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**

<table>
<thead>
<tr>
<th>Engineering Characteristic</th>
<th>Target Spec (Minimum requirement)</th>
<th>Target Spec (Ideal)</th>
<th>Design Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submerged in 1m Water</td>
<td>30 min</td>
<td>30 min</td>
<td>30+ min</td>
</tr>
<tr>
<td>Minimum Solar levels</td>
<td>2.9 hours/day</td>
<td>2 hour/day</td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-20 to +50 °C</td>
<td>-30 to +60 °C</td>
<td>Max +53°C</td>
</tr>
<tr>
<td>Weight</td>
<td>15 pounds</td>
<td>10 pounds</td>
<td>3.6 pounds</td>
</tr>
<tr>
<td>Connectivity</td>
<td>WiFi</td>
<td>Extended WiFi</td>
<td>WiFi (25m)</td>
</tr>
<tr>
<td>Battery Life</td>
<td>2.5 hours</td>
<td>10 hours</td>
<td>3.7</td>
</tr>
<tr>
<td>Price (in bulk)</td>
<td>$700</td>
<td>$200</td>
<td>$500</td>
</tr>
</tbody>
</table>

**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.

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

**Thermal Testing/Simulations**

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 45.2°C, 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”](image)

**Waterproof Design & Testing**

- 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

![Figure 2](image)

**MIPI Flex Cable**

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

![Solar Panel Controller Diagram](image)

**Acknowledgements:**

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

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**FLIR Helios**

Kate Anvick | Nicholas Besse | Michael Cosley | Madeline Dippel | Dane Frederick | Carlos Beltran | Salim Benhaddou

Garrison Carter | Aaron Chang | Ben May | Yiyue Ma | Xinwei Zhang | Weiyi Zhou

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**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

![Thor Board Image](image)

**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

![Interrupt Controller Image](image)

**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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**Figure 1**

Camera featuring “Design Curve”

**Figure 2**

**Figure 3**

**Figure 4**

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**A Brighter Security Solution for Peace of Mind**

**MIPI Flex Cable**

**PCBs**

**Solar Panel Controller**

**Interrupt Controller**

**Thor Board**

**Accessibility**

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![Waterproof Design & Testing Diagram](image)