

Background

All security cameras that dominate the market have wires. Due to the need for cable routing, installation costs make security systems too expensive for most consumers. However, current cableless options, such as the EyeTrax Ranger system, cost upwards of \$2,000, not including monthly cellular data connection fees. The FLIR Helios is a cableless low-cost alternative to these security cameras which integrates solar power and WiFi capabilities to remove nearly all cabling.

Overview

The low power infrared (IR) Lepton and the FUJI visual cameras allow the Helios to provide 24/7 security, while being powered solely by the sun. When not streaming video, the Helios enters a low-power sleep cycle to conserve energy. A website and Android application give the customer the opportunity to view a live stream or 80 hours recorded video. The Helios will sell for about \$500 and due to its simple installation the secondary costs are negligible.

Design Specifications

Engineering Characteristic	Target Spec (Minimum requirement)	Target Spec (Ideal)	Design Spec
Submerged in 1m Water	30 min	30 min	30+ min
Minimum Solar levels	2.9 hours/day	2 hour/day	<ul style="list-style-type: none"> Failed with 2W solar panel To be tested with new solar panel
Temperature Range	-20 to +50 °C	-30 to +60 °C	Max +53°C
Weight	15 pounds	10 pounds	3.6 pounds
Connectivity	WiFi	Extended WiFi	WiFi (25m)
Battery Life	2.5 hours	10 hours	3.7
Price (in bulk)	\$700	\$200	\$500

The FLIR Helios



Figure 1

Solidworks Render of the FLIR Helios

Hardware / Key Components



Camera Enclosure

The enclosure is designed to be injection moldable, and IP67 water and dust proof.



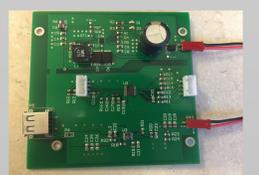
Faceplate

This plate will be made from acrylic to allow the PIR sensor to detect outside the camera domes. Ribbing increases the surface area to allow for a watertight seal with 3M's VHB adhesive tape.



Custom Flex Cable

Two 30-pin adapter boards allow for camera module mobility. Traces contain both differential pairs and I²C signals.



Power Board

This board includes the solar charge controller, DC-DC converter, and outputs to the battery.

System/Assembly Overview

The enclosure is designed for easy assembly in production though it contains many parts. An overview of major components and how they fit together is shown in the diagram below, *figure 2*.

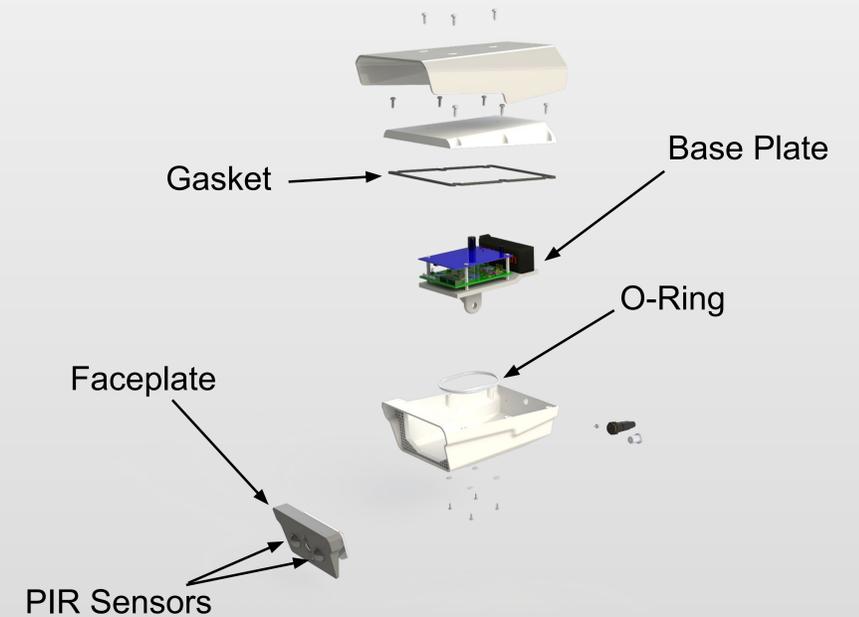


Figure 2 : Camera Assembly

Connectivity

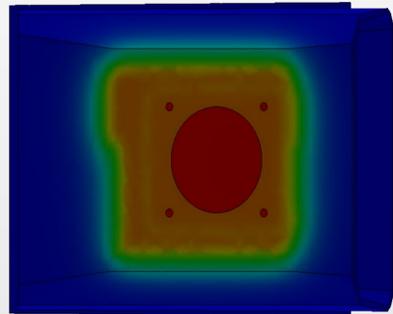


The Helios seamlessly connects to a Wi-Fi network, allowing for the user to view live video from the web or an Android phone.

