.

V. CONCLUSION

The proposed fluid flow control system using peristaltic pump is a complete ready to use system that can work in manual as well as automated form. It can be used in small industries to separate liquids and slurries from the mixtures. In future the automation can be built up such as system control can be made available on mobile to access from anywhere in the world using IOT based techniques.

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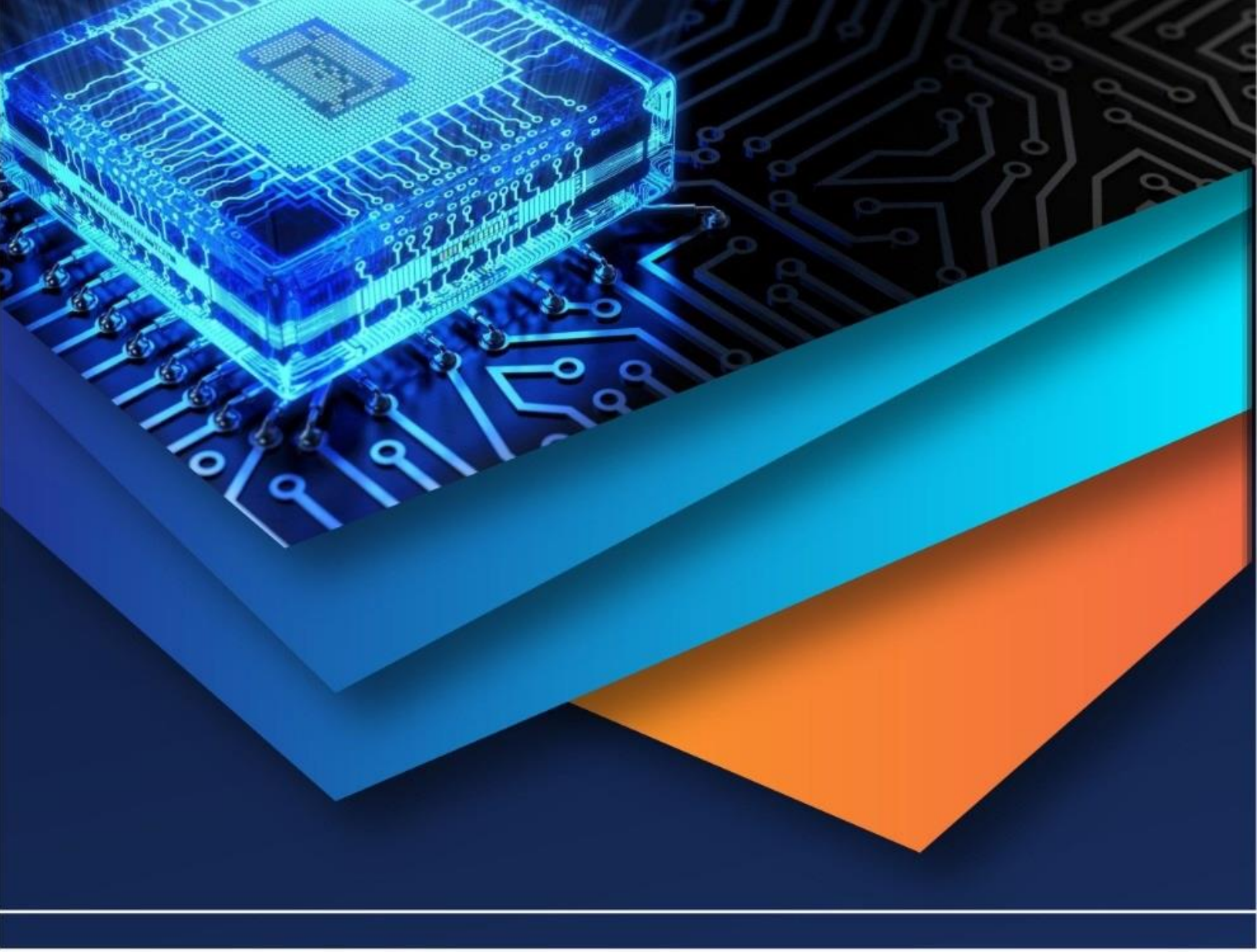

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