CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Cameron C. Jones

Project Number

34044

Project Title

Is It Warm in Here or Is It Just Me? Regulating Thermal Comfort with Personal Peltier Modules

Abstract

Objectives/Goals

Enormous amounts of energy are being used every day to heat buildings, vehicles, and other places that human beings occupy. Taking advantage of how humans perceive warmth, it may be possible to develop a personal thermal regulation device that can deliver the same comfort level with less wasted energy. My Peltier device delivers timed pulses of heat to the wrist or arm of a user. The sensation of the heat pulses changes the perceived thermal comfort level of the subject when exposed to temperatures. My hypothesis is that it is possible to regulate a person#s perception of ambient temperature and thermal comfort using a wearable computer controlled device based on the Peltier effect.

Methods/Materials

Attach 4 temperature sensors to the Arduino. Then take the first three sensors and tape them to the subject#s chest, back, and arm. Position the fourth sensor away from the subject to detect ambient air temperature. Select desired power level, pulse width values, and delays for Peltier module using the control program. Attach the Peltier surface to desired location on body. Place the test subject in cool environmental conditions. (14C - 19C). Start the Arduino serial monitor to begin data logging of the temperature sensors. Monitor test subject comfort level (on a -5 to 5 scale) and record internal temperature at 2 minute intervals for 15 minutes total. Repeat the steps above changing the pulse width, delay, test subject, and/or environment.

Results

After performing experiments in different environments using different parameters for the pulse width and delay time, I showed measurable improvements in perceived thermal comfort for two different test subjects exposed to environments ranging from 14C to 19C for 15 minutes at a time. I evaluated tests where the Peltier surface was applied to the inner arm near the elbow. I found the effect was more pronounced when it was used on the inner arm near the elbow.

Conclusions/Discussion

Subjects reported improvements in thermal comfort of one to two levels based on a ten point scale. My device was able to demonstrate this effect using an average power of approximately 4 watts. This project demonstrates that it is possible to influence thermal comfort by low power manipulation of skin temperature in small areas of the body. This could allow the design of clothing with integrated Peltier modules that would help preserve thermal comfort in cool conditions.

Summary Statement

Regulating thermal comfort with computer controlled personal Peltier modules.

Help Received

My father helped purchase the parts and assisted in debugging the control program.