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Design of a Automatic Inject Insulin Dosing System

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ABSTRACT: Diabetic Mellitus (DM) can greatly reduce the patient's quality of life if left untreated. Traditional insulin infusion techniques involving a syringe and needle are impractical and unpleasant. Insulin pumps are a great alternative to achieve ease of use and personal comfort. An existing low cost insulin pump is further modified to have additional features to improve user experience. The pump is highly precise delivering accurate quantities of insulin irrespective of external conditions. The invention of insulin pump was a relief for diabetic patients, as they could dispense insulin dosages self-reliantly. The design aspects and architecture of the insulin pump is presented here.

I. INTRODUCTION

Insulin is a hormone produced by pancreas to process and regulates glucose level in human body. The irregularities in insulin production may lead to a group of metabolic disorder known as Diabetic Mellitus (DM). There are two variants of DM: Type-1 diabetes, where the body is incapable of producing adequate amount of insulin and Type-2 diabetes, where body is incompetent to make use of insulin in a proper manner. In both cases the treatment includes insulin injection via a syringe or using an insulin pump. Insulin can be injected in two ways: as bolus and as basal. Basal is a small dose of insulin injected in a regular interval. To avoid sudden raise in blood glucose level after a meal, a heavy dose of bolus is injected before the meal. An insulin pump is a compact portable electronic gadget permanently connected to the body to deliver required amounts of insulin by means of a catheter set below the skin, usually abdomen area. Nearly 300 million people around the globe suffer from diabetes, yet only 0.1 percent of them use insulin pumps to treat it. Here, we discuss the current literature on the evolution of insulin delivery devices with a focus on the pros and cons of technologies and anticipated improvements. Considering the vast number of technologic solutions available on the global market, only the most popular devices applicable to patient care are outlined here. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

II. RELATED WORK

NAME	YEAR	TITLE OF THE PAPER	METODOLGY USED
A. H. Clemens, P. H. Chang, and R. W. Myers,	On 2015	The development of Biostator, a Glucose Controlled Insulin Infusion System (GCIIIS)™.	Glucose controlled insulin infusion system(GCIIS).
Domingo, J.F.C., Ruiz, R., Aldana, F., et al	On Dec.2015	'Adaptation drift suppression in blood glucose self-tuning control'	Drift suppression based control.
Turksoy, K., Quinn, L., Littlejohn, E., et al	On sep.2015	'Multivariable adaptive identification and control for artificial pancreas systems'	Multivariable adaptive method.
Balakrishnan, N.P., Rangaiah, G.P., Samavedham, L	On 2014	'Review and analysis of blood glucose (BG) models for type 1 diabetic patients', I	Normal blood glucose level analysing.
Haidar, A.	On 2017	The artificial pancreas: how closed-loop control is revolutionizing diabetes'	Closed loop control method is used.

III. EXISTING SYSTEM

In existing system, patient needs to get hospitalized for regular monitoring of the patient. It is not possible once he/she is discharged from the hospital. This system cannot be used at home. The existing systems are measuring the health parameters of the patient and send it through zigbee, Bluetooth protocol etc., These are used for only short range communication to transfer the data. Not all the time the doctor can fetch these details.

IV. PROPOSED SYSTEM

- This is the small amount of insulin that your insulin pump continuously gives you. Your pre-programmed rate is determined by your own body's needs and programmed by your healthcare professional.
- Because the quantity can be more precise and the rates can be customized e.g. can vary each hour if need be, an insulin pump can mimic a healthy pancreas more closely.
- Diathermy is a therapeutic treatment commonly prescribed for muscular and joint associated pains. The term 'diathermy' means 'through heating' or producing deep heating directly in the tissues of the body.
- It simulates the circulation, relieves pain, enhances rate of recovery of healing the tissue. We do this pain relieving process by using peltier module.

