Final Project Review (FPR)

Neptune

Team 16
April 12, 2016

Team 16 Introduction

Frankie Viscusi
EE ’16 - Team Manager
Power System &
Floodlight Relay

Hang Do
EE ’16
Alarm & Power System

Scott Powell
EE ’16
Camera & Audio Analysis

Faculty Advisor: **Daniel Holcomb**

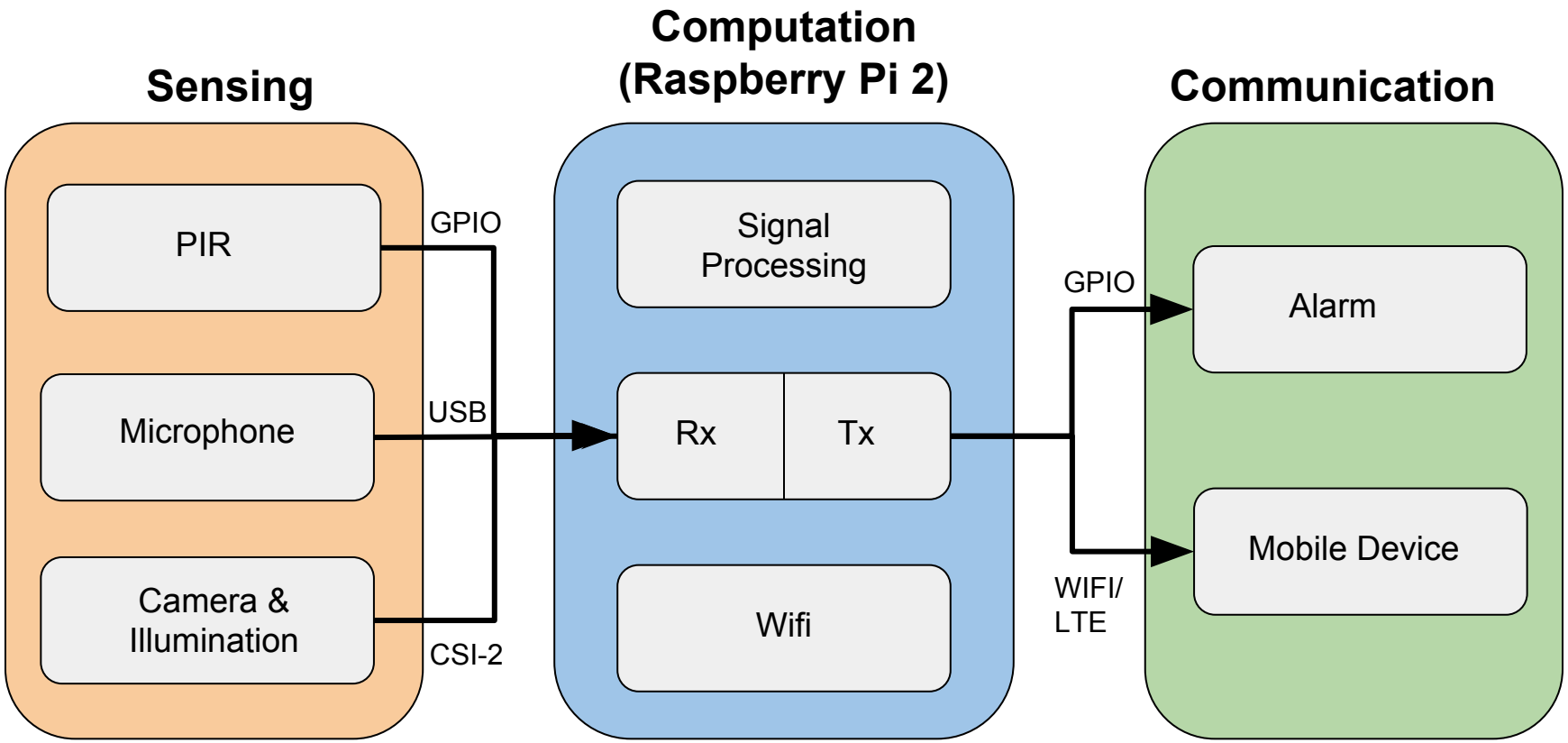
What is Neptune?

