F.I.R.E (Ferguson Intervention Recording Equipment)

Jacquelyn Ingemi (EE)

Brian Gleadle (CSE)

Andrew Kelley (EE)

Shane Ryan (EE)

Advisors: Prof. Burleson and Prof. Holcomb

System Overview

Original Ideas:

-Vehicle data repository
-BlueTooth data transmission between local memory unit and camera
-All-in-one unit (camera and local memory unit)
-Proximity capacitive touch sensors
-Eyeglasses mounted
-4G capability / live-streaming

Final Design:

Chest mounted camera and microphone with belt mounted Local Memory Unit and NFC sensor array, all powered by battery

Main Accomplishments:

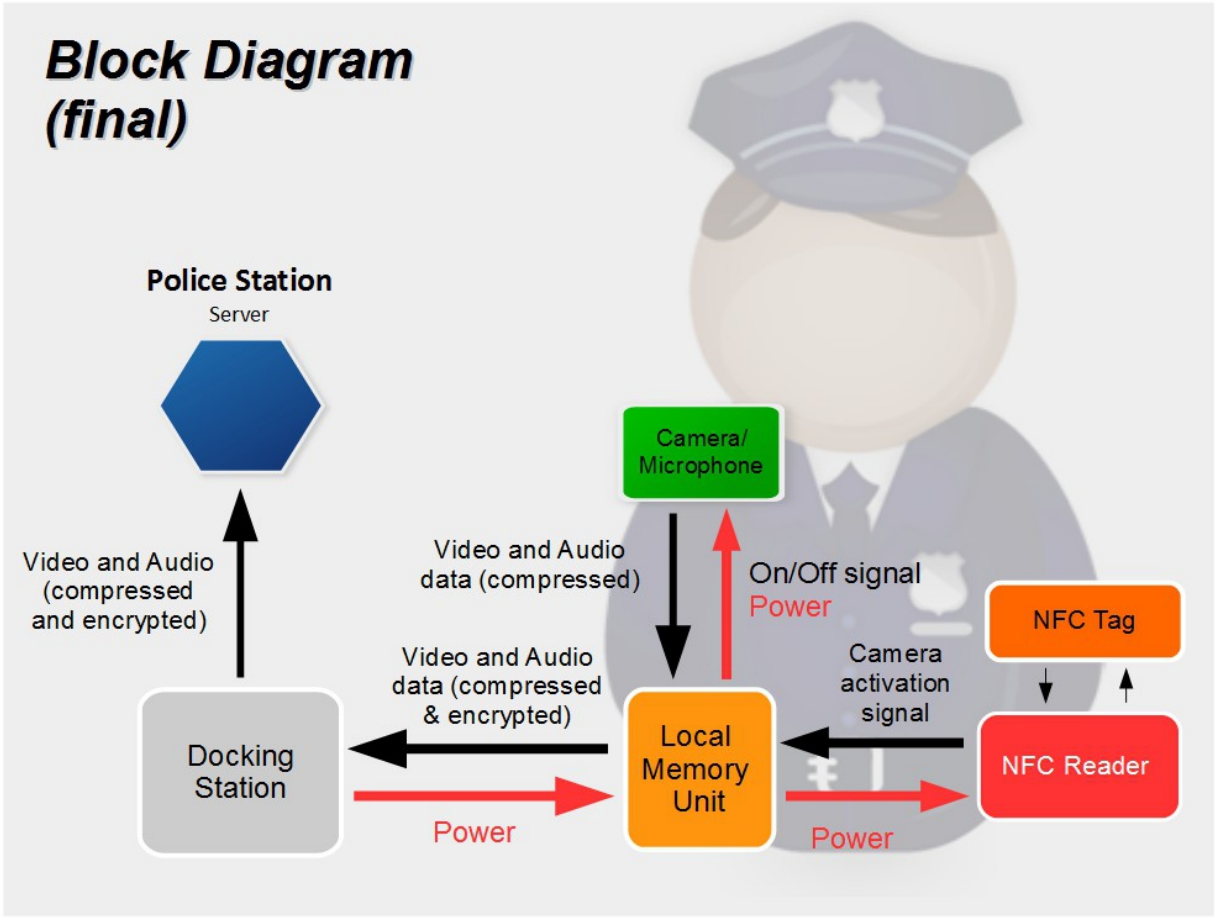
1.Simply, easy to use
2.Small, lightweight, and functional
3.Given that many breakout boards were used, our design shows that an even smaller and more efficient system could be developed

Overall System Functionality

Final Requirements Met:

- **Video/audio compressed to record 2.2GB/Hour**
- **Real time clock**
- **Push-button camera activation**
- **AES encryption implemented**
- **NFC reader for camera activation**
- **Independent activation of camera and mic**
- **Pre-record of two minutes**
- **GPS**

Final Block Diagram



Overview – Camera/Mic Unit

Parts:

- **Logitech C270 webcam w/mic**
- **USB connection instead of ribbon cable with BBB Camera Cape**
- **Auto-light correction, noise-cancellation and improved gain**

Function/Connections:

- **Both power and data flow are controlled via USB connection to BBB**
- **Current software version activates both video and audio upon device trigger**

Logitech C270 webcam in 3-D printed enclosure

Overview – 3D Printing

- Autodesk Inventor 2015 (free trial version)
  - CAD software to develop enclosure models
  - Created .stl files (STereoLithography or Standard Tessellation Language)
- Uprint SE Plus 3D printer in M5
- About 3 drafts per enclosure before finished product
- Problems mostly involved in attaining accurate locations for enclosure ports
- Changing dimensions of models in Inventor also non-intuitive
- NOTE: 3D printed material not ideal
  - Plastic too brittle; metal enclosure for LMU more realistic
  - Need for waterproofing not considered

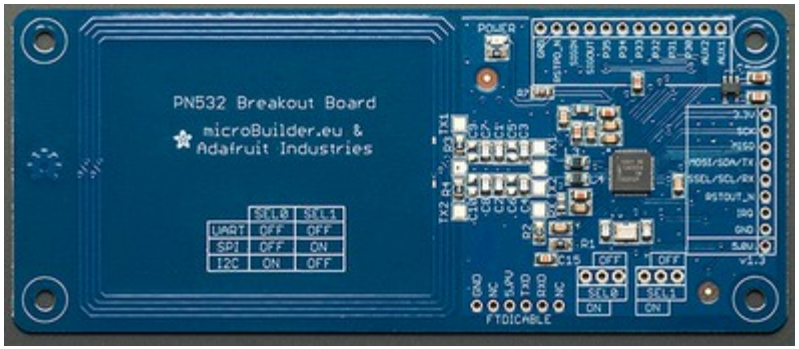
Overview – NFC Sensor Array

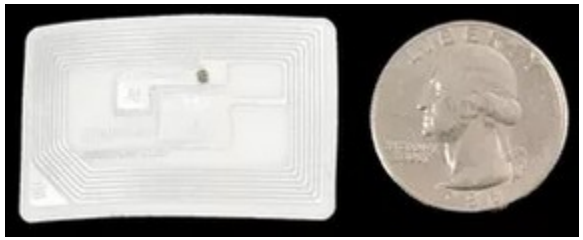
Design:

- **NFC evaluation board has been replaced with Adafruit's PM 532 Breakout Board.**
- **Made to work with Beaglebone Black**

Function:

- **Detects when tag is removed from field and turns camera with audio on**
- **Tags have been affixed to handcuffs**





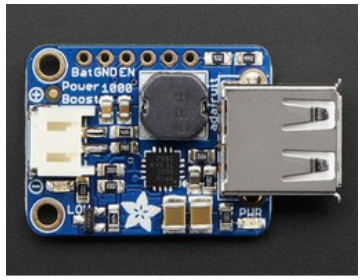
Overview – Local Memory Unit (LMU)

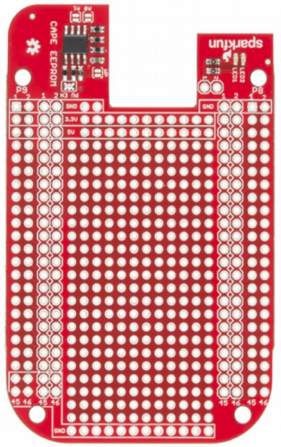
Parts:

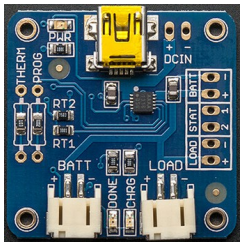
- **Proto-cape with EEPROM**
- **Polymer Lithium battery (3.7V at 2000mAh)**
- **USB LiIon/LiPoly charger - v1.2**
- **PowerBoost 1000 Basic - 5V USB**
- **GPS Chip**

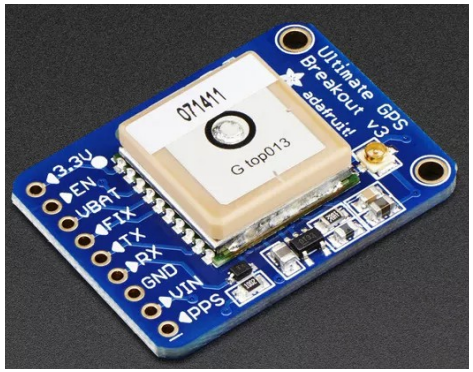
Function/Connections:

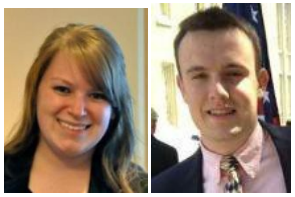
- **LMU receives weapon pull signal via GPIO pins in proto-cape**
- **Activates recording via USB connection to camera/mic**
- **Compresses and stores data into EEPROM with timestamp and GPS information**





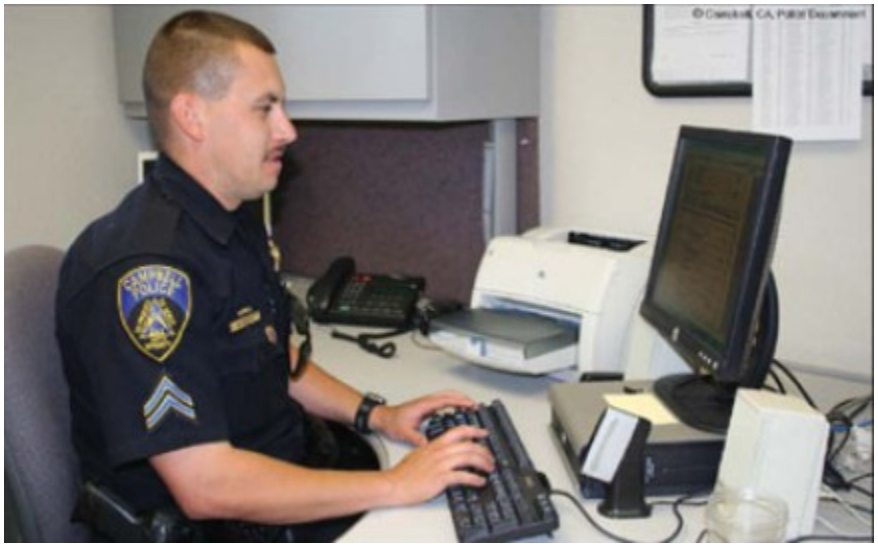






Security Overview

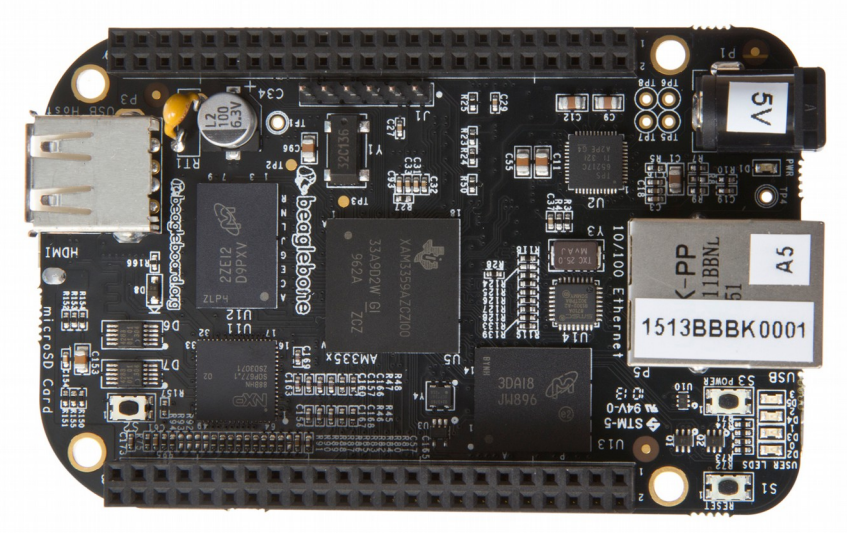
-Data is encrypted using AES encryption algorithm
-Key is generated which can be assigned to person who wishes to access recordings
-There are multiple use scenarios for the key management
-The most likely scenario would involve the keys being held by ranking officers or head IT personnel
-Thus, the key management system can fit any department ranging from large (PDNY) to small (any town around Amherst area)



Overview – Software Component

Parts/Design:
- BeagleBone Black
- (1 GHz, 512 MB DDR3L & 4GB eMMC Flash)

Software Implementations:
- Built on Angstrom distribution of Linux
- Automatic activation built with Python
- Recording with FFMpeg
- GPS communicating over UART
- NFC communicating over I2C



Encodings:
- Video: MJPEG
- Audio: AC3_Fixed
- GPS: NMEA

Libraries Used:
- LibNFC, Adafruit_BBIO, PySerial, PyCrypto