Acknowledgements:

We would like to thank Marcel Tremblay, Kai Moncino, Sean Tauber, Jim Van Vorst from FLIR systems, as well as our UCSB faculty advisors and staff Tyler Susko, Ilan Ben-Yaacov, John Johnson, Steve Laguette, Andrew Hall, Ian Johnston, Roger Green

Thermal Testing/Simulations



One of the greatest dangers to the camera's internal electronics is overheating. To combat this, hand calculations, simulations, and physical tests were performed.

A picture of the initial testing apparatus is shown to the right. As is noted in the FLIR one thermal image, the temperature remains at 45.2C, which is well below the max temp ratings of the THOR Board and Lepton.



Design for Injection Molding

- Uniform wall thickness is maintained throughout the housing so that it can be injection molded from PC-ABS in production
- Injection molding allows the camera housing to be low cost
 - Ex: The "Design Curve" (figure 1) allows uniform wall thickness to be maintained while providing structural support for screw bosses

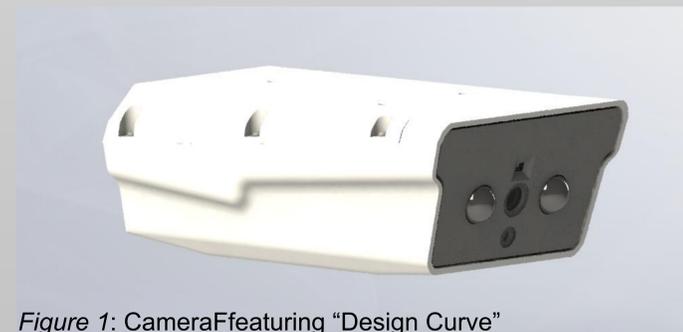


Figure 1: Camera featuring "Design Curve"

Waterproof Design & Testing

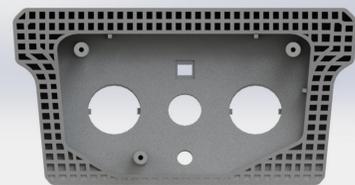


Figure 2



Figure 3

- Used maximum adhesive surface area on all seal surfaces, such as in the ribbing shown in figure 2
- Straight ledge design for gluing the gasket into the enclosure top (figure 3)
 - Allows gasket to be die cut with the top remaining injection moldable

MIPI Flex Cable

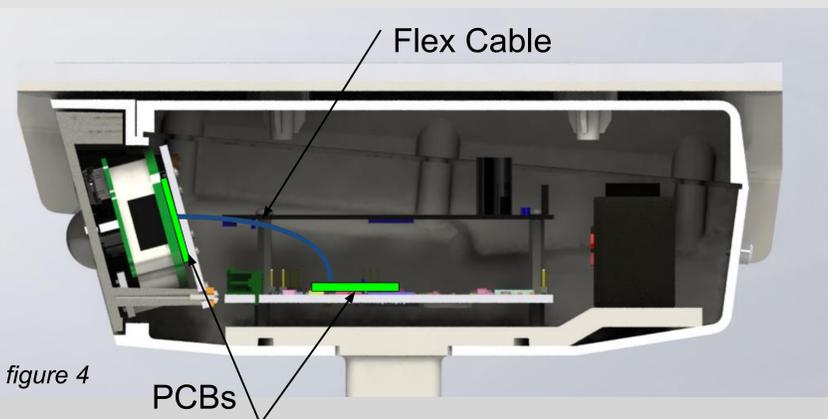
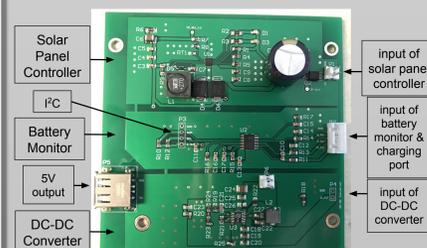


figure 4

Two boards were designed to support a MIPI flex cable interface between the THOR board and the two cameras (figure 4). This allows us to mount the camera in front, while heat-sinking the THOR board from below.

Solar Panel Controller



The solar panel controller is designed to take a 0–42V input voltage range and output a maximum 600mA current at a constant 12.6V

Thor Board

- FLIR-provided board responsible for onboard power management via MCU, sensor communication, and video encoding
- Powered by ARM Cortex A9 CPU and BusyBox OS
- SD card and Wi-Fi support
- Remote login with multiple devices via SSH, FTP, or web



Interrupt Controller

- The PIR sensor detects heat images within its FOV
- When a threat is detected, the MCU sets the interrupt GPIO pin high for the CPU
- Helios begins recording only upon active edge through an interrupt
- The recorder subroutine prunes the SD card filesystem and recording remains active while a threat is still present



Accessibility

- The Android app and website allow the user to view recorded and live video with a few clicks or taps
- Common Gateway Interface provides standard protocol for devices accessing the web server
- An alert message is sent from the Helios to the Android app upon recording
- Complete RTSP and VLC plugin support



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