Frankie

- Drowning Prevention and Pool Security System
- Uses a PIR sensor to detect human movement in combination with audio analysis to detect splashes
- Alerts those nearby with audible alarm located poolside
- Contacts the person in charge via MMS picture message

Block Diagram - Neptune

Frankie



Promised FPR Deliverables

Scott

- ✓ Design and implement PCB/Protoboard for Neptune system
- ✓ Refine tone of audible alarm
- ✓ Incorporate floodlight/relay to be triggered upon picture capture to handle night-time disturbances
- ✓ Fabricate enclosure for the Neptune system
- ✓ Test system in a real pool environment
- ❑ Implement Simulink on the Raspberry Pi for audio analysis

Specifications

Scott

Specification	Goal	Actual
PIR Sensing Range	10.25ft. 120° view	One PIR covers Inflatable children's pool (60 x 60 x 13 in)
Weight	< 3lbs	5lbs
Power consumption (DC)	< 50 W	36 W
Alarm Decibel Level	> 30 decibels	80 decibels
Weatherproof	Watertight	Sheltered
MMS Message Sent Time	< 1 minute	< 1 minute
Alarm/Floodlight Response Time	Immediately upon splash detection	Immediately upon splash detection

Kiddie Pool

Scott

- Water depth: 10.4 inches
- Dimensions (Width x Length x Height): 60x60x13 inches

Machine Learning- Sound Classification

Scott

- During CDR, we promised to incorporate a form of machine learning to improve the effectiveness and reliability of audio analysis
- We planned on accomplishing this via Matlab/Simulink with MIR toolbox
- Discovered python audio analysis and machine learning library PyAudioAnalysis, which we believe to be better and easier to integrate
- Will utilize this to classify sound segments between “splash” and “non-splash”

Machine Learning- PyAudioAnalysis

Scott

- "Python library covering a wide range of audio analysis tasks, including: feature extraction, classification, segmentation and visualization"[1]
- Advantages:
  - Library is publicly available requiring no subscription
  - Integrates very well with the python software already present on Pi
  - Can be trained on a pool environment

[1] https://github.com/tyiannak/pyAudioAnalysis/wiki

Machine Learning- PyAudioAnalysis

Scott

- We collected samples based on an inflatable children's pool and a bucket filled with water
- We recorded several .wav files of "splash" and "non-splash" sounds and placed them into separate folders
- Using this data, PyAudioAnalysis aids us in training a classifier through its feature extraction capabilities and machine learning algorithms
- Our system will continuously record audio segments, and classify each into the appropriate category

What is not working?

Scott

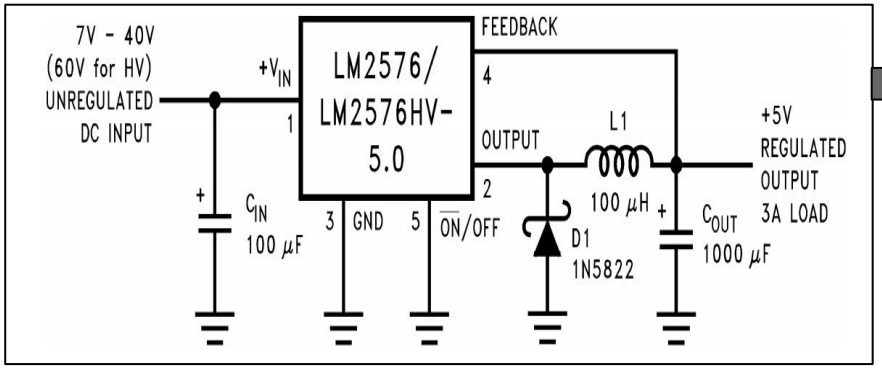
- Splash Classification (false positive readings)
- MMS Messaging Hiccups occasionally
  - Worked perfectly until a few days ago, maybe an update on GMail to the amount of messages sent in a short amount of time. To be investigated

