Automatic Fluid Dispenser with temperature control for Biochemical Analysis

Kalana Date[1],J.P. Kalambe[2],Disha Hargode [3],Dharvesh Gayadhane [4],Mradul Barendiya[5],Tushar Sonwane [6]

[1]Associate Professor, NKP Salve Medical College

[2]Associate Professor, Department of Biomedical Engineering Shri Ramdeobaba College of Engineering and Management, Nagpur, India

[3]Student, Shri Ramdeobaba College of Engineering and Management, Nagpur, India

[4]Student, Shri Ramdeobaba College of Engineering and Management, Nagpur, India

[5]Student, Shri Ramdeobaba College of Engineering and Management, Nagpur, India

[6]Student, Shri Ramdeobaba College of Engineering and Management, Nagpur, India

Abstract

In this paper we are designing an automatic fluid dispensing system for biochemical analysis.Automated controlled dispenser is a system consisting of the machines which will dispense the fluid with accuracy. The system is made up of high temperature resistant material for heating and sterilizing the system regularly for maintaining the accuracy in readings. It consists of the peristaltic pump which will take the fluid from the storing chamber and dispense in the petri dish with full accuracy simultaneously. It consists of storing chamber for reducing the health risk to the operator using bare hands to dispense the fluid. A specialized interface is provided to give input to the system. The command given by the keypad determines the amount of liquid to be dispensed in the petri-dishes. No such systems are readily available in the market which is low cost and user friendly.

Keywords : *Automatic Dispenser; Regulated Input; Biochemical Analysis; Sterilization;*

DOI Number: 10.14704/nq.2022.20.9.NQ44225 **Neuro Quantology 2022; 20(9):1949-1951**

Introduction

Microbiology laboratory is dedicated to the culturing, examination and identification of microorganisms including bacteria, fungi, yeast, etc. In microbiology laboratories plenty of solutions are made and readings are taken out by mixing various fluids in various amounts. The essential criteria for obtaining the correct reading of samples provided is directly proportional to the pouring or adding of accurate amount of fluids in a petri dish before its solidification. Accurate and time efficient systems are in great demand, automated techniques supersede manual practices a need of time, we introduce a wireless, automated, cost effective, yet reliable and efficient system of fluid dispensing (S. M. Omair,Nageen Shahid ,M. A. Haleem ,M. Azam,M. W. Munir,M. Z. Ul Haque,2014).By adding the components with accuracy lab workers ensure the accuracy of the readings taken out from the product. Because the liquid is handled as well as dispensed manually so there is less occurrence of samples with the perfect amount of fluid in it. So the probability of occurrence of perfect samples is very less which leads to wastage of resources. For accurate and small precise dispensing Graphical User Interface is designed for automation of peristaltic pumps for dispensing of liquid into the dish (J P Kalambe,S Palekar, P Anasane, 2020).The system operation is sliced into three layers of operations; user layer, decision making layer, and an action layer, the user layer consists user input operations through GUI, decision layer consists of processing (Arduino atmega328p) which is done over the data from user layer and action layer consists of motors, pumps and associated circuitry(G. S Shankaraiah, S Yellampalli, 2014). Handling the biochemicals is done with bare hands which is hazardous for the lab workers as the fluids are at high temperature. Hence, there is a necessity for the fluid dispenser to be fully automatic.During this paper we design the automatic fluid dispensing unit with a dedicated chamber to maintain temperature and to dispense the fluid in multiple petri-dishes to save the time of the lab workers.

2 Method and Materials:

2.1 *Components*

The components used in the proposed methodology are a linear actuator, DC motors, peristaltic pump,constant power supply, L293D motor drivers, Arduino Atmega328P, IR sensor, Keypad, LCD, Stepper motors. The circuit diagram for the assembly is shown in fig 1.

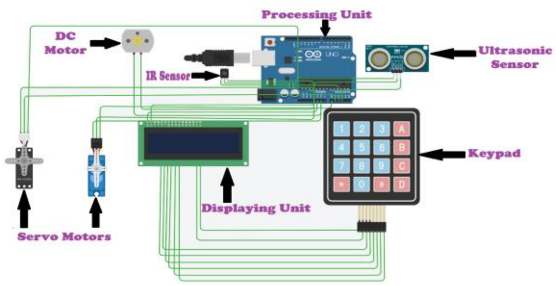

Fig 1. Fig: Circuit Diagram

In fig. 1 total working of the system is shown. The Keyboard is working as an inputting unit. The LCD display acts as a display unit; it displays the input given to the system through the keypad. Servo motors are used as linear actuators which will move the petri dishes. Arduino is acting as a processing unit and carrying all the processes in the system. Ultrasonic sensor is used for detecting the level of the fluid. Dc motor is used for giving the power supply to the system.

2.2 *Method*

The flowchart of the proposed method is shown in figure 1.1. When the system is powered ON,it will take input from the user, there are three modes provided in input they are sterilization, dispense and reverse clearing mode, sterilization mode will start sterilization process, dispense mode will take dispensing amount (ml), starting the linear actuator and rotating the tray, and one-by-one the petri dishes come below the pipe attached to the linear actuator, and the one-to-one occurrence of petri dishes is controlled by a specific delay. Now, as the dish comes below the dispensing area, the linear actuator on which the pipe is attached is pushed down by the actuator until the pipe gets positioned according to the petri-dish location. When the pipe is exactly above the petri-dish, the peristaltic pump will be turned on for a specific time to aspirate a specific amount of liquid (user inputed) from the heat Enclave and will dispense it to the petri-dish where it is to be dispensed in accurate amounts . After this process gets completed, the pipe attached to the linear actuator gets reconfigured, the sample tray rotates till the next petri-dish comes below that pipe and the whole process gets repeated until all the petri-dishes are covered.The process takes place considering the flow such that no air bubbles occur.

