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Simultaneous Drug Delivery System

Dhruvin Trivedi[1], Vishwa Chavda[2], Yash Patel[3], Kishan Ramoliya[4]

***Abstract* — This paper is about the future of the drug delivery system, which can improve the design and implementation of an Arduino based automated drug delivery system. Here Arduino Uno is used as the main brain of the system which has been connected to the stepper motor. This motor is connected to the syringe pump. Syringe pump is a device that delivers drug of the syringe to the patient in a very precise manner. The improvement comes in the next step of this paper which is having another motor used to deliver drug of the intravenous (IV) simultaneously. For this a device called Infusion pump is used that delivers drug of the intra-venous (IV sets) to the body in a fixed amount of ml set by the doctors. The main advantage we have that this both systems use a single type of motor named stepper motor. So, we can easily initialize both motors just we have the different calculation of the programming values and the step sizes of them. Both devices are operated by battery as well as having single keypad and single controller with each one having their unique operation motor due to their specific requirements of step sizes.**

Keywords—drug delivery system, automated drug delivery system, arduino uno, stepper motor, flow rate, biomedical projects, syringe pump, infusion pump, iv pump, therapeutic, administer medication, biomedical research, bolus, portable device, operation theaters, automatic drug delivery system, ICUs, hospital, ambulance.

I. INTRODUCTION

Aim to do this research is to improve applications of medical devices used to deliver fluids into a patient's body in a controlled manner. And also, to acquire less spaces acquired by this devices in the ICUs or the OTs or any other departments of the hospital. That may be capable to deliver fluid/ drug/ nutrients. Such as insulin or other hormones, antibiotics, chemotherapy drugs, and relievers. This system involves the administration of medication through a needle or catheter. It is prescribed when a patient's condition is so severe that it cannot be treated effectively by oral medications. Typically, "Infusion Drug Delivery System" means that a drug is administered intravenously, but the term also may refer to situation where drugs are provided through other non- oral routes, such as intramuscular injections and epidural. To deliver drug to the patients in a specific amount at a particular time.

II. PROBLEM STATEMENT

Which problems causes these devices to come in picture? Some of the practical world problem statements are written below. Smart pumps have made dosage errors a lot less likely, which has led to their increase in popularity. As of 2013, 72.9% of all U.S. hospitals were using smart infusion pumps (a stark increase from just five years prior), and their popularity has only grown since then. However, this technology is not completely infallible. While there are several safety mechanisms in place that can prevent a great number of infusion errors, these mechanisms can sometimes be overridden by staff members.

Pump cleaning procedures need to be accurately followed on a regular basis. It's not only about the physical cleaning itself; it may also come down to how a given device is transported and whether those methods could potentially be unsafe.

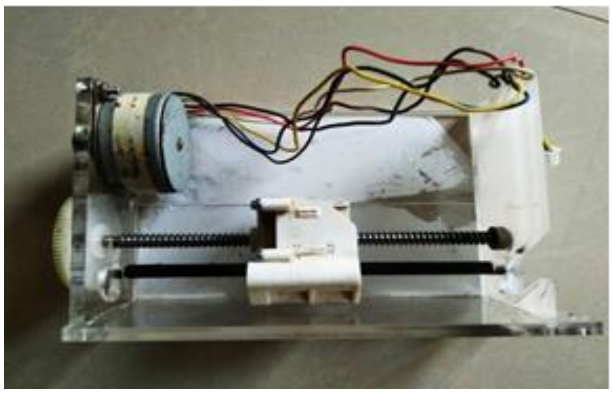
In many hospitals and other medical facilities, alarm fatigue can be a real problem. Although smart pumps and other medical devices come equipped with alarms and other warning systems as a precautionary measure to protect patients, being bombarded with too many alarms can cause staff members to literally tune out. As a result (and through no real fault of their own), the most important alerts may be missed.

So, what is the solution of this problems? Simple we must use some techniques that can limits the problem caused to the staff of the hospital when using this type of manual devices. For that these devices must be easy to use, easy to carry, handheld and must be battery operated also.

III. METHODOLOGY

A. Overview of 1st system

Defi Stepper driver circuit work by sending current through various phases in pulses to the stepper motor. There are four types of morphology to drive stepper based on frequency wave (also called one-phase-on drives, two-phase on, one-two phase-on drives and micro stepping drives).

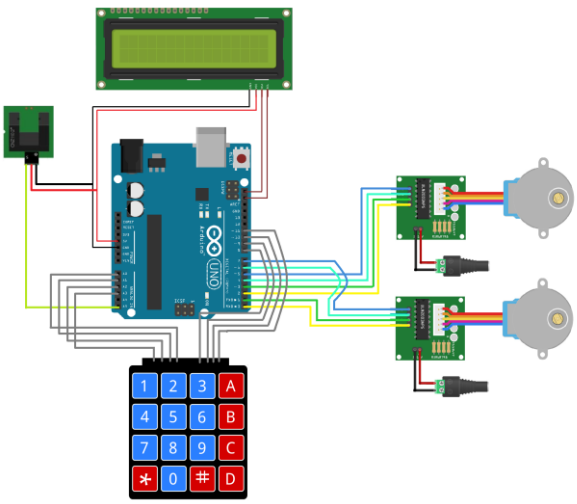


Syringe is placed on the socket of syringe pump. The plunger moves reverse and forward with sufficient pressure. Those pressure push the syringe for define time of dosage. Plunger relates to helix, which unify the plunger direction. The whole system is connected to simple gear system operated by stepper motor. Thus, stepper motor is connected to driver circuit. A driver circuit is used to control stepper motor driving speed.

