Electronic Valve with Quantitative Control System for Medical Application

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***Abstract*: This paper presents the function of the quantitative control in a variety of flow systems especially in a medical application. A new type of electronic valve with quantitative control is designed to control the blood flow of the patient. The valve collects flow pulse signal from the impeller Hall flow sensor through the Load sensor. It's also used to control relay in order to real-time control solenoid valve. This load sensor will sense the weight of the glucose and displayed it on the LCD display and sends the data to the Hospital staff's Android app. In the next stage we are giving a flow input in ml/sec, in one second a particular quantity of glucose should go to the outlet this will be controlled by a solenoid valve.**

***Keywords*: ARM7microcontroller, Solenoid Valve, Load sensor, Hall flow sensor, Medical application**

I.INTRODUCTION

In order to achieve the function of the quantitative control in a variety of flow systems, a new type of electronic valve with quantitative control is designed. The valve collects flow pulse signal from the impeller Hall flow sensor. Micro controller chip is used to calculate the flow value and cumulate the total value. It`s also used to control relay in order to real-time control solenoid valve. Electronic valves have been widely used in production and daily life. Now electronic valves are moving towards four directions of streamlining, intelligent, generalization and customization. Except for switch function of basic solenoid valve, dedicated solenoid valves also have some kind of special function or apply to some special occasions, such as gas solenoid valves, steam solenoid valves, oil solenoid valves, refrigeration solenoid valves, high temperature solenoid valves and explosion-proof solenoid valves and so on.In this paper we are interfacing a load sensor to the ARM micro controller, this load sensor will sense the weight of the chemicals and displayed it on the LCD display. In the next stage we are giving a flow input in ml/sec, in one second a particular quantity of chemical should go to the outlet this will be controlled by a solenoid valve.

This can be implemented in automatic flow control of glucose in hospital, in physical vapour deposition, in chemical supply control of plants which grows in water (hydroponics). The Drip bottle weight is measured using an electronic load cell and information about it will be sent to IoT server of the Hospital. But here for demonstration purpose we are sending the data to the basic android mobile App, through using the Wi-Fi module. When bottle gets a threshold level it intimates to the Wi-Fi module and sends the data to the Doctor and hospital staff. Doctors can control the flow rate by sending commands from the phone.

Prof. Fan Yang [1] describes the proper research In order to achieve the function of the quantitative control in a variety of flow systems, a new type of electronic valve with quantitative control is designed. The valve collects flow pulse signal from the impeller Hall flow sensor. STM32 chip is used to calculate the flow value and cumulate the total value. It's also used to control relay in order to real-time control solenoid valve. The communication network of upper and lower computer is built through the serial port of STM32, which achieves remote real-time monitoring between the upper computer and multiple quantitative control valves. Experiment results show that the electronic valve has a high precision and the error is less than 2.5%.

Prof. shuxiang Guo [2] describes about the solenoid actuator based novel type micro pump, In the medical field and in biotechnology, a new type of micro pump that can supply micro liquid flow has urgently been demanded. It is our purpose to develop a novel type of micro pump that has the characteristics of flexibility, driven by a low voltage, good response and safety in body. In this paper, we propose a new prototype model of a micro pump using solenoid actuator as the servo actuator. This paper describes the new structure and the motion mechanism of a micro pump using a solenoid actuator and discusses the possibility of the micro pump. This micro pump consists of two one-way valves, a pump chamber made of elastic tube, and a casing. The overall size of this micro pump prototype is 18mm in diameter and 54mm in length. Characteristic of the micro pump is measured. The experimental results indicate that the micro pump has the satisfactory responses, and the proposed micro pump is able to make a micro flow and is suitable for the use in medical applications and in biotechnology.

Prof. Takalkar Atual S [3] describes about This paper deals with design of nozzle/diffuser and the use of piezoelectric effect for the actuation of diaphragm of valve-less micro pump which has application in medical field for drug delivery. A three dimensional FE model of nozzle/diffuser and actuator is used for numerical simulation. Fluid flow analysis of nozzle/diffuser is performed to calculate their efficiency and frequency. The simulation is performed for variable converging and diverging angle

by varying their length and width to calculate steady flow rate. Analysis of actuator unit is also carried out by using the COMSOL multi-physic software. The simulation of actuator unit depends on mechanical properties of material such as Young's modulus, Poisson's ratio. The numerical result used to predict the actual behavior of actuator unit for higher frequency range which helps in proper selection of material. The comparison between analytical and numerical results is done which helps in predicting the flow rate and actual working of micro pump.

