Project Sauron
Preliminary Design Review

Senior Design Project
Fall 2015
Meet The Team

Advisor: Tilman Wolf

Zach Goodman
EE

Walter Brown
CSE & CS

Omid Meh
CSE & EE

Jose LaSalle
EE

SDP15: Project Sauron
Goal

Develop a real-time recording system to localize and track targets in a noisy environment and output clear audio and video.
Current Solutions?

Video Surveillance

• Non-Directional Noisy Audio
• Data intensive

Phone Tapping

• Need to breach carrier network
• No/Minimal visual

Directional Microphone

• Track one at a time
• No visual
Our Solution: Sauron

- Input video feed
- Arbitrarily distributed mics
  - Requires calibration
- Target tracking and AV recording
- Parallel recording of multiple targets
- Speech to text
Who cares

- Government
  - Homeland security
  - Law Enforcement
  - Forensics
- Corporate
  - Facility security
- Residential areas
System Requirements

• Operate within human voice frequency spectrum
  • 80Hz - 3kHz (Necessitates 6kHz sampling frequency)

• Adapt to arbitrary Microphone Distribution
  • Microphone Distribution must operate in the Gunness Student Center

• Real-time
  • Video (30 frames per second)
  • Position updates (12 updates per second)
  • Video, audio, and transcript must be accurate within 5 seconds.

• Accurate
  • Visually flag target within a meter
  • Must be able to isolate audio within a cubic foot
System Overview

Multi Channel Audio Feed
Video Feed
Data Retrieval for Post Processing
Data Saving
Target Selection
Real-time Results

Multi Channel Audio Feed
Video Feed
Processor Algorithm

1. User selects target from video input
2. Obtain visual description of target
3. Repeat:
   1. Find region in video where target could be
   2. Map visual coordinates to delay differences
   3. Find loudest human voice near delay differences
   4. Isolate sound source and highlight the detected target
   5. Audio to Text
Risks vs. Payoffs

Risk:

Unethical applications
Limited audio and video coverage
Hard to conceal

Payoff:

Easy identification of individuals for user
Arbitrary setup
## Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>8</td>
<td>$30</td>
<td>$240</td>
</tr>
<tr>
<td>Audio Amplifier</td>
<td>8</td>
<td>$5</td>
<td>$40</td>
</tr>
<tr>
<td>8-channel Receiver (ADC)</td>
<td>1</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Digital Fish-Eye Camera</td>
<td>1</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Computer</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Software (Matlab, Labview)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$480</strong></td>
</tr>
</tbody>
</table>
MDR Deliverables

- Reproduce Acoustic Beamformer Functionality
  - Establish Hardware Setup
    - Microphone to ADC
  - Establish Interface
    - Microphone Input into MATLAB
    - Be able to analyze 8 channels in MATLAB
- Development of real-time software framework
- Video input into MATLAB