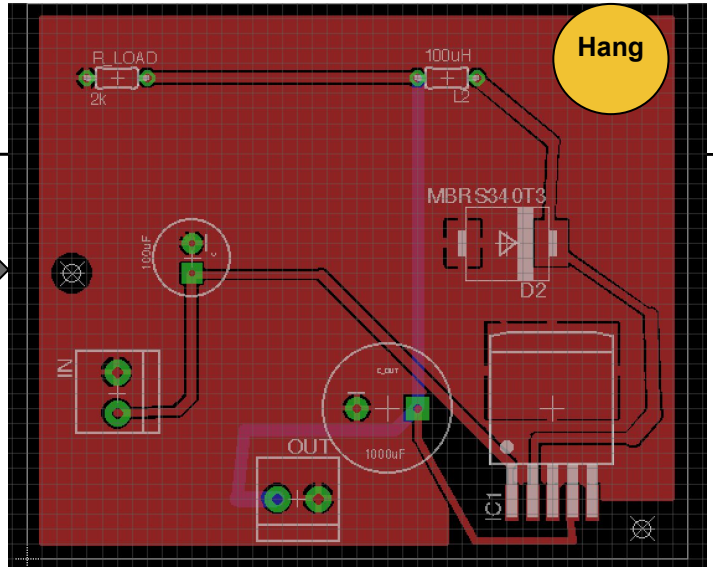
What is working?

Scott

- PIR Sensor- detect heat signatures around pool
- Picture message via WI-FI to cell phone
- Temperature check
- GUI to configure phone number and location
- Alarm (loud and appropriate tone)
- Splash detection (detects true positives)
- Floodlight illumination

