Initial Project Documentation

PROJECT MINUTEMAN

A network of audio sensors capable of detecting gunshots in a building.

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GROUP 4

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Project Narrative

For years, our country has witnessed massacres committed by mass shooters at various locations including workplaces and schools. The public response to these events have varied, but have almost always been the same. Gun control activists call for more legislation, forcing pro-gun groups to scramble to defend against these legislation attempts. Whatever your stance on that issue, it's clear that after all this time, it is very unlikely we are going to find effective legislation that we will all agree with. A technological solution to this problem is necessary, not just because all groups can agree on it, but because it can reliably respond to these events and save lives regardless of legislation issues.

Our society has advanced to a stage that technological solutions to difficult problems are becoming reality almost every day. Already several solutions have been revealed such as door blocking systems (http://www.schoolkidshealthcareblog.com/2015/introducing-the-barracuda-intruder-defense-system.html), inflatable slides allowing occupants on the upper floor of a building to escape (https://slidetosafety.com/), and more. These solutions are not divisive, inexpensive, and are signs that the market is capable and willing to create more technological solutions to this issue in the future.

This project will aim to fulfill two primary goals. The first goal is to provide a solution that can provide rapid but accurate detection of a firearm discharge within a building. Then respond by informing authorities and building security and providing details as to the location of the shooter. The second goal is to provide a network environment that can connect with other solutions for coordination in responding to the detected threat. It is the hope of this project that it will become a starting point that will enable other technological solutions to the threat of mass shooters.

This project was inspired by a previous Senior Design project called GLASS (http://www.eecs.ucf.edu/seniordesign/fa2013sp2014/g03/index.html) which was an outdoor audio detection system that could accurately pick up the sound of a gunshot, discern the type of firearm used, triangulate the location of the gunshot, and then report that information to authorities. Additionally, there are current products on the marketplace that offer similar services to our project, such as ShotSpotter (https://www.shotspotter.com) which offers a range of products, including a Campus Security item.

Project Description

The features of our project are to create an audio sensor system that can be installed indoors. This system is to accurately detect gunfire discharges, being able to discern them from other distractions such as engine backfires or glass breaking. It is to be able to discern the general location of the gunfire within the building. Then it is to inform the authorities. It is also to provide a network from which other security devices can connect to and utilize.

This system in its basic form will be affordable for most facilities such as schools, public buildings, or places of large public gatherings. Although this is not the primary intention of the project, the devices will also be available for home security or other private facilities looking for security as well. This system will have a lot of potential for expansion, either through additional technologies created by this design team or by third-parties wanting to make a difference.

Requirements

The project will fulfill the following requirements:

- At least two separate multi-directional audio sensors to detect events that could include a gunshot. Connected to the building's power supply.
- A central hub with FPGA to connect the sensors and analyze events. Connected to building's power supply or to host computer.
- A program/app that can be downloaded to a host computer to manage a network of devices and receive alerts from the hub device.

