Initial Design Review

Self-Powered Wireless Thermal Camera

UCSB FLIR Capstone Team
Product Description

What:
- Solar-powered security camera that is reliable, easy to install, and power efficient

Who:
- Homeowners, businesses, construction, ranchers

How:
- Record in both visual and thermal styles to allow 24/7 monitoring
- Wireless video stream to the web & phone
- Internal memory when needed.
Initial Specification

- Design for solar insolation levels in Seattle
- 100% Duty Cycle, 365 days a year
- IP67 Spec: Dust-tight, water immersion (up to 1m)
- Modular solar panel and radio antennae for maximum usage
- Multiple mounting options
- Combined visible and IR imaging
- Accurate image detection: recording important objects
Board Block Diagram

Red = Power
Blue = External
Yellow = Module
THOR Board (Bottom View)
Rough Sketch
Parts

Processor: Ambarella

- ARM Cortex A9 architecture, 28 nm process
- Core voltage: 1.1 V
- UART, I2C, SPI, USB, HDMI, I2S, NAND, 10/100 MAC, and more interfaces
- Linux SDK for development
  - Linux 3.8.x kernel with patches, drivers, tools, and more
  - Libraries for ISP, 3A, dewary, and codecs
Passive IR Sensor

Passive IR Sensor: Part # Parallax #555-28027 Rev. B

- Detect a person up to 30 ft away via heat levels emitted by surrounding objects
- Optional mounting for #2 sized screws
- Includes MCU and CPU wakeup control when PIR detects an object
- Source: 3.3 V DC, 3mA active
Parts

WiFi Module: Part # AMPAK AP6234

- Send video stream to connected hosts
- Integrated dual band (2.4GHz/5GHz) IEEE 802.11 a/b/g/n
- SDXC interface with processor
- Supports Bluetooth 4.0
- Module provides SDIO V2.0 Host interface for Wi-Fi
  - UART is provided for Bluetooth Host interface
Parts

SD Card Reader/Connector: Hirose DM3AT SF PEJM5

- Write to SD card when connection is unavailable or when not broadcasting
- SDXC Interface with the processor
  - Minimum Serial Speed 10MB/s
- 4-connection points of metal cover to PCB assures secure connection of ground circuit and provides EMI protection
- SDIO (Serial) spec: 3.3V at 220mA
Parts

Ambient Light Sensor: Part # ISL29102

- .3 lux to 10,000 lux range
- Temperature Range: -49 Celsius to +85 Celsius
- Close to human eye spectral response
- Good IR rejection
- 1.8V to 3.3 V supply Range

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin Name</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Supply (1.8V to 3.3V).</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No connect</td>
</tr>
<tr>
<td>4</td>
<td>REXT</td>
<td>Connected to an external resistor to GND setting the light-to-voltage scaling constant.</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>No connect</td>
</tr>
<tr>
<td>6</td>
<td>VOUT</td>
<td>Voltage Output.</td>
</tr>
<tr>
<td>-</td>
<td>PD</td>
<td>Thermal Pad. Thermal pad can be connected to GND or electrically isolated.</td>
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Illuminance

<table>
<thead>
<tr>
<th>Lux</th>
<th>Example</th>
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<tbody>
<tr>
<td>400 lux</td>
<td>Sunrise or sunset on a clear day.</td>
</tr>
<tr>
<td>1000 lux</td>
<td>Overcast day; typical TV studio lighting.</td>
</tr>
<tr>
<td>10000–25000 lux</td>
<td>Full daylight (not direct sun)</td>
</tr>
<tr>
<td>32000–100000 lux</td>
<td>Direct sunlight</td>
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</table>
Parts

Accelerometer: Part # MMA8652FC

- Motion Detection for portable power saving ("Auto-Sleep" and "Auto-Wake")
- 3-Axis, 12-bit, Digital Accelerometer
- I2C interface with programmable Interrupts
- 1.95V to 3.6 supply voltage
Parts

MIPI Interface: Flex Cable

- Cable length: 6-12 in
- Uses D-PHY to support application requirements
- 1.5 Gbps per lane
- Low-power, low noise generation, and high noise immunity
- Half-Duplex Protocol
- Works in conjunction with MIPI’s Camera Serial Interface - 2.
Parts

Visible Camera:

● 2.8mm
● 4MP Camera
● Full 1080p video recording capabilities
● Connection through MIPI interface (explained later)
Parts

Lepton Thermal Camera:

- Captures infrared radiation input and outputs a uniform thermal image
  - Used during low-light situations or favorable weather conditions (for thermal imaging)
- MIPI/SPI Video Interface
  - Export compliant frame rate (< 9 Hz)
  - Field of View: 50 deg
  - Image size: 80x60px
- Uses standard cell-phone-compatible power supplies:
  - 2.8V to sensor, 1.2V to digital core, and flexible IO from 2.5V to 3.1V
  - Low operating power, nominally 150 mW (< 160 mW over full temperature range)
Critical Elements

- THOR board + SDK Complexity
- Confining to Military Spec
- Overheating
- Power Management with the THOR Board
  - Solar Panel size, power draw without recharging
Product Development Team

- **CE Team (5)**
  - Ben May (leader), Garrison Carter, Aaron Chang, Carlos Beltran, Salim Benhaddou

- **EE Team (3)**
  - Weiyi Zhou (leader), Yiyue Ma, Xinwei Zhang

- **ME Team (5)**
  - Madeline Dippel (leader), Michael Cosley, Nick Besse, Kate Anvick, Dane Frederick

- **FLIR team**
  - Marcel Tremblay, Louis Tremblay, Kai Moncino, Rebecca Potter, Sean Tauber, Travis Frecker
CE Development Responsibilities

Ben May - Embedded Systems, S/W
Garrison Carter - Embedded Systems, Structural
Aaron Chang - Embedded Systems, Networking
Carlos Beltran - Embedded Systems, Power
Salim Benhaddou - Embedded Systems, S/W
## FLIR Team SubGroups

<table>
<thead>
<tr>
<th>Thermal</th>
<th>Structural</th>
<th>Power</th>
<th>Emb. Sys.</th>
<th>Software</th>
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<tbody>
<tr>
<td>Maddy</td>
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<tr>
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Carlos
Salim
Aaron
Questions?