Prof Jingguo wen [4] describes The demonstrates an example of the solenoid valve driver scored on AVR microcontroller. With a discussion over the system's hardware architecture, we further explain the communication protocol between the module and system controller, as well as the corresponding software control process. Besides, we illustrate the reliability and flexibility of our design in both the software and hardware phases. The driver module has proved effective and satisfying in practices on related projects.

II. PROPOSED SYSTEM

A Saline is used for the patient when the patient becomes unhealthy. In the time of operations the food cannot give to the patient so saline will be provided for their health. DENGUE FEVER, DIAHHERA, MALARIA, CHOLERA, DYSENDRY, FEVER are the main disease. Saline will be provided for the people who are suffering from the above stated diseases, if not able to stop the saline infusion when there is low saline in the bottle then there is a chance of the BLOOD to be returned to the bottle and also if there is a more infusion of the saline than the specified prescription then there is a chances of death of the patient.

The solution for the above mentioned problem is, automatically close the valve in the absence of human operator, The load cell is used to continuously monitor the weight age of the saline bottle and it will be displayed on the LCD display, when it reaches the critical level an automatic message will be sent to a hospital staff's Android app.

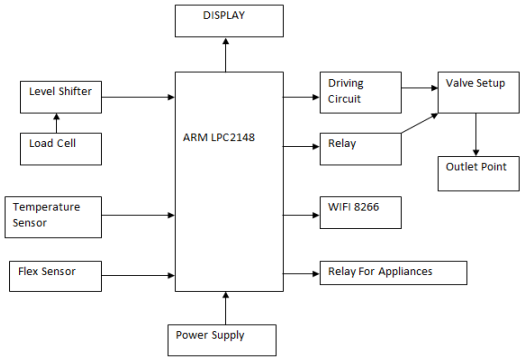

Fig.1 Block Diagram Of Transmitter Of Electronic Valve System Fig.2 Receiving Data On The Android App

The System Consists of ARM, Load Cell, Solenoid Valve, Keypad, Relay, and ESP8266 as shown in the Fig.1. Drip bottle weight is measured using an electronic load cell and information about it will be sent to the data using a WIFI Module through the basic android Mobile App as shown in the Fig.2. When bottle gets to threshold level it intimates to the hospital staff. Doctor can control the flow rate by sending commands from phone. When the bottle weight gets completely empty ARM controller sends the command to Valve mechanism such that it will be blocked and there will be no reverse blood flow. Temperature Sensor is used to monitor the body temperature after drip is injected to patient. If the temperature detects low values then also valve will be closed and it will be intimated to doctors. Flex Sensor connected to patient hand can read hand gesture of a patient using which we can atomize the switching of devices in the room.

III. WORKING PRINCIPAL

In this Electronic Valve system we Interface the load sensor, LCD, keypad and measuring the weight of fluid in mili-liter. And the relay, solenoid valve will be used to verify the functionality. Then the hall flow sensor and inlet, outlet will verify the flow rate for the different flow rate cases. Then it will display all the information on the LCD screen and it sends all the data to the Android app through the WIFI Module. The Fig.3 shows the Model of the saline level monitoring and control system.

Fig 3. Model of Saline level Monitoring and Control System

The System Consists of ARMLPC2148, Load Cell, Solenoid Valve, Keypad, Relay, and ESP8266. Drip bottle weight is measured using an electronic load cell. then information about it will be sent to Doctor's android app using a WIFI Module. For demonstration purpose we are Sending data to basic android Mobile App Shown in the Fig.2. When bottle gets to threshold level it intimates to doctor and hospital faculty. Doctor can control the flow rate by sending commands from phone. When the bottle weight gets completely empty ARM controller sends the command to Valve mechanism such that it will be blocked and there will be no reverse blood flow. Temperature Sensor is used to monitor the body temperature after drip is injected to patient. If the temperature detects low values then also valve will be closed and it will be intimated to doctors. Also the temperature sensor will be used to check the patient body temperature so that all the information will be sent the Doctor's Android App.