B. Overview of 2nd system

- A 3D printed customized IV pump is developed by us to efficiently improve the drug delivery system. It is needful due to the stepper motor requirement.
- Also known as peristaltic pump used to deliver the drug with the compression of IV lines. Both pumps are attached with the microcontroller for desired and control flow of drugs as per patient requirement. In addition, connected the keypad to set a desirable speed and dosage time for drug delivery to various pumps.

- Also, the drug delivered by these pumps is much precise with the use of stepper motor. Timer programs is only added for only syringe pump it is reset for another syringe placement when drug is fully delivered to the patient.



- Photo interrupted sensor is added for this process and auto reset mode work when build-in plastic plate touch to the interrupt sensor.

IV. RESULT

In this paper after implementing the whole structure into one piece as shown in fig we found certain outcomes as we discussed into the introduction part. Which are the flow outcomes of the project by the step sizes of the stepper motor and the programming values of the motors. The outcomes we gain and put here in the result area are having ± 2 ml approximately from exact value. Because we measure those values using syringe and the test tube.

Let's first discuss the syringe pump values.

No.	Set ml	Delivered ml
1	10	9.8
2	20	19.5
3	30	29.0
4	40	39.7
5	50	48.8
6	55	53.5
7	60	58.3
8	65	64.0
9	70	68.0

As per the above results we found that the values which are comes are having values lower than the actual input. Because every time the motor rotates to the end approximately 1 or 2 steps left unfinished because of the auto reload function we put into the program, for easy functioning of the system by not delivering the drug more and to avoid outside physical stress on the system. It damages the whole system of changes the revolution values of the track we put in the initialization of the syringe pump counters.

The next is infusion pump. In this the from the value we initialize is more than a syringe pump because the value of syringe is less than a IV sets. So, the test case's values are to be also different. We use accuracy to 1 decimal point. This experiment is done via the standard IV and the beaker for the checking of outcome.

Secondly discuss the IV pump values.

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The above values are having variations from the input value is approx. ± 5 ml. It happens because we test this using IV line. Because in ideal scenario the IV set is used with the IV line only due to this the reservoir and IV line have some drug and

we cannot measure the whole IV because of drug need to be flushed out into the whole path. Because air particles can be harmful for the human body.

The above both the tests are done using standard hospital set of instruments.

V. FUTURE IMPLEMENTATION

This project can be further improved in future in several different ways. We just don't think about the improvements only. Instead, we conclude some revolution can be done on the current prototype as well. In this project we can add nebulizer which also delivers drug to the patient. It currently does not have any controlling features. But it can have timer counter circuit that delivers drug in a 1:10 ratio. Where 1 is a waiting time in hours and 10 is equal to 10ml after 1 hour elapsed.

Another thing we can add into this is to add number of syringe and infusion pumps, once the system got medical approval we can design multiple inputs into 1 actual prototype. It is already available in the market as a separate system but we can put that into one simple structure which also reduces the cost.

We can add the mobile application, Where a physician can see real time drug delivery from the different pumps. It also alerts the user when any error occurs or pumps got emptied.

REFERENCES

[1] R. Assunção, P. Barbosa, R. Ruge, P. Guimarães, J. Alves, I. Silva and M. Marques, "Developing the control system of a syringe infusion pump," 4799.

[2] A. Cohen, "A COMPUTER-CONTROLLED SYRINGE DRIVER FOR USE DURING ANAESTHESIA A Modification of the Graseby MS16A," 1986.

[3] V. E. Garcia, J. Liu and J. L. DeRisi, "Low-cost touchscreen driven programmable dual syringe pump for life science applications," HardwareX, vol. 4, p. e00027, October 2018.

[4] S. H. Lee, W. Kang and S. Chun, "Dynamic behavior analysis of drug delivery devices using a dynamic gravimetric method," Flow Measurement and Instrumentation, vol. 62, p. 105–112, August 2018.

[5] V. Lien and F. Vollmer, "Microfluidic flow rate detection based on integrated optical fiber cantilever," Lab on a Chip, vol. 7, p. 1352, 2007.

[6] M. Oellers, F. Bunge, P. P. Vinayaka, S. van den Driesche and M. J. Vellekoop, "Optofluidic flow-ratio sensor system for microchannels," Sensors and Actuators B: Chemical, vol. 275, p. 292–299, 13 December 2018.

[7] PBE, "See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication," 2291.

[8] K. Pusch, T. J. Hinton and A. W. Feinberg, "Large volume syringe pump extruder for desktop 3D printers," HardwareX, vol. 3, p. 49–61, April 2018. typesetter, "00-19.PDF," 2000.