Thermal Imaging Detection System for Security

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Background

SECURITY is always the first priority for everybody. Soldiers in the battlefield are in potential danger of enemies behind them, and their security would be protected if they knew that enemies were behind him; bicyclists are also in potential danger of incoming cars from behind, and their security would be protected if they could know when a car is approaching from behind. FLIR OWLIR was developed to address these issues using a system with an infrared camera to enhance security.

Overview

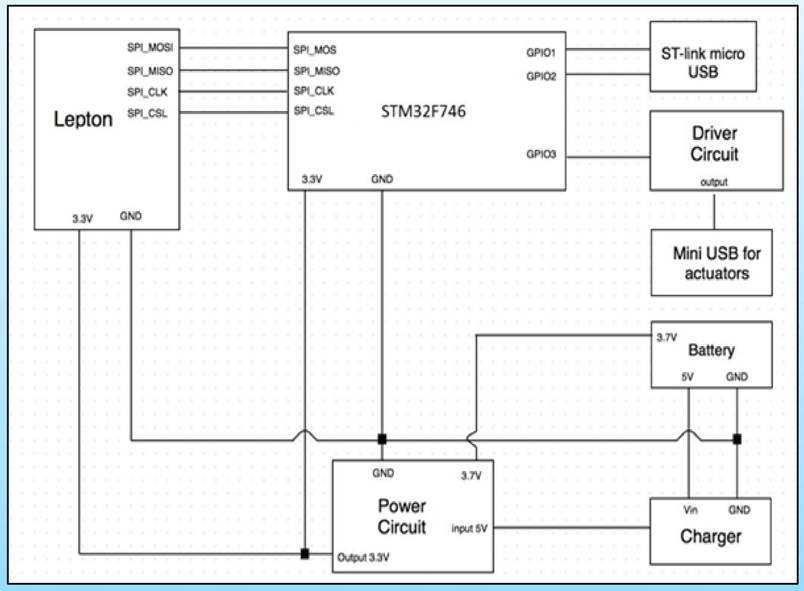
FLIR OWLIR is a water resistant and shock resistant wearable device that uses infrared cameras to detect designated objects or humans and notify the users through various actuators. FLIR OWLIR consists of two parts: main housing and actuator housing.

Features:

- Detection of objects or humans using infrared
- Alarm users with actuators
- Wide variety of actuator choices such as LEDs, vibration motors, and jawbone speakers
- Small, Compact and wearable device
- Long battery life
- Two housing system

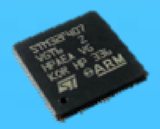
Our main housing and actuator housing.

Hardware Block Diagram



Hardware Component

FLIR Lepton Thermal Camera
- World's smallest and long wave infrared camera
- Resolution 80x60 pixels

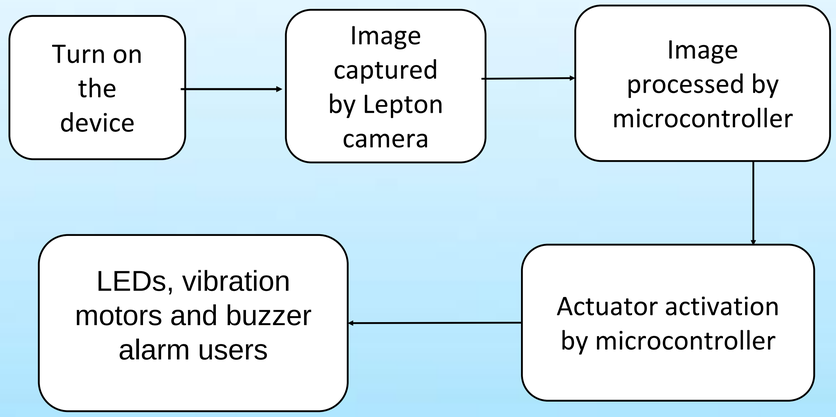


STM32F746 Microcontroller
- Communicates with Lepton using I2C and SPI
- 100MHz CPU is capable for completion of task

