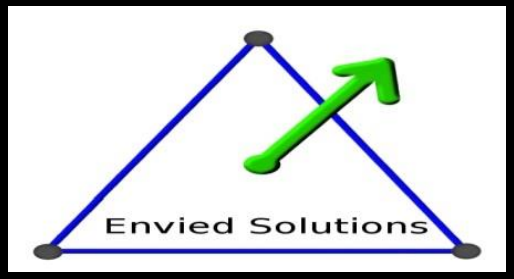



**WhereTo**

# The Indoor Direction Finder for the Visually Impaired

**April 22nd .2013**

# Development team

- Wilson Chen – Chief Executive Officer (CEO)
  - High-level software & UI development
- Alan Fang – Chief Financial Officer (CFO)
  - Hardware development
- Phillip Peach – Chief Operating Officer (COO)
  - Hardware and Software interface development
- Shaham Shafiei – Vice President of Marketing (VPM)
  - Mechanical Design

# Outline

- Introduction And Motivation
- System Overview
- System Specifications
- Business And Marketing
- Time And Budget
- Project Timeline
- What We Learned
- Future Work
- Conclusion
- Acknowledgments
- Questions?

# Introduction and Motivation

Envied Solutions proposes erecting a system that will help visually impaired people navigate through buildings without another person's assistance. Therefore **WhereTo** system would provide the visually impaired user a greater degree of freedom and would drastically improve their standard of living enable them to live a more independent and happy life.

# System Specifications

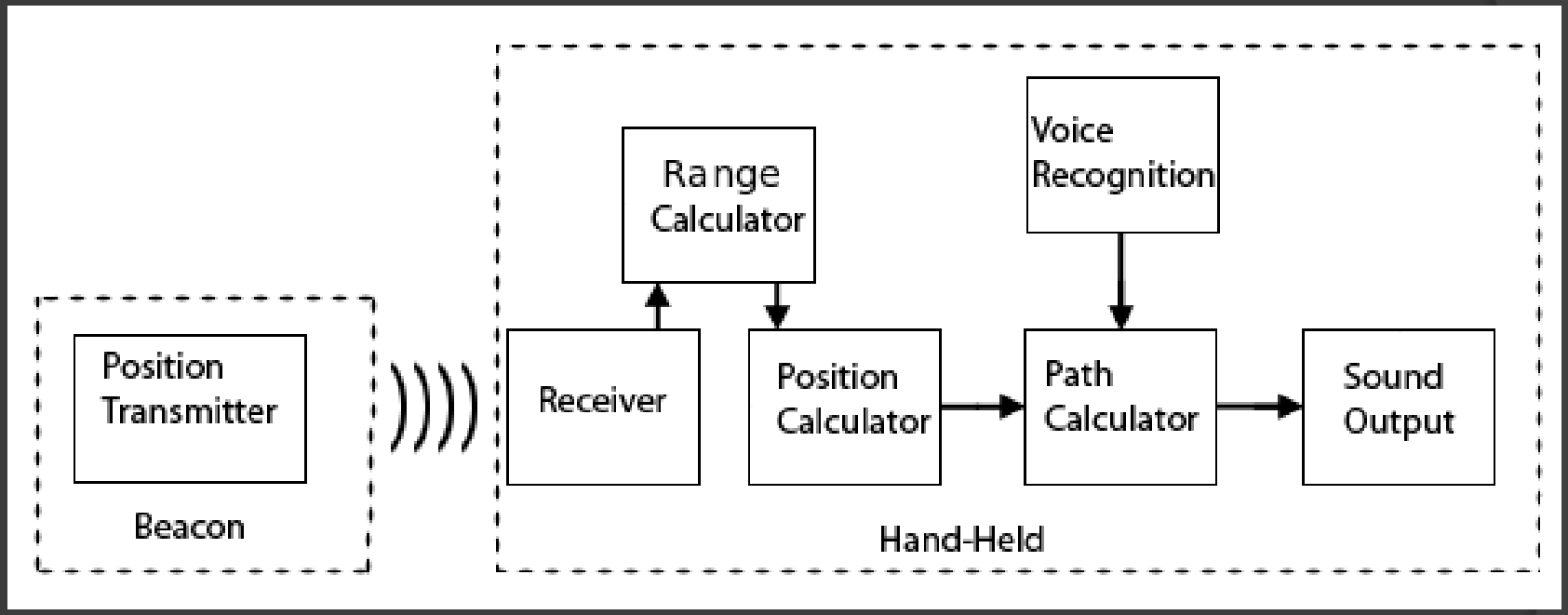
- Transmitter/Receiver
  - Raspberry Pi
  - Arduino
  - VCO
  - Filter
  - Battery
  - Regulator

**Hardware**

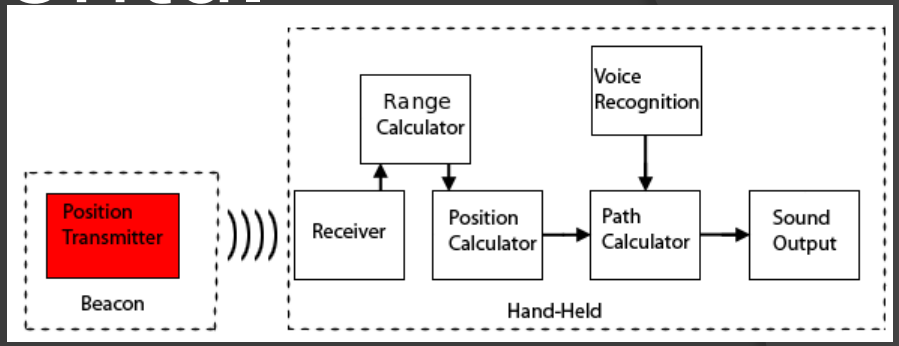
- User Interface
  - Voice recognition by the synergy of Voxforge, Hidden Markov Model Toolkit (HTK), and Julius
  - Trilateration positioning
  - A-star path-finding
  - Audio feedback

