MINIGUARD THERMAL FLOW SENSOR

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MiniGuard
INNOVATIVE SENSING SOLUTIONS

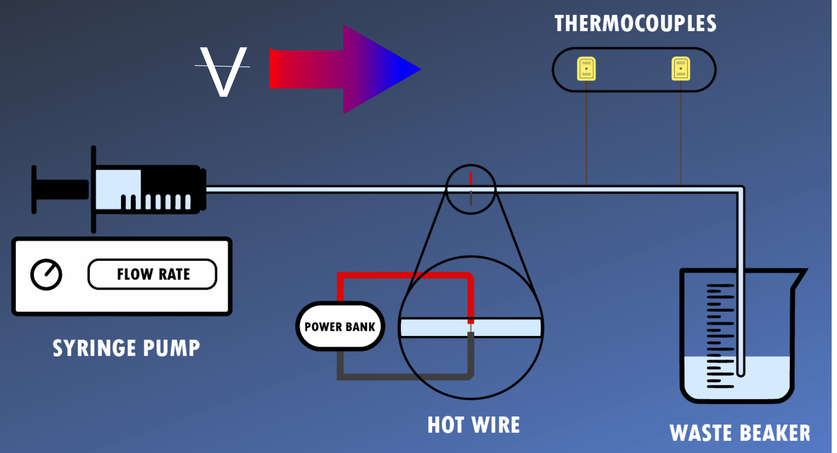
Background

Currently, no insulin pumps on the market offer in-line, real-time sensing of insulin flow into the body. The absence of accurate insulin monitoring may lead to life-threatening situations such as hyperglycemia and hypoglycemia. Studies have shown that approximately 400,000 people in the U.S. during 2014 had admitted themselves to the hospital for such conditions due to incorrect insulin dosages provided by their insulin pumps.

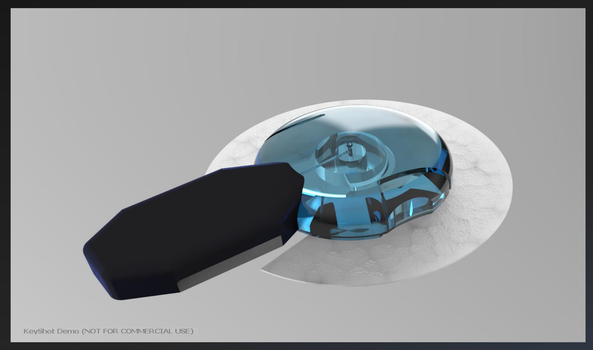
Overview of Solution

MiniGuard is a thermal flow sensor which uses changes in power to calculate flow rate. A wire placed perpendicular to the fluid pathway is heated by an external power supply to a preset temperature at a known flowrate. Fluctuations in flowrate after this initial state cause the temperature of the wire to change and thus a change in power supplied is needed to bring the wire back to the preset value. This change in power supplied is then correlated to a flowrate.

Functional Flow Diagram

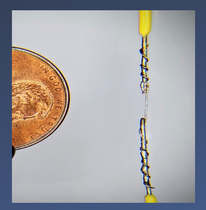


MINIGUARD SENSOR



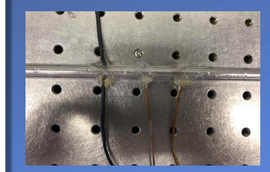
In the figure above, you can see how the miniguard sensor will be attached to the cannula of the infusion set. The cannula houses the needle which delivers insulin to the patient. This location serves three functions: avoids twisting of the insulin tubing, allows the sensor to account for losses due to leaks, and implements the sensor without extensive redesign to the existing insulin sets.

Key Components



Heating Element: Nichrome Wire
The above shown wire is placed within the fluid and heated by a constant power supply.

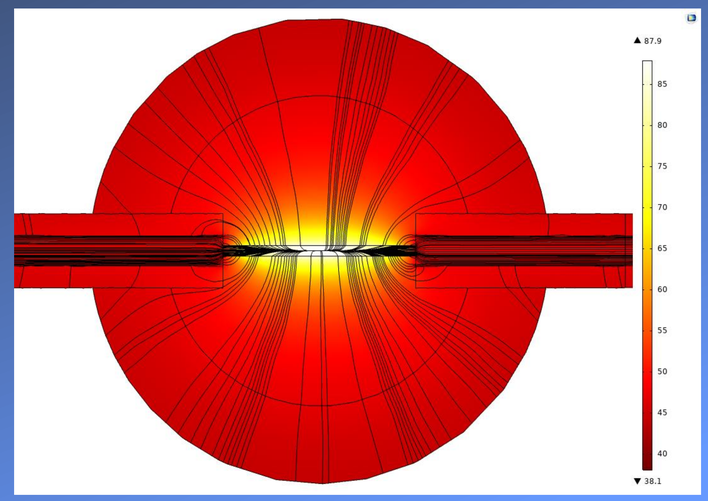
DMM
A high precision digital multimeter is used to calculate the power being supplied to the nichrome wire. A device of this precision is needed to increase the sensitivity of the Miniguard Thermal Sensor.



Thermocouples
Thermocouples were used to ensure that the fluid in the tubing does not exceed a temperature of 40°C. Because past this temperature, insulin starts to degrade and would be a dangerous for the patient.

Test Setup Illustration

Heat Diffusion Streamlines



As the fluid travels across the nichrome wire, it removes some of the heat. This process is shown above via the black heat diffusion streamlines.

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