IV. HARDWARE DESIGN OF THE SYSTEM

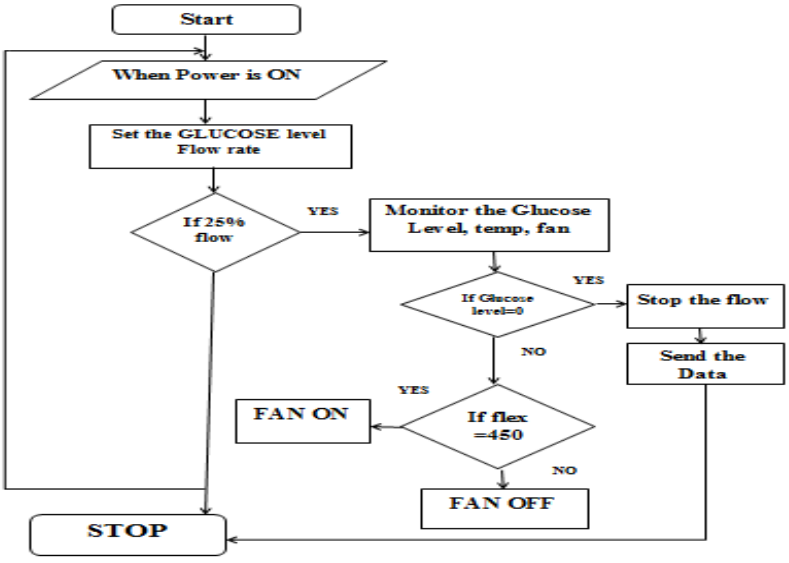

Fig.3 Flowchart Of Hardware Design

The flowchart shows the hardware description of this project, when the hardware initializes with the power supply on, then it checks for the glucose level flow rate in the switch rates, if we sets flow rate for the 25% then, it checks for the body temperature by using the temperature sensor and the flex sensor will be on or off for the fan available in the room (depends on the patient need).If glucose level is zero then it will stop the flow and sends the data to the hospital faculty through the Wi-Fi module of his Android App. If glucose level is not zero then it checks the flex sensor is less than or equal to 450, if its yes then fan will be on, or else it will be off. The same will repeat for the 50%, 75% and 100% of the flow rates of the glucose level which is shown in the Fig.3.

V.EXPERIMENTAL RESULTS

Through this project it is able to Measure the Drip bottle weight monitoring using a load cell, and also we can set the Flow control using the electronic valve and hall flow sensor which is very much helpful in looking after the patients in the hospitals for the observations specially during the night time. And it also controls the reverse blood flow of the patient when glucose level is zero and shows all the data on the LCD display, and also checks the body temperature of the patient through the temperature sensor which is placed on the patients hand, and if patient wants fan ON/OFF ,then through the flex sensor which is placed on the patients finger, he or she can operate just bending the finger then that can ON/OFF the fan in the room. All these details will be Display it on the LCD display as shown in Fig.5 and sends all the data through the Wi-Fi module of Hospital faculty's Android App as shown in Fig.4.

Fig.4 Android App

Fig.5 LCD Display Outcomes

VI. CONCLUSION

This paper presented Electronic valve with Quantitative control system, In order to realize for flow control in drip, as a small, compact and advanced technology in the medical field. Here the continuous flow of medicine through drip to the patient is automatically controlled for three different flow rates 25 %, 50%, 75% of the IV cannula pipe. This can be done by measuring the level of medicine through the drip and is compared with set point and flow of medicine is stopped when it reaches the desired critical point. This method can be used for the overcoming of the human interference mistakes such as blood oozing back to bottle, when the nurse has not on time to patient place. The proposed model implemented using manual switches to control the flow rate of saline, the same model can be achieved using IOT concepts. Here IOT replaces manual switches by software like user friendly mobile apps so that doctors can control flow rate by sitting at place. IOT concept models can be implemented for remote destinations like villages. Doctors can sit in a different city, different floor of a building, or in their house and patient can be anywhere, monitoring and flow rate controlling can be done. Using same IOT concepts one doctor can monitor several patients report on the mobile app or computer screen so one doctor can monitor several patients.

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