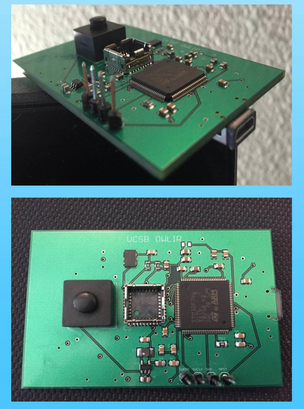
Rechargeable Lithium Battery
- Capacity of 2000 mhA
- Support the system to work for 12 hours

Battery Charge
- Capable with a small size
- Easy to use with a USB cable

Functional Flow Chart



PCB and Schematic



PCB Board dimensions: 2.72 x 1.77 in

Future Improvements

- Develop a more advanced algorithm which can detect all human shapes
- Integrate a temperature sensor into the system which can measure the outside temperature making the detection more accurate
- Develop wireless connectivity that there will be no need to use a USB cable to connect actuators with the system

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FLIR Haptic Vision: A Screenless Infrared Camera System

Andrew Wong, Andrew Smith, Charles McIntosh, Jackson Christoffersen, Richard Behiel

Abstract

Traditionally, thermal cameras rely on a screen to output visual information to the user. However, there exist scenarios in which a screen may not be desirable or accessible, but in which infrared information may still be useful. FLIR Haptic Vision is an experimental thermal camera system which utilizes haptic actuators instead of a screen. It is designed to test a broad range of potential screenless infrared camera applications.

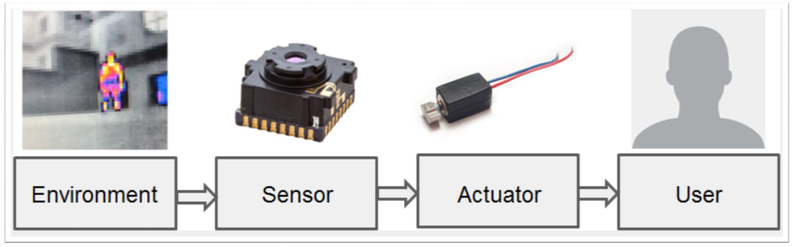

Figure 1. Overview of Haptic Vision's operation.

Materials

2.5-mm thick ABS plastic walls give the sensor and actuators a strong, shockproof exterior. Inside the sensor, Poron foam secures the battery and camera in place, and prevents unwanted dislocation in the event of an accidental drop.

Waterproofing is achieved with the use of a BISCO 1280 solid silicone gasket which lines the perimeter of each component, and a ring of glue which surrounds the camera window. Additionally, silicone button covers and a rubber O-ring around the Micro-USB ports provide waterproof electronic functionality.

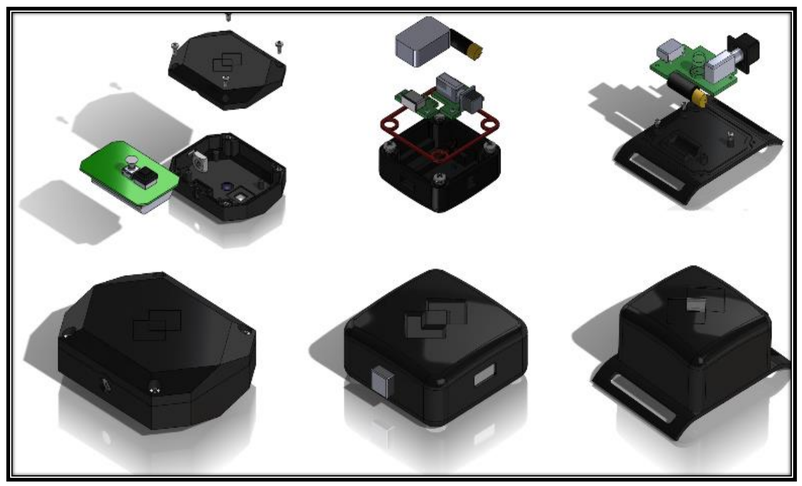

Figure 2. Sensor (left), helmet actuator (center), and wrist actuator (right) renderings and exploded views.