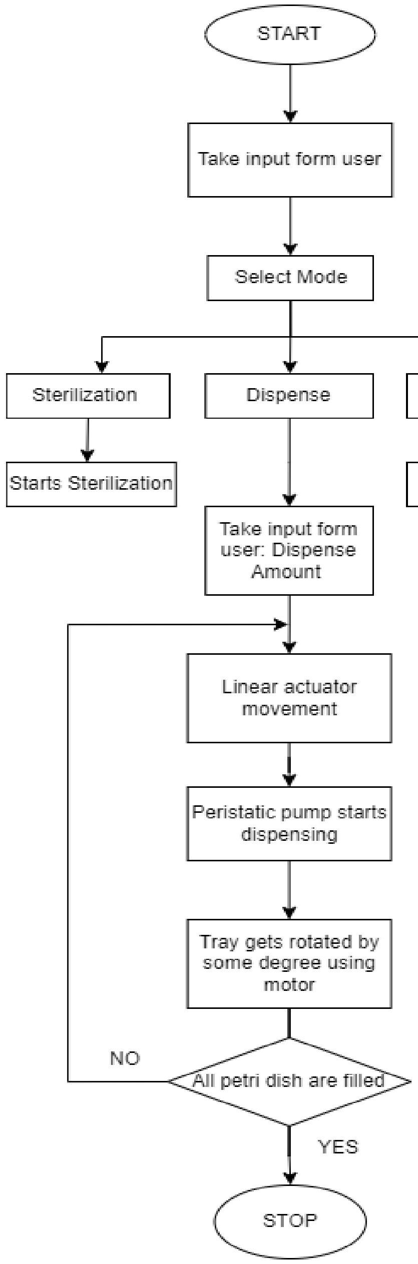

Figure 2.1 *Flow Chart*

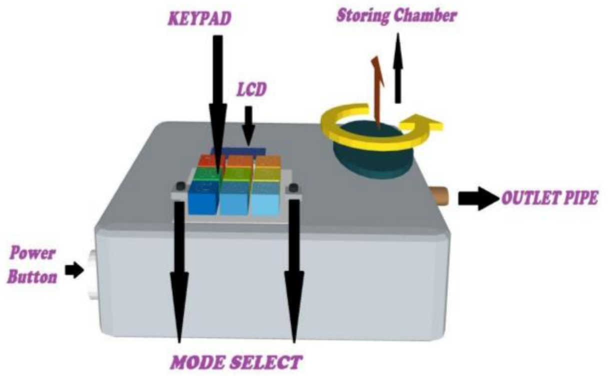

Fig 2.2: Fluid Dispenser System

In fig. 2 the front view of the dispensing unit is represented. The input unit(Keypad), displaying unit(LCD), dispensing unit, power input, storing chamber and outlet pipe is shown.The Keypad shown is specially designed keeping in mind the arrangement of the machine to make it convenient for the user to operate the dispensing machine with ease, Power Button is given on side panel to make operating dispenser handy as conventional machines used to have it in back resulting in inconvenient finding button, Mode Select buttons are given to quickly switch the modes(which are preset)by just a flick of fingers. LCD provides an interface making the machine operator very versatile and adapt to operating the machine very quickly. The storing Chamber is used to store the liquid which is insulated so as to maintain the temperature of fluid for a certain period of time. The storing chamber includes but is not limited to certain features which make the machine very useful for storing different kinds of solutions. The chamber is specially designed to store certain temperature liquids ranging from ice cold to super hot tea. Outlet pipe is the dispensing unit which is made up by material sustaining temperatures as high as 200 degree Celsius.

3 Results and Discussions

We are using an Atmega 328 microprocessor as our main controlling unit and most of the components are interfaced with it. The peristaltic pump as a main unit which will carry the task of dispensing the fluid. It will get the required input of the current through DC supply.. A motor driver (L293D) is also connected for regulating the circuit by regulating and passing some required current .We have added the keypad for giving the input to the system as well as starting and stopping the system . So when the current will pass through the circuit the pump will start working. As soon as the user gives an input through GUI the microprocessor will start working and the controlled amount of fluid will be dispensed in the respective petri-dish with maximum accuracy.

4 Conclusion

All the microbiology labs worldwide require an automated system which will pour the fluid with maximum accuracy. We made a system which will reduce various problems associated with handling fluids in microbiology labs. The main factor the lab requires is associated with its working is sterility. If the sterility is not maintained in the lab it means the samples are exposed to impurities so there arises an issue of reducing accuracy of readings. Sometimes it becomes super difficult for the lab workers to obtain the readings because the processes in the experiments are sensitive and small factors can affect the readings. So we have taken the account of sterility to be maintained in the system. For reducing the errors and wastage of sample components we have developed a GUI (Graphical User Interface) to make the system user friendly. To prevent the hands of workers from burning we are keeping the total system automatic.

References

[1]S. M. Omair,Nageen Shahid ,M. A. Haleem ,M. Azam,M. W. Munir,M. Z. Ul Haque, "Fluid Dispenser Prototype: A Time Based Approach",2014

[2]Dr. Jayu Kalambe,Sangeeta Palekar,Purwa Anasane, "Development of Programmed Liquid Dispensing Framework for Microfluidics Based Analytical Device", IEEE Students Conference on Engineering and Systems (SCES), July 10-12,2020

[3] G. Satya Shankaraiah, Siva Yellampalli, "Android based Fluid Dispensing and Blending System Automation",International conference on Computational Intelligence and Computing Research,2014