CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)	Project Number
Kavya M. Pandrangi	38444

Project Title

Automated Insulin Delivery Model with Feedback for Diabetics: A Microcontroller and Sensor Based Bioengineering Project

Abstract

Objectives/Goals

Many diabetics constantly monitor their blood sugar levels and administer insulin as needed. To help diabetics, extensive research is being done to create a device which functions like pancreas by automatically administering insulin as needed, but many obstacles stand in the way of adoption - e.g., trust issues. The goal of my project is to design a contraption to simulate artificial pancreas which will also provide real-time feedback to the users to alleviate trust issues.

Methods/Materials

I used acid-base neutralization concept to simulate the process of insulin normalizing high blood sugar levels using vinegar in place of blood and baking soda for insulin. First part of my design consists of a DC motor configured to pump baking soda solution when the vinegar solution is acidic enough. A conductivity sensor is placed in the vinegar jar to work like a variable resistor as the baking soda is pumped. The potentiometers in my circuit are calibrated such that the pump would stop pumping baking soda as soon as the vinegar is neutralized. To provide feedback to the user, I created a mobile application that takes input from an arduino connected to an ultrasonic level sensor. I connected ultrasonic sensor to the top of the baking soda solution jar so I can measure the amount of baking soda left in the jar as it is being pumped into the vinegar jar. The Arduino then publishes the information to the mobile app about when the baking soda was pumped and how much is left. When the level of the baking soda is low enough, the arduino will send out a notification to the app. This would alleviate the user engagement and trust concerns since the user would be getting constant feedback whenever insulin is pumped.

Results

After I calibrated the potentiometers to stop the pump when the vinegar solution is neutralized, I was able to accurately determine how much baking soda solution (i.e., insulin in the model) was used. I was then able to publish this information to the mobile app as well as to determine when the insulin reservoir needs to be refilled or replaced.

Conclusions/Discussion

This model shows that automation and real-time monitoring of insulin delivery are feasible. Some enhancements are still necessary which I plan to address in future: miniaturization of the circuits, more accurate ways to determine insulin levels in the pump (instead of ultrasonic sensor) and publishing blood sugar levels also to the application.

Summary Statement

My project is about building an automated insulin delivery model with real-time mobile app based feedback for diabetics using a microcontroller and ultrasonic and conductivity sensors.

Help Received

I learnt about acid-based neutralization and electronic circuit concepts at school. I then designed and programmed the model after reading thru online material on circuits, arduino and sensors. My mom reviewed my circuit and dad reviewed my code.