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Diabetics Diagnosis and Curing Mechatronics System

Abhin. S. P[1], Anshad. K[2], Joyal Joy[3], Kiran Jose[4]

Department of Mechatronics Engineering, Malabar College of Engineering and Technology, Desamangalam, Pallur P O, APJ Abdul Kalam Technological University (KTU), Thiruvananthapuram, Kerala, India
Email: *abhindassp2001[at]gmail.com*

Abstract: ***In this paper, we are discussing a mechatronics system that maintains the glucose level in our body. Going through the paper reader can get a general idea about, how to implement a device that automatically controls the glucose level in the human body. The paper is specifically focused on diabetics patient.***

1. Introduction

The aim of the study is to implement a system that automatically senses the intensity of the glucose level in the blood and cures them by injecting the drug. According to [1] we can get a general knowledge about the automatic device that maps various diseases and cures them by injecting drugs. Based on [1], we can design a specific device "Automatic Diabetics Diagnosis Device".

Here, we design a portable non - invasive device that detects glucose level in the blood and heal the variation by injecting drug. According to [2] we can detect the level of glucose non- invasively (without taking blood). After calculating the glucose level, an injecting mechanism injects a specific amount of drug with respect to the variation.

2. About Diabetics

Diabetics known as diabetes mellitus is a medical condition which high blood sugar levels over a long period of time. It occurs due to mainly two conditions case 1 is does not produce enough insulin in the pancreas or failure inefficient use of insulin produced in it. There are several types of diabetics according to different cases.

3. Methodology

In this part, we are discussing the detail of "Automatic Diabetics Diagnosis Device". Generally, the device is a mechatronics system. Every mechatronics system has mainly three parts sensing part, processing part and actuation part.

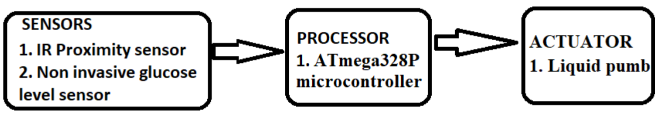

Figure (i): Block diagram of the system

In this project sensing part is explained according to [2] it is a non - invasive method of glucose level sensor throughout the paper. According to science, this is a spectroscopy method of finding the different elements. Here we use the IR spectroscopy method of sensing glucose. IR radiation is first transmitted through the blood and receives the radiation by an FGA10 photodiode.

ATmega328p microcontroller chip is used as a processing unit the sensed analog signal is processed by the processor and finds the glucose level. There is a general formula for converting the voltage signal to glucose level.

$$\text{GlucoseLevel}=18*\log(\text{sensorVoltage})+C$$

The processor calculates the dose of the injectable drug according to the glucose level.

The injection mechanism injects the drug into the body according to the dose calculated by the processor. According to [3] the author uses a stepper motor to inject insulin into the body. We need a proper mechanism to inject the drug, the accurate mechanism for injection is the lead screw mechanism, which is highly accurate and simple. This mechanism is implemented when the device is designed in macro scale, If we need to implement the device (micro or nano scale device) inside the body we can use MEMS micro pumps like piezo - electric micro pump.

4. Sample Design

The system can design on two different scales, if we need to implement the system inside the body MEMS - based design is better. In this section, we demonstrate the design sample macro - scale device.

To implement this we need OLED display, Arduino UNO, Power supply, injection mechanism, IR transmitter (LED), FGA10 Photo Diode, IR proximity sensor, OPAM amplifier Resistor & motor pump.

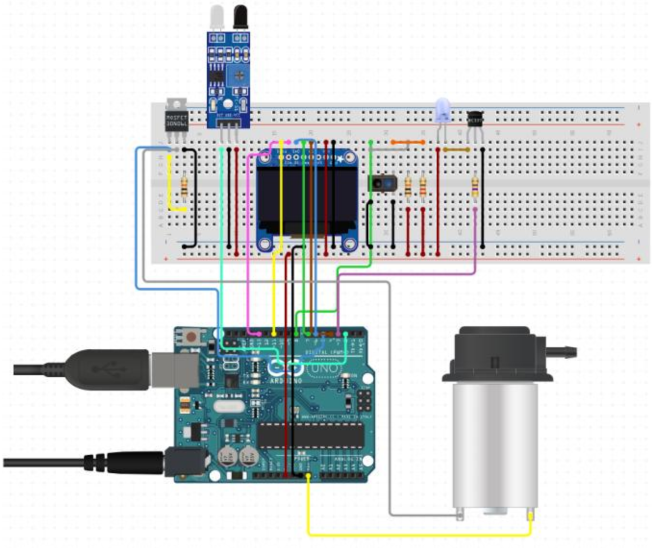

Figure (ii): Circuit Diagram of the system

Using this diagram we can implement the system and verify the output. The code is provided in the appendix. The sensing circuit diagrams are clearly described in [2].

5. Conclusion

In future the space missions and tourism are increase gradually we can use these technologies for emergency situations. The potential advancements and developments in the field of mechatronics can revolutionize the way medical diagnoses are made and treatments are administered. It implies a vision of a future where mechatronics, a multidisciplinary field that combines mechanical engineering, electronics, computer science, and control systems, plays a pivotal role in improving healthcare outcomes.