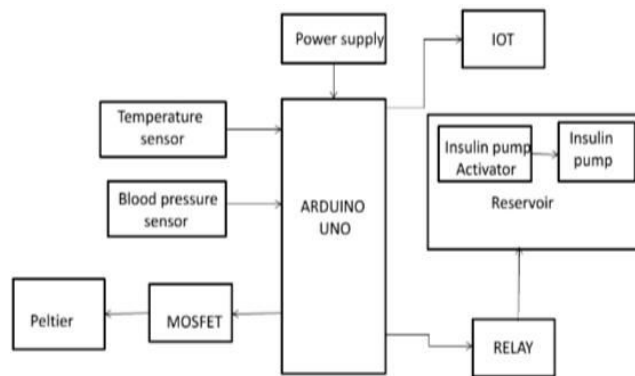
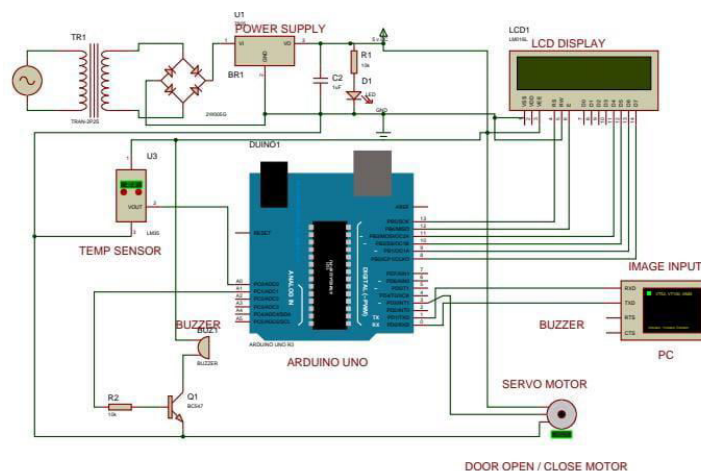
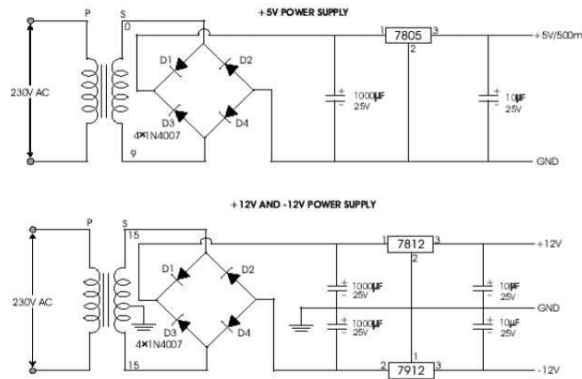


Fig 1 Block Diagram

V. WORKING PRINCIPLE AND METHODOLOGY



Power supply:



The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

Liquid crystal display:



Fig 2 LCD Display

A **liquid crystal display (LCD)** is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically-modulated optical device made up of any number of pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome. The earliest discovery leading to the development of LCD technology, the discovery of liquid crystals, dates from 1888.

Pressure sensor:



Fig 3 Pressure Sensor

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators and piezometers, manometers, among other names. Pressure sensors can vary drastically in technology, design, performance, application suitability and cost. A conservative estimate would be that there may be over 50 technologies and at least 300 companies making pressure sensors worldwide.

Temperature sensor:



Fig 4 Temperature Sensor

A thermistor is a type of resistor whose resistance varies with temperature. The word is a portmanteau of thermal and *resistor*. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range [usually $-90\text{ }^{\circ}\text{C}$ to $130\text{ }^{\circ}\text{C}$].

Relay:



Fig 5 Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are doublethrow (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

Pump:



Fig 6 Pump

A **pump** is a device used to move fluids, such as liquids or slurries. A pump displaces a volume by physical or mechanical action. Pumps fall into five major groups: **direct lift**, **displacement**, **velocity**, **buoyancy** and **gravity** pumps. Their names describe the method for moving a fluid. A positive displacement pump causes a fluid to move by trapping a fixed amount of it then forcing (displacing) that trapped volume into the discharge pipe. A positive displacement pump can be further classified according to the mechanism used to move the fluid:



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VI. RESULT

IOT BASED INSULIN DOSING

Temperature : 032
Pressure : 165
Status : HIGH_PRESSURE

PUMP ON PUMP OFF

Your message _____ SET TIME

IOT BASED INSULIN DOSING

Temperature : 066
Pressure : 85
Status : HIGH_TEMPERATU
RE

PUMP ON PUMP OFF

Your message _____ SET TIME

IOT BASED INSULIN DOSING

Temperature : 042
Pressure : 85
Status : NORMAL

PUMP ON PUMP OFF

Your message _____ SET TIME



VII. CONCLUSION

The prototype of a low cost insulin pump was developed. The pump was put through numerous experimental iterations and proved to be highly accurate with respect to the injected insulin dosage. The pump being compact and light weight can be easily worn under clothes. Safety is guaranteed by the built-in functional monitoring system and the overall usage of low cost materials in fabrication finds the device economic. The performed tests show that the accuracy of the results were verified using as reference values those manually calculated based on the characteristics of the selected actuator. Test results validate the effectiveness of the systems. The mobile application allows the user to calculate the correct amount of insulin to be administrated for bolus mode based on the patient ingestion.

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