EOI/UCSB 2019-2020 Capstone Project Proposal

Low cost, Non-Contact Infrared Reference for Hand Held Thermometers

Decisions are made every day in Industry and in Doctors' offices using inexpensive non-contact thermometers, but how close are these devices' readings to the true temperature? This project will create a commercially viable reference to perform quick checks for low cost thermometers.

Company and Personnel Background

Electro Optical Industries (EOI) was founded in Santa Barbara 55 years ago. We are a long-standing company both in the Santa Barbara area and in the Optics Industry. We design and manufacture optical test equipment for all camera and sensor applications from UV and Visible to Infrared. EOI was instrumental in the development of Infrared Detector industry in Goleta by supplying the first commercially available blackbody Infrared sources. Now we supply precision photonics instrumentation for camera manufactures on a worldwide basis. We also have a line of Security and Surveillance systems based on Infrared imaging and real time machine vision analysis used to protect people, airports, power plants and ships.

Stephen Scopatz will be the POC for this project. Stephen is the General Manager and Lead Engineer at EOI. He has been an Optics Engineer for decades developing pioneering work in machine vision and biomedical applications. He holds a BS in Physics from the University of Southern California and MSE (Engineering) from Purdue University. He has 7 patents and 13 publications; he is a Senior Member of SPIE (Optics and Photonics Society) and a board member of the Santa Barbara Science and Engineering Council.

Product Justification

There are a wide variety of non-contact hand held thermometers used in doctors' offices and industrial settings. Many of these devices are calibrated at the factory and never checked again. This is not an ideal situation for measurements that a decision is based on, for example does the patient have a fever or is this circuit board running too hot. This product will provide a low cost, single temperature to check the thermometer's current accuracy. The pictures below are for non-contact thermometers that cost less than $30. The goal for this product is to provide a low-cost reference that will prevent a child's fever from going untreated or allowing a circuit to fail because of a bad reading from a "cheap" thermometer. The customer will learn the bias of the readings from the hand-held thermometer and confidently make decisions using the thermometer reading plus the bias correction.

Project Goal

Create a small (≈35 mm square) IR Source that can be set to a single temperature in the range from 32° C to 100° C. The total cost of the parts is to be <$150, lower is better. The heating element is to be one or more power transistors; using the source emitting plate as the heat sink (Note: this heater will be unique in our industry). The thermal sensor, either a PRT (platinum resistance thermometer) or a one wire temp sensor, will be imbedded in the source plate. A student designed board or a Raspberry pi will be used to create a closed loop feedback to maintain the set temperature. PWM will be used to turn the transistors on and off rapidly to maintain the temperature set point. The packaging will include indicator LED's for ready/not ready at set temperature and one for power. A user interface (communication port TBD) will be used to set the temperature from a PC or similar.

Design Challenges for the team:

- Selecting a power supply
- Selecting the power transistors and designing the circuit to run them
- Determining how to read the temperature sensor in the source plate
- Designing or selecting the microcontroller and communication protocol/port
- Breadboarding the Electronics and then developing a circuit board for the product.
- Writing the microcontroller code

Design Challenges that could be done by the team and/or EOI (depends on the size and the skills of the team)

- Selection of temperature measurement device
- Determine if a fan is needed to assisting in controlling the temperature

Design Challenges to be handled by EOI

- Design of the target plate
- Mechanical mounting of the plate
- External packaging and internal insulation for the final product
- Calibration method

Low cost IR Source
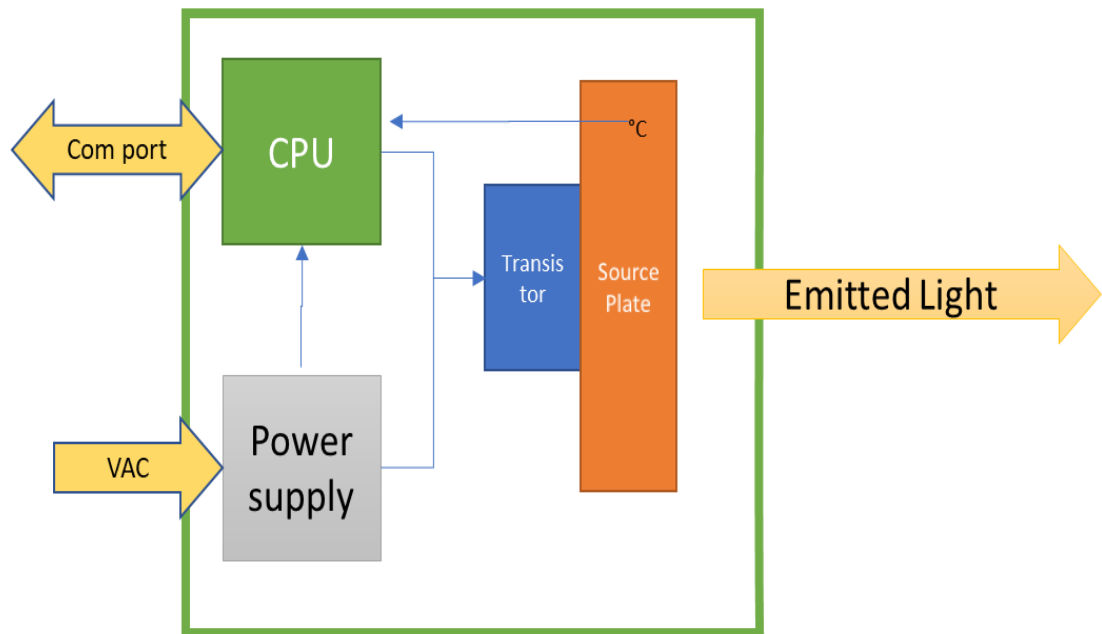
Support provided by the sponsor

- Will provide the emissive source plate and housing.
- Temperature measurement probes
- Calibration references
- Access to EOI's Engineering staff to answer questions

Project Deliverables

One set breadboard electronics for the project in the winter quarter

One fully functioning prototype including software to set temperatures, perform the control loop and external communication to complete the project.

Costed Bill of Materials (including the sponsor supplied parts)

Documentation of system design history and schedule, experimental data, data analysis, final schematics, and any other relevant documentation necessary to demonstrate system design and function such that EOI will be in a position to reproduce the system.

Ideal Team Makeup

- Between 3-5 EE or CE students
- Ability to develop microcontroller software coding (Python or C++ preferred) with interface to hardware
- PCB design and layout
- Ability to test and troubleshoot system performance

Student Requirements

Team participants must sign a nondisclosure agreement and an invention assignment agreement.

What you will learn doing this project

- Real world closed loop feedback control
- Validation of performance against the product requirements
- Monitoring of product cost during each step of the design phase
- Engineering Output = Documentation Package for the product and not the product itself (but don't let that scare you, it is a product development mindset that can take years to learn)

Points of Contact:

Website: electro-optical.com

Stephen Scopatz
Electro Optical Industries
Stephen.scopatz@electro-optical.com
805-690-5234

Final pitch: EOI is well known among the IR camera companies in the local area both the large ones and the startup companies; this will be good association if you plan to work in the area after graduation.