To elaborate on the concept:

1) Advanced Diagnostics: The future of diagnosis involves the integration of mechatronic systems to enhance medical diagnostics. This can include the development of advanced imaging technologies, such as high - resolution medical scanners or imaging robots, that provide detailed and real - time information about the human body. These systems may utilize innovative sensor technologies, data processing algorithms, and machine learning techniques to improve accuracy, speed, and diagnostic capabilities.
2) Precision Medicine: Mechatronics can contribute to the future of curing by enabling precision medicine approaches. By combining robotics, automation, and sensing technologies, mechatronic systems can assist in delivering targeted treatments with high precision. For example, robotic surgical systems can enhance surgical procedures by providing surgeons with enhanced dexterity, precision, and visualization, leading to improved surgical outcomes and reduced invasiveness.
3) Wearable and Implantable Devices: Mechatronics can enable the development of advanced wearable and implantable medical devices that monitor vital signs, deliver therapies, or provide real - time feedback on the patient's condition. These devices can incorporate sensors, actuators, and communication technologies to enable continuous monitoring and personalized treatments. Mechatronic systems can help ensure seamless integration, comfort, and reliability of such devices for improved patient experience and treatment efficacy.
4) Intelligent Drug Delivery Systems: The future of curing can involve mechatronic systems that enable precise and automated drug delivery. These systems can incorporate sensors to monitor patient response, actuators to control drug release, and smart algorithms to optimize dosing. Mechatronics can facilitate the development of personalized and adaptive drug delivery systems that adjust treatment parameters in real - time based on patient needs, improving drug efficacy and reducing side effects.
5) Enhanced Patient Experience: Mechatronics can contribute to enhancing the overall patient experience during diagnosis and treatment processes. Automated systems, robotic assistance, and smart interfaces can improve patient comfort, reduce procedural complexities, and provide real - time feedback to healthcare providers. Mechatronic systems can also facilitate remote monitoring and telemedicine, enabling patients to receive timely care from the comfort of their homes.
6) Integrated Healthcare Systems: The future of mechatronics in diagnosis and curing envisions the integration of various healthcare systems, devices, and data sources to enable seamless communication, interoperability, and decision support. Mechatronic systems can facilitate data fusion, real - time analytics, and decision - making algorithms that assist healthcare professionals in diagnosing, monitoring, and treating patients more effectively.

In summary, the future of diagnosis and curing mechatronics systems envisions a convergence of advanced technologies to revolutionize healthcare practices. Through the integration of robotics, automation, sensing, and intelligent algorithms, mechatronics can enable advanced diagnostics, precision medicine, wearable devices, intelligent drug delivery, enhanced patient experiences, and integrated healthcare systems. These advancements hold the potential to improve healthcare outcomes, personalize treatments, and ultimately enhance the quality of life for patients.

Appendix

Arduino source code: - please the circuit diagram according to pinMode.

```
#include <Wire. h>
#include <Adafruit_GFX. h>
#include <Adafruit_SH1106. h>
#define OLED_RESET - 1
Adafruit_SH1106 display (OLED_RESET);
int irprox=9;
int irLedPin = 10; // digital output pin connected to IR LED
int wpumb = A1; //digital output pin connected to waterpumb
int irReceiverPin = A0; // analog input pin connected to IR receiver
int glucoseLevel; // variable to store glucose level

void setup () {
```

```
 Serial. begin (9600);
 pinMode (irLedPin, OUTPUT); // set IR LED pin as output
 pinMode (wpumb, OUTPUT); // set waterpumb
 pinMode (irReceiverPin, INPUT); // set IR receiver pin as input
 display. begin (SH1106_SWITCHCAPVCC, 0x3C); // initialize with the I2C address of the OLED display
 display. clearDisplay (); // clear the display
 display. setTextColor (WHITE);
 display. setTextSize (1);

 }

void loop () {

 // turn on IR LED to start measurement
 analogWrite (irLedPin, 180);
 delay (50); // wait for LED to stabilize

 // read IR receiver output and convert to glucose concentration using calibration curve
 int sensorOutput = analogRead (irReceiverPin);
 //sensorOutput = sensorOutput*0.5;
 glucoseLevel = convertToGlucose (sensorOutput);
 //Water pump module
if (irprox==1)
{
int c=10; // it is vary according to pump efficiency
delay ((glucoseLevel/80) *c);
 analogWrite (wpumb, 255);
}
 // turn off IR LED to end measurement
 digitalWrite (irLedPin, LOW);
 display. setCursor (10, 10);
 display. println ("Glucose level");
 display. setCursor (60, 25);
 display. println ("gm/dL");
 display. display ();

 display. setCursor (10, 25);
 display. println (glucoseLevel);
 display. display ();
 Serial. println (glucoseLevel);


 delay (1000);
 display. setCursor (10, 25);
 display. clearDisplay ();

 // delay for 1 second before taking another measurement
}

int convertToGlucose (int sensorOutput) {
 // implementation of calibration curve to convert sensor output to glucose concentration
 int glucoseConcentration=18*log (sensorOutput) +42;
 // implementation of calibration curve goes here
 return glucoseConcentration;
}
```

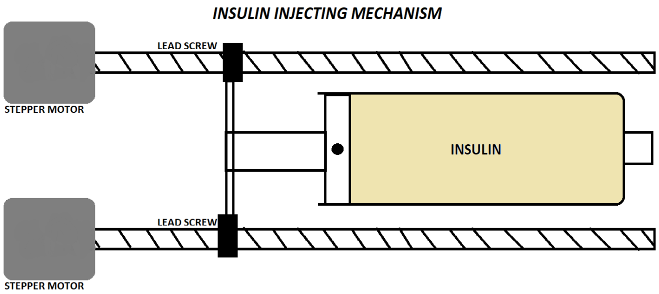

Figure (ii): Injection mechanism of (for macro device)

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