# A Handheld Thermal Imaging Projecting System

lumen
infrared in a new light

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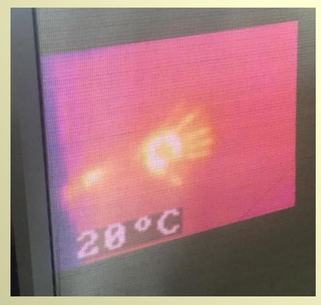
FLIR

## Introduction

Current thermal imaging technology involves viewing an image on a handheld display.


In many applications it would be beneficial to see exactly where the thermal profile is relative to the object.

## A New Perspective




The Lumen projects the thermal image directly onto the surface

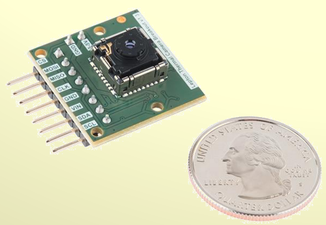
## Our Product

The Lumen combines the FLIR Lepton camera with a laser pico projector.


### CXN0103 Pico Projector

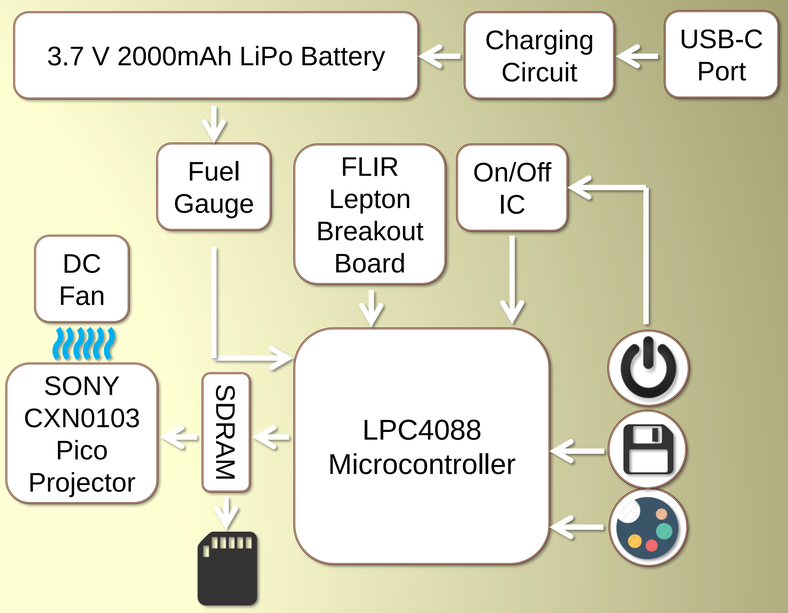
- 30 Lumen brightness
- 3W max power draw
- 42.1˚ Field of View

### FLIR Lepton

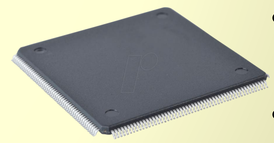


- 52˚ Field of View
- 80 x 60 thermal image
- 150 mW power draw

## System Overview




### LPC4088



- Controls communication between components
- Receives data from Lepton and sends it to the projector

### Button Functionality

- Power ON/OFF
- Save Image
- Color Palette Cycle

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UC SANTA BARBARA engineering

# Thermal Flashlight

**Anthony Murchison, Ben Harding,
Cody O'Connell, Kyle Rubin, Rajan Kasiraj**

## Abstract

**FLIR Systems, Inc. is the world's largest commercial company in thermal imaging and sensing. The challenge was to create a thermal flashlight, a device that would show an object's temperature by projecting a color gradient directly onto the object that corresponds to its temperature profile (Fig 1).**


**Figure 1. What the naked eye sees (left), the thermal gradient revealed by the Flashlight (right)**

## Design Specifications

**Table 1. Design Specifications**

| Consideration | Performance Spec. |
|---|---|
| Simple User Interface | Minimal Buttons |
| Handheld Size | Less than 8 x 4 x 4 inches |
| Weight | Less than 3 pounds |
| Impact Resistance | 5 foot drop test |
| Overheating | Dissipates 5 Watts |
| Ergonomics/Aesthetics | Comfortable and Appealing |

## Thermal Considerations

**Overheating was the largest concern throughout the project. Calculations, simulations (Fig 4), and experiments were performed in order to mitigate risk, ensuring the 5W generated by the internal components was dissipated. The final design uses an internal fan to blow air through the enclosure, cooling the components which allows it to operate in ambient air temperatures ranging from -10C to 40C.**

