REALWEAR: FLIR Lepton INFRARED CAMERA FOR HMT-1

STUDENTS: RICHARD BURBERRY, NICHOLAS MATHEWS, NATHAN MCCOWN

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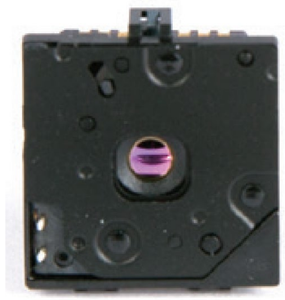
The HMT-1

- RealWear's premier industrial wearable headset
- Provides hands-free, voice-controlled navigation and adjustable LCD display
- Use Cases: Manufacturing, training, telehealth, hands-free/remote collaboration

FLIR Lepton 3.5

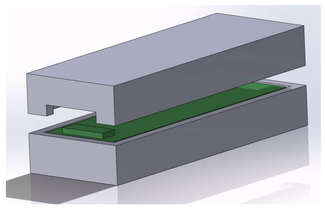


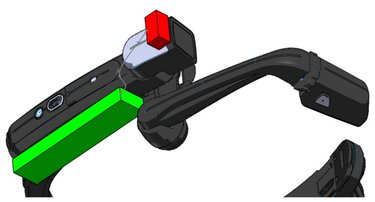
[2]

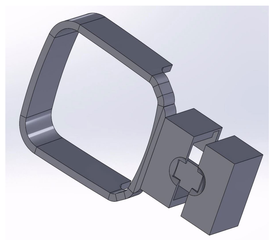
- Extremely small IR Camera with comparatively high-resolution output and performance
- Perfect for HMT-1 industrial application
- High resolution, micro thermal imaging camera
- Low power operation, nominally 150 mW

3D Design

- Used Solidworks to design both PCB housings
- Camera board mounted to existing HMT-1 camera interface to allow for rotation
- Flexible main board mounting options
- Had to maintain IP66 dust/water compliance
- Main board must fit in green volume below, camera board must fit in the red volume below

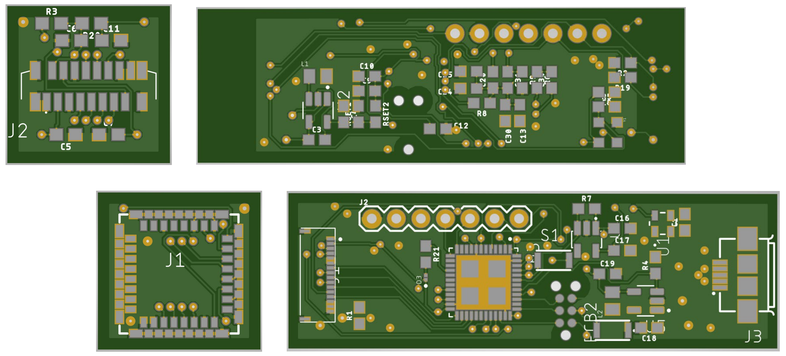






PCB Design

- Built out the footprints for pin attachment and created detailed part files in Eagle
- Designed schematic in Eagle using the parts we had created
- Created board layout, maintaining 6 mil trace separation, and with space saving in mind, working to keep dimensions within the areas on the headset we were given
- Separated the circuit into sub circuits based on schematic to streamline layout process
- Kept components with shared electrical nodes as close to each other as possible to both keep the design cleaner, minimize losses in longer routes, and minimize external noise
- Had to update certain parts that went out of manufacturing with comparable parts, ideally finding those with shared footprints
- Located and oriented connectors on boards with real-world application in mind
- Have large, easily probed test points for all the major signals/power rails on the board
- Split into main board and camera board, connected via a 16-pin ribbon cable

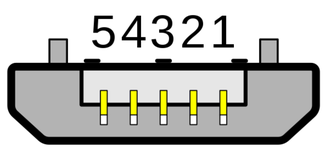


Micro-USB Connection

- Our PCB Design interfaced with the headset via a Micro-USB to Micro-USB connector
- Micro-USB cables don't have strictly recognized standards which for our project became a big issue
- Purchase of several different cables was necessary to examine the differences allowed us to debug the problem of our PCB not connecting to the HMT-1
- The main issue arose from the 5th pin present in Micro-USB cables called the ID PIN. Typically this pin grounded on one end and not connected to anything on the other to identify master and slave connections respectively. Much variation in the functionality of this pin causes significant issues

Pin	Name	Cable color	Description
1	VCC	Red	+5 VDC
2	D-	White	Data -
3	D+	Green	Data +
4	ID		Mode Detect
5	GND	Black	Ground

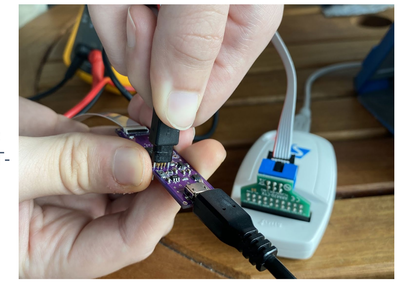
[1]



Micro-B [1]

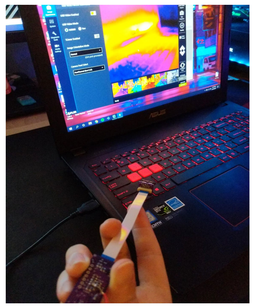
Firmware

- Utilized open source Firmware (FW), made available by PureThermal
- Flashed STM32F4, a powerful ARM Cortex-M MCU processor, via micro-USB connection, standard STM bootloader, and a bin file
- Pictured to the right, we are flashing using the JTAG connector that is on our board, via the ST-Link programming software
- Able to successfully change firmware versions over either USB or JTAG for versatility



Final Product

- We were able to meet all project expectations, including successful electrical design, flashing the FW, interfacing our board with the HMT-1, and 3D design/attachment of the boards.
- We were able to use the infrared camera identify varying heat signatures using the HMT-1



Future Work, References, and Acknowledgments

- Replace ribbon cable with more flexible, secure, and durable connection
- Shrink board down further
- Manufacture boards with updated ground connection
- More robust 3D design for main board attachment

Faculty: Tai Chen, Payman Arabshahi, Brandon Yee (TA)
Undergraduate Students: Richard Burberry, Nicholas Mathews, Nathan McCown
Industry Mentors: Alex Rodriguez

[1] *N/A*, Photos found on the W ikipedia Commons, Accessed on May 11th
[2] Photo: https://www.flir.com/globalassets/imported-assets/document/lepton-3-3.5-datasheet.pdf

ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY of WASHINGTON

ADVISORS: Alex Rodriguez, Tai Chen, Payman Arabshahi

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