CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)	Project Number
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Project Title

A Novel Design and Evaluation of Temperature Controlled Smart Sock with Fuzzy Logic Control

Abstract

Objectives/Goals

Currently, there are not many options to heat or cool the body without adding or dropping layers. Additionally, there is no way to intelligently increase and decrease one#s temperature except by using electric clothing, heaters, or some other alternative which requires user intervention. The goal of this project is to change this and correctly apply a certain amount of heat to the user#s foot using an electric sock based on the temperature measured inside and outside the shoe and on the activity level of the user. The system would be deemed successful if it kept the user's temperature at a comfortable 30º C in all conditions without the user intervening.

Methods/Materials

First, I connected the microcontroller to my smart phone through an application, so I could see the data gathered. Next, I allowed the microcontroller to control the heat by creating a circuit in which I used two transistors to control the heating element. Then, I added the three sensors to the circuit, so the microcontroller could sense the temperature and the user#s movement. After, I coded the microcontroller to use fuzzy logic to determine how much heat is needed. I tested the system in three temperature conditions while both staying still and moving. They were i) hot temperatures for which I used a hair dryer for the heat, ii) normal temperatures for which I used normal lab conditions, and finally iii) cold temperatures for which I used a bucket of ice.

Results

The data gathered verified that the system did maintain the user's temperature at a comfortable level for the hot and normal conditions. Additionally, the cold situation where I was not moving made the heating element output lots of heat which brought my foot temperature significantly closer to the wanted comfortable temperature. That being said, while I was moving and my foot was cold, the fuzzy logic in the microcontroller caused the output to be around 50% which meant that my foot stayed cold and uncomfortable.

Conclusions/Discussion

In conclusion, the fuzzy logic system paired with the electric sock did help keep the foot at a comfortable temperature though changes in the fuzzy logic system to allow movement to have less of an impact on the output may be necessary to further optimize the system.

Summary Statement

This project is aimed at creating a smart sock that uses fuzzy logic in conjunction with three sensors to accurately output a level of heat that is comfortable for its user.

Help Received

I conceptualized, created, and tested the whole system while my mentor, Dr. Ismail, supervised me.