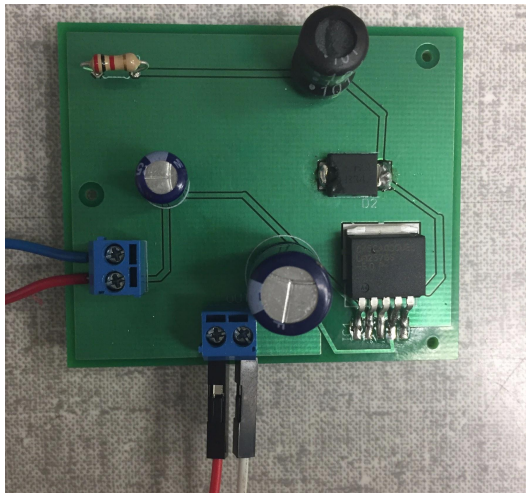
PCB Design - Voltage Regulator





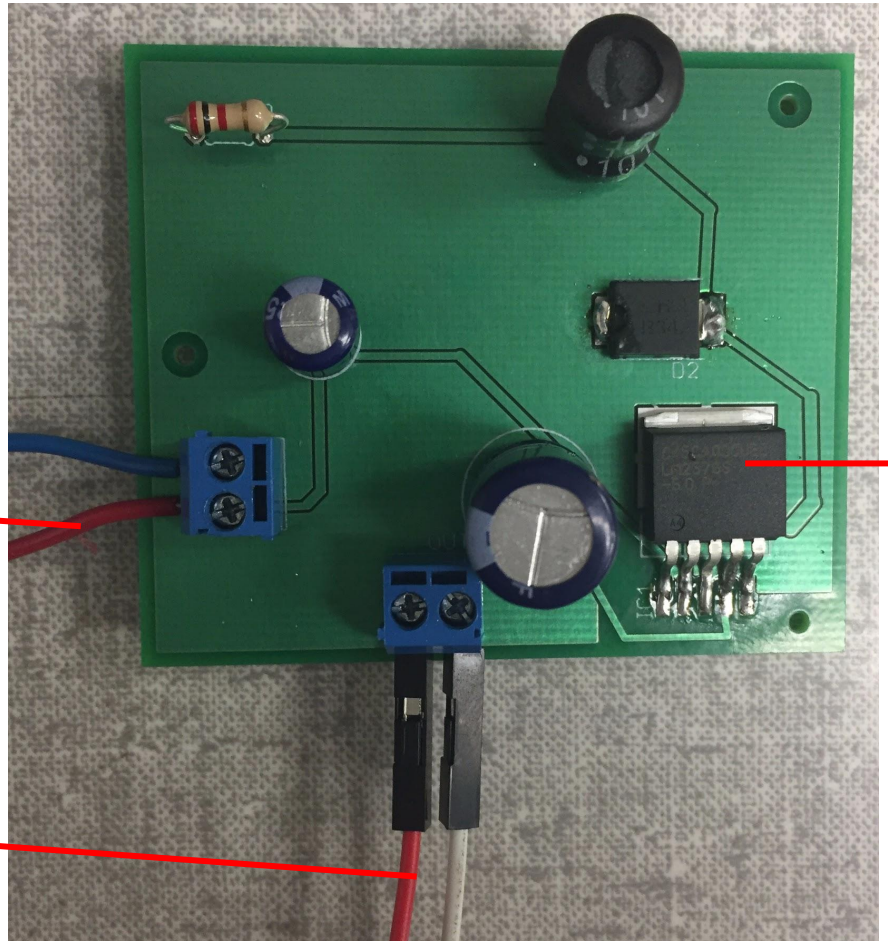
LM2576 Voltage Regulator PCB Board

- LM2576 3A Step-Down Voltage Regulator
- Ordered from Sunstone for $64/board



PCB Results

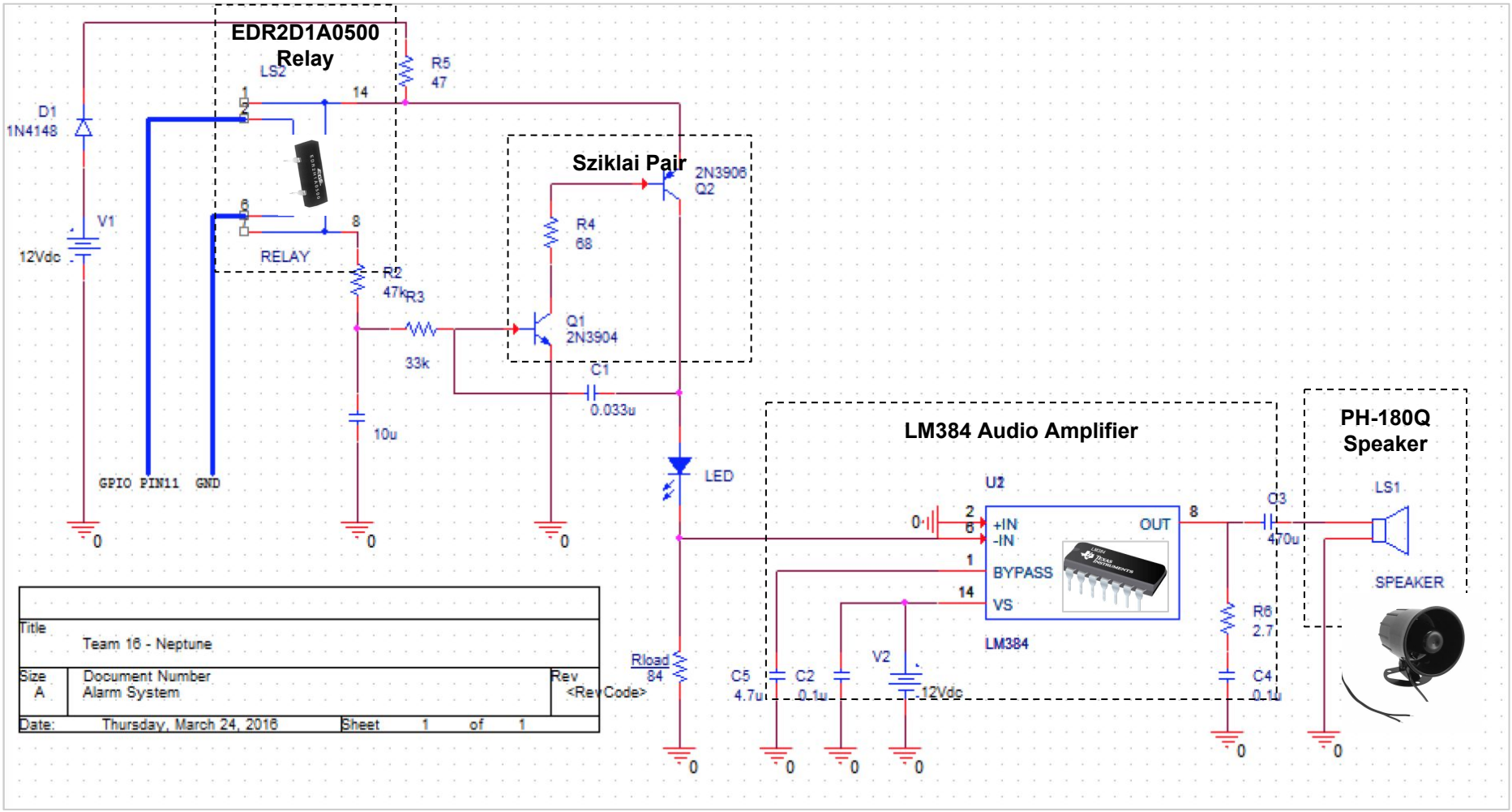
Hang



LM2576 Voltage Regulator

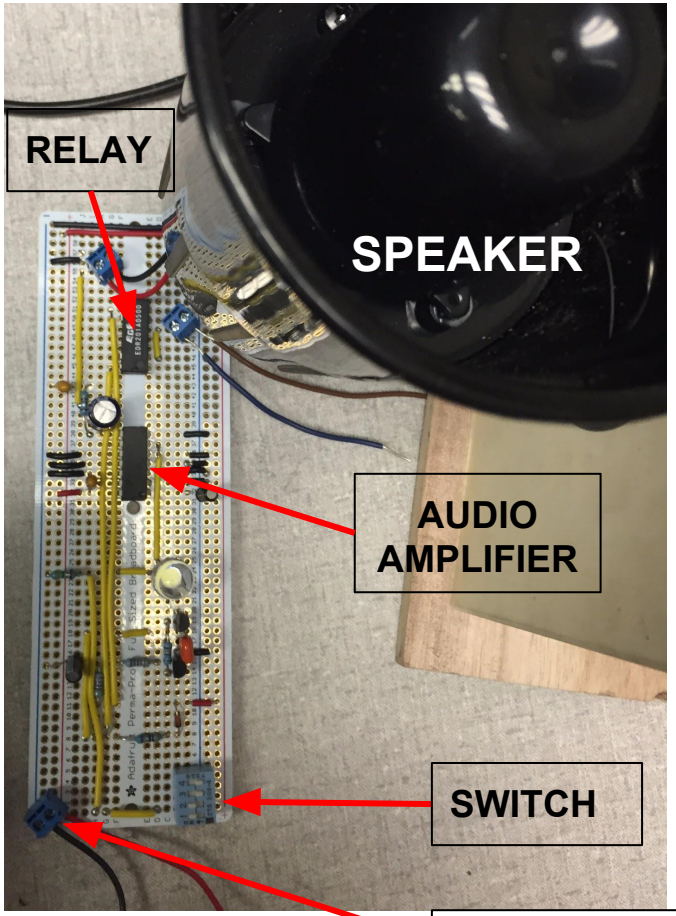
AD/DC Adapter and LM2576 Voltage Regulator Results shown in Digital Multimeter