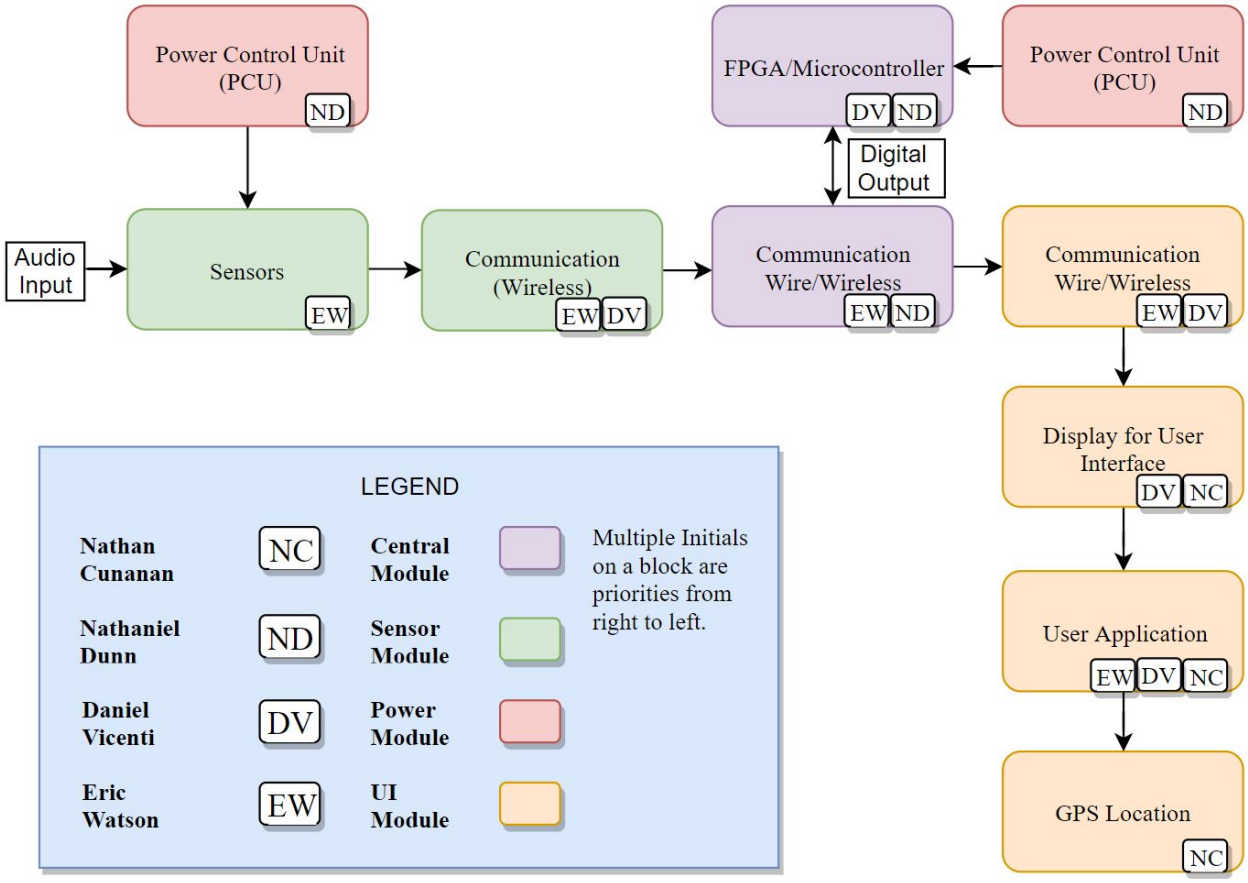
Specifications

The project will fulfill the following specifications:

- The sensors are connected to the central hub, which is connected to the host computer program.
- The sensors send events of a certain decibel range to the hub for analysis.
- The hub analyzes the event and confirms if it is a firearm discharge. It does this by filtering out noises by searching for a specific pulse signature in the event.
    - Can discern the firearm type through machine learning and by utilizing a database of audio samples.
- The hub triangulates the general location of the gunshot from sensor data of the event between multiple sensors.
- The hub sends out an alert to host computer.
- The program contacts authorities, building security, and other individuals inside the building.
- The program provides data to other devices connected to the network through the program.

- The program provides an administrator/staff member with the ability to cancel an alert/call a false alarm.

Block Diagram



The diagram above shows the modules and division of tasks given to each individual member of the group. The blocks were made by looking at the objectives and requirements of the project. Each module represents a necessary function of the system. In each block there is a function description and an abbreviation of initials. This divulges each group members' tasks for the project and the level of priority they have in that area. The priority is given from right to left.

Project Budget and Financing

Material/Part	Quantity	Price	Total
Microphone	3	$2	$6
Circuit Board	2	$90	$180
Network Adapter	1	$15	$15
Wifi Module	3	$10	$30
USB port	2	$2	$4
Power Supply	4	$20	$80
FPGA	2	$100	$200
		Total	$515

This is our minor look into the budget and financing for our project. This budget will change as the project gets more dense and more as we go further along the journey of making this project. We hope to have a targeted budget of $1000 or less by the time we have to purchase the parts.

Project Milestones

Milestone	Time Duration	
Task	**Start**	**End**
Research	1/10/2019	2/15/2019
Group Formed	1/10/2019	1/10/2019
Divide and Conquer	1/10/2019	1/30/2019
Task Division	1/10/2019	2/1/2019
Project Meeting	2/7/2019	
Update Divide and Conquer	1/31/2019	2/13/2019
FPGA/Microcotroller	1/21/2019	2/15/2019
Power	2/1/2019	2/15/2019
Communication	2/1/2019	2/15/2019
Sensor	2/1/2019	2/15/2019
Application	2/1/2019	2/15/2019
GPS	2/1/2019	2/15/2019
Software-Hardware Integration	2/1/2019	2/15/2019
First Draft Senior Design	2/15/2019	3/27/2019
Design	2/15/2019	4/20/2019
FPGA/Microcotroller	2/15/2019	4/10/2019
Power	2/15/2019	4/10/2019
Communication	2/15/2019	4/10/2019
Sensor	2/15/2019	4/10/2019
Application	2/15/2019	4/10/2019
GPS	2/15/2019	4/10/2019
Second Draft Senior Design	3/29/2019	4/10/2019
First Design Revise	4/10/2019	4/15/2019
Second/Final Design Revise	4/15/2019	4/20/2019
Final Draft Senior Design	4/12/2019	4/20/2019
Verification/Implementation	4/25/2019	TBD
FPGA/Microcotroller	4/25/2019	TBD
Power	4/25/2019	TBD
Communication	4/25/2019	TBD
Sensor	4/25/2019	TBD
Application	4/25/2019	TBD
GPS	4/25/2019	TBD
First Test Revision	5/20/2019	5/30/2019
Second/Final Test Revision	5/30/2019	6/30/2019
Final Project Presentation	TBD	

Decision Matrix

The project was decided through meetings that took place after class and at certain meeting times. After the first three meetings we created a priority project list shown below. We weighted our individual desires and what resources the project would cost. We ranked what we wanted with one being the best and 5 being the worst. The score is added up in the Decision Matrix below in the Group Ranked tab. After this each project was analyzed with how much time it would consume. The cost of the project and capacity of knowledge that we would want to expand:

Project Idea	Nathan	Nathaniel	Daniel	Eric	Added Lowest Score	Group Ranked
Master/Slave RC Car	3	4	2	4	13	3
Warning Bracelet	2	1	3	2	8	2
Gunshot Detection	1	2	1	1	5	1
Laser Guided Drone	4	3	4	3	14	4
Mini Surveillance	5	5	5	5	20	5

Time	Cost	Knowledge	Resource Cost	Total	Total Rank	
3	3	4	10	23	3	
1	2	3	6	14	2	
2	1	2	5	10	1	
5	4	1	10	24	4	
4	5	5	14	34	5	

The ranking show with the Group Ranked and the Total that the Gunshot Detection project was the best option for our group. This project was taken well by all members in our group with the desire to help each other in time of need. This project will not only cost the least but it will also help expand the knowledge of the group.