CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)	Project Number
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Project Title

Developing an Artificial Pancreas: Dealing with Diabetes

Abstract

Objectives/Goals

The objective of the project is to create an artificial pancreas and provide a solution to increase efficiency of the closed-loop system.
It is tested to see if it can model a real pancreas and tested on different levels of pH (modeling glucose and insulin).
The goal is to find an optimum range of the difference in the pH of the modeled solutions that will reduce dangers involved with incorrect dose of insulin for a Type 1 diabetic.

Methods/Materials

A conductivity sensor is designed using plastic straw, copper wire, and Styrofoam. The artificial pancreas is designed on a breadboard using resistors, jumper wires, potentiometers, MOSFET, and AA batteries. The conductivity sensor is connected to the artificial pancreas using alligator clip wires. The artificial pancreas is tested using vinegar and baking soda modeling insulin and blood sugar levels. Peristaltic liquid pump with metal leads is used. The resistors form voltage divider. The potentiometers and conductivity sensor form a voltage divider. The output of the second voltage divider is equal to the voltage of the gate on the MOSFET. The voltage divider controls whether the gate conducts energy between the drain and source. When pH of the solution turns 7, the conductivity sensor senses and the MOSFET turns off so current doesn't flow and the pump turns off.

Results

The conductivity sensor senses the solution with pH above 7. The pump starts to run and neutralizes the pH of the solution to 7 and stops. This happens 50 times, which means the pump works. The pH of vinegar solutions ranged from 2.5-6.5 and that of baking soda were 6, 6.5, 7, 7.5, and 8. I observed that if two sets of vinegar and baking soda solution have same difference in pH levels, the time taken to neutralize the solutions are same.

Conclusions/Discussion

The artificial pancreas met all requirements in the engineering goal. It sensed the low pH making the pump run, which operated 50 times. Another observation is when the difference in pH and time taken to neutralize the solutions are plotted on x-y plane, the graph is a straight line. There is a linear correlation between difference of pH levels of solutions and time to neutralize the solutions. Correlation is modeled by the equation $y = 3.75x - 0.01$ with $r^2 = 1$. From the correlation line, it is concluded that if we can maintain the difference of the pH level at some central tendency, the risk of Type 1 diabetes can be minimized.

Summary Statement

I created and tested an artificial pancreas using various pH levels of baking soda and vinegar (modeling glucose and insulin); linear correlation was found when difference of pH and time to neutralize the solutions were plotted on x-y plane

Help Received

I designed the project and conducted the experiment independently. My science teacher guided me through this project and reviewed my results.