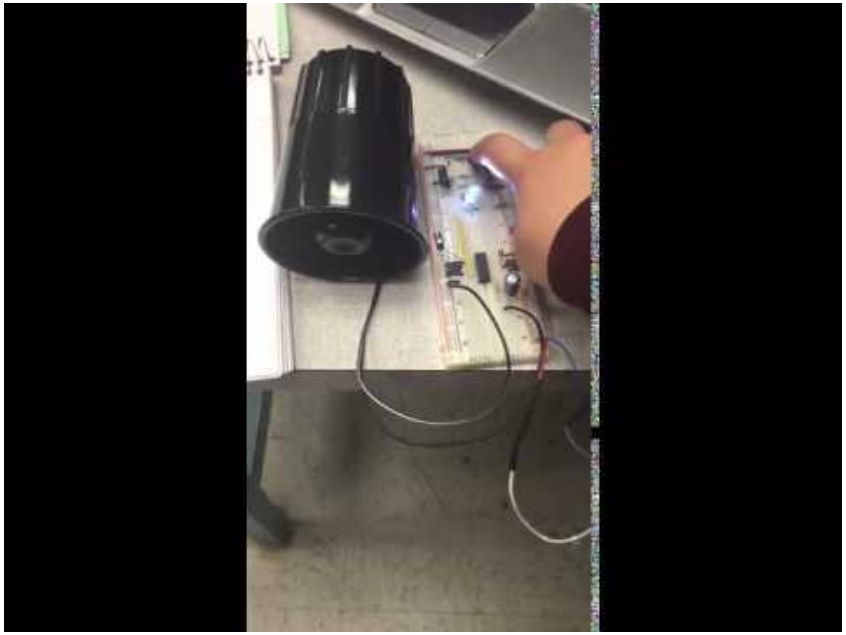
Alarm System Schematic - Revised



Alarm System Results

Hang





Result of Neptune Alarm System

Floodlight

Frankie

Lithonia Lighting oflm 150q 120 lp bz

- Outdoor floodlight purchased at Home Depot for a cost of approx. $10
- Plug housing ($3) used to adapt the wall mounted floodlight for use in a 120V outlet.
- Relay allows the floodlight to be turned on only when an intrusion is detected