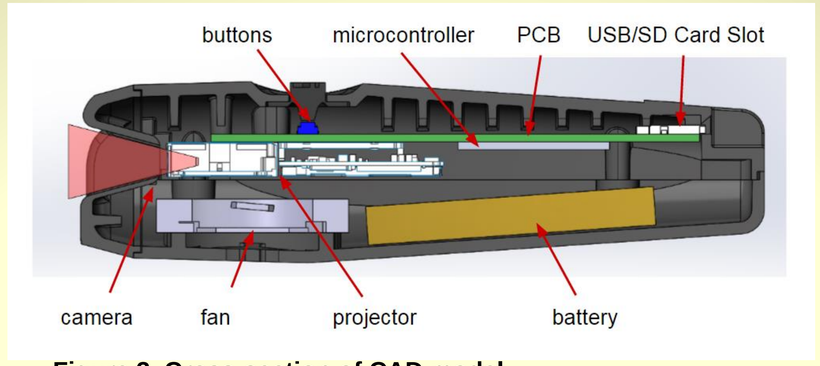


**Figure 3. Cross-section of CAD model**

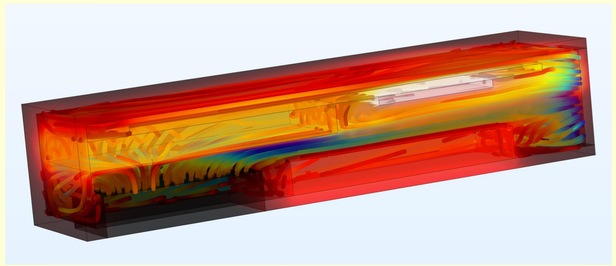

**Figure 4. COMSOL model with coupled fluid and heat transfer**

## Shock and Impact Considerations

**Because this is a handheld device, this product needs to be able to survive accidental drops and collisions. In order to increase its shock capacity, the design has internal ribbing and an external elastomer skin, which envelopes it much like an iPhone case. The materials used for the outer shell and the elastomer skin were carefully selected based on their material properties. SOLIDWORKS simulations were used to find stress concentrations that indicated additional ribs and fillets were needed.**

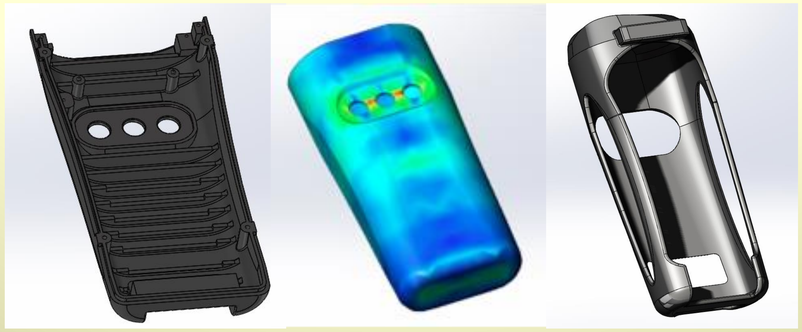

**Figure 5. Ribs and fillets (left), SOLIDWORKS simulations (middle), Elastomer casing (right)**

## Aesthetics and Ergonomics

**Any handheld consumer device needs to look good and be comfortable to hold. Figure 6 shows the final shape after many iterations and feedback from potential consumers.**


**Figure 6. Final CAD model (without elastomer)**

## Production Cost

**Based on quotes and economy of scale approximations, the estimated cost to produce the thermal flashlight would come to roughly $250.**

## Moving Forward

**This project was constrained by the available projector technology, which had limited range and brightness. In addition to using a more advanced projector, it would be beneficial to add an optical calibration feature to aid in the assembly process, and either a temperature dependent control system for the fan or a water-proof enclosure which relies on conduction paths instead of a fan. There is also room for a larger battery if desired.**

## Acknowledgments

**We would like to thank FLIR for sponsoring this project, in particular Marcel Tremblay and Kai Moncino. We would also like to thank Ted Bennett, Petros Serbana, Tyler Susko, Stephen Laguette and Stephanie Johnson for their support. Finally, we would like to thank our EE team: Lorena Covarrubias, Zach Schmidt, Vishaal Varahamurthy, and Anna Wu**