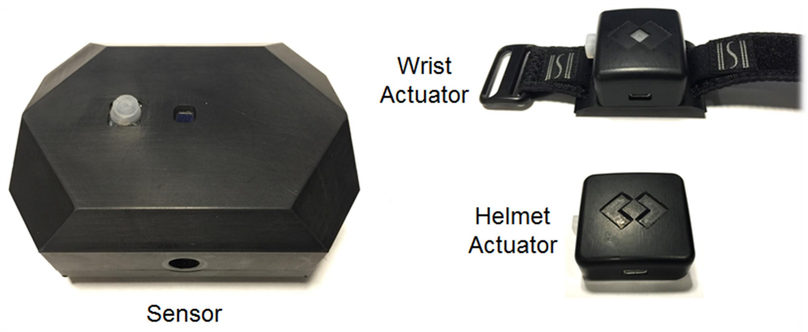

Figure 3. Haptic Vision system prototype.

Design Development

To operate durably and reliably, Haptic Vision must withstand expected environmental conditions and accidents. The three main risks in this area are overheating, exposure to water, and the possibility of being dropped from a height of two meters.

These risks, as well as factors such as manufacturability and versatility of mounting configuration, were taken into consideration throughout the design process. The final result is a Haptic Vision system which satisfies the risk requirements, is suitable for high-volume injection molding, and is compatible with any standard ¼-20 camera mount.

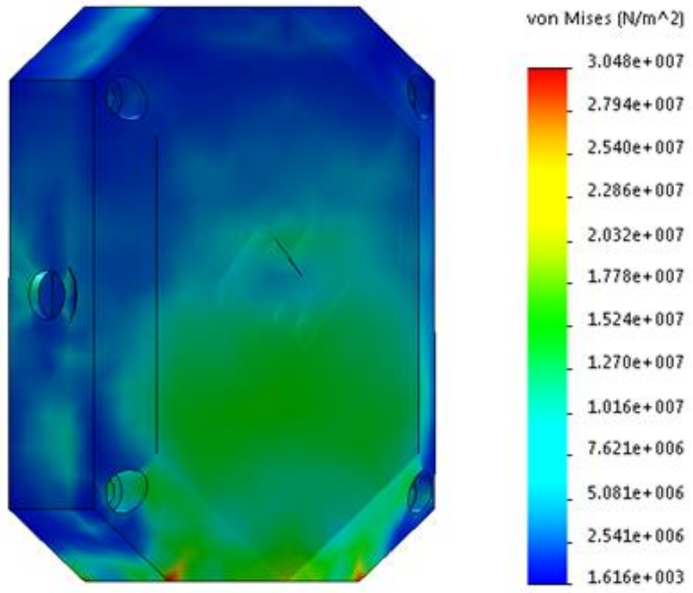

Figure 4. SolidWorks simulation of dropped sensor housing

Testing Methods

A COMSOL thermal model was created, and validated by an experiment to within 2 °C, to show that the Lepton camera would not exceed its maximum operating temperature in any realistic scenario. A 1-m, 30-min waterproof test showed that the device meets the IP-67 standard[1]. Additionally, a series of three 2-m drop tests demonstrated the durability of the sensor.

Figure 5: Sensor helmet mounting system.

Results

The Haptic Vision prototype has passed waterproof, thermal, and drop tests in accordance with the design requirements. These results provide confidence that the housings designed for each component of the system will perform as required under real-world conditions, and will be able to adequately protect the internal electronics. Full device functionality will be tested in the near future, once the working electronic components are manufactured.

Acknowledgments

FLIR (Marcel Tremblay, et. al.), Pr. Tyler Susko, Pr. Steve Laguette, Pr. Dave Bothman, Dr. Trevor Marks

References

[1] ***Straßenfahrzeuge; IP-Schutzarten; Schutz gegen Fremdkörper, Wasser und Berühren; Elektrische Ausrüstung [Road vehicles; degrees of protection (IP-code); protection against foreign objects, water and impact; electrical equipment], May 1993.***