Enclosure

Frankie

Birdhouse

- Cheap, easy to manipulate, and aesthetically pleasing
- Provides shelter while allowing the camera and microphone to have open exposure
- Easy to mount alarm siren, floodlight, and PIR sensors
- Also holds Raspberry Pi 2 and associated wiring

Case from Digikey

- Protects sensitive electronics from the elements
- Holds alarm circuitry, Voltage regulator PCB, and 12V AC/DC converter
- Affixed to the bottom of the birdhouse

Cost Breakdown

Frankie

New Parts	Cost
Birdhouse	$11.67
RPi 3D Printed Enclosure	$8.88
Voltage Regulator PCB	$78.15
Terminal Blocks	$2.95
Subtotal	$101.65

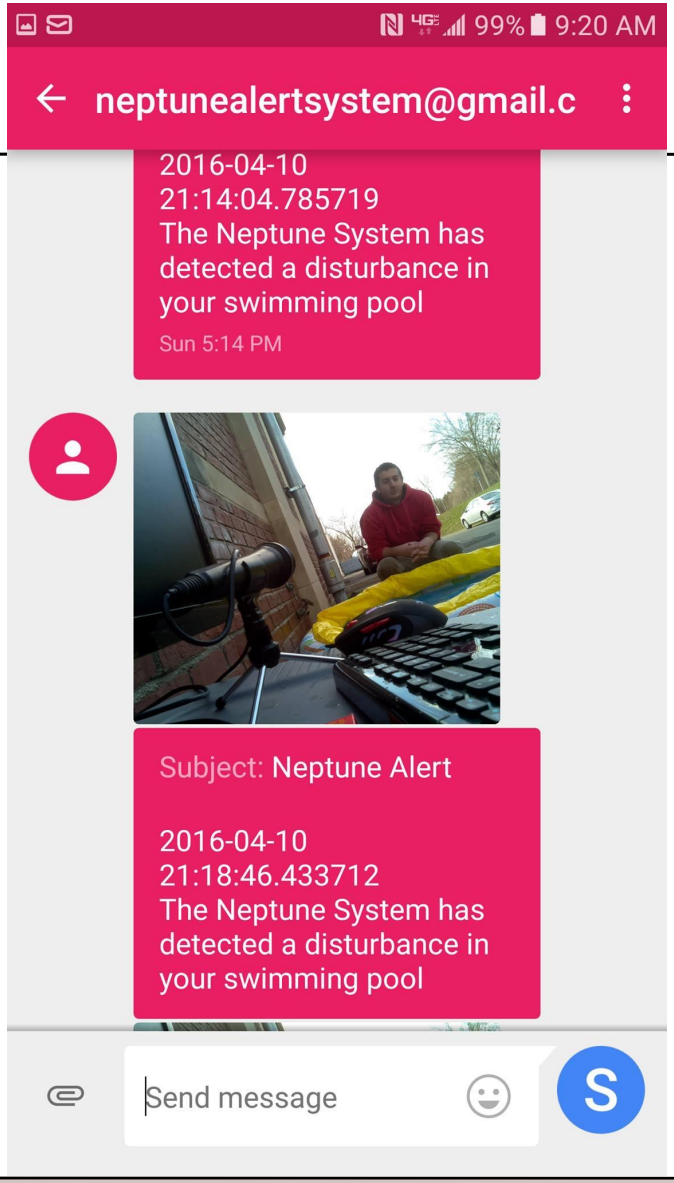
Total Cost **$259.24**

Part	Cost For Parts Prior to CDR
Speaker	$11.29
Audio Amplifier	$2.13
Voltage Regulator	$2.68
Floodlight Relay	$7.95
USB Microphone	$32.99
USB Wifi Adapter	$8.50
PIR Sensor	$9.95
Camera	$26.65
Raspberry Pi 2	$35.00
Floodlight	$12.97
12V 3A AC/DC Converter	$7.48
Subtotal	$157.59

DEMO

DEMO - With an inflatable children pool

Text Message



DEMO - With a bucket of water


SAMSUNG