**Software**

# System Overview



# System Overview Cntd.



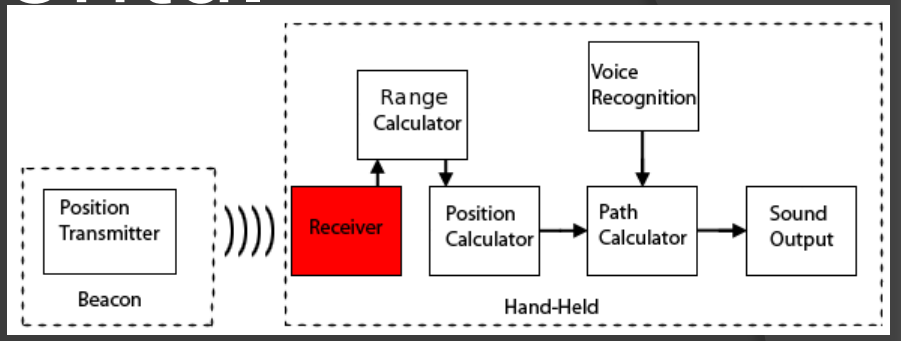

BFSK Transmitter (complete)

- Transmits data using

Binary Frequency Key Shifting

- Controlled by a Raspberry Pi
- Frequency is varied using a Voltage Controlled Oscillator
- Output frequency is transmitted ultrasonically
- As built the data rate was very low: 71 bits/second

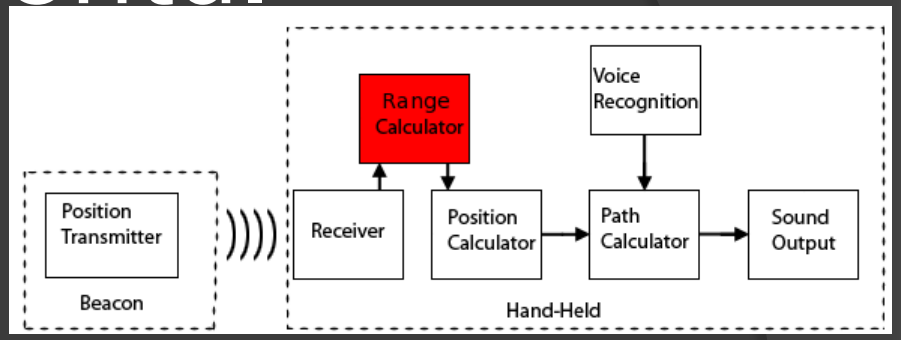
# System Overview Cntd.




BFSK Reciever (complete)

- Receives the transmitted ultrasonic signal and passes it through a bandpass amplifier
- Amplified signal is sampled by an Arduino
- Raspberry Pi uses those samples to calculate the determine the frequency and decode the data

# System Overview Cntd.



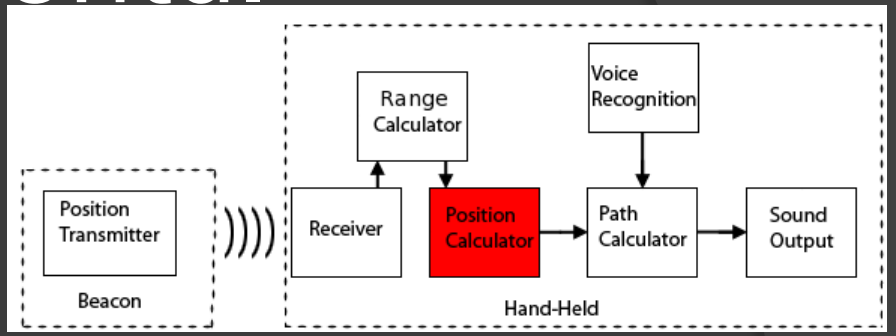

Range Calculator (not-implemented)

- Would have used time-of-flight calculation between time transmitted and time received
- Low data rate and time resolution made this too inaccurate to use

# System Overview Cntd.

Trilateration:

(complete)

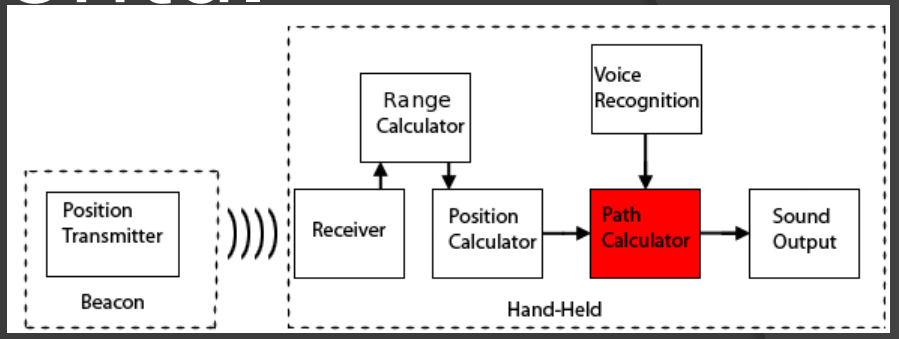



- Use digitized signal strengths to determine user position on a room-map
- Makes use of overlapping circles/spheres to narrow down the precise position
- In contrast with the popular triangulation, no angles are measured

# System Overview Cntd.

A-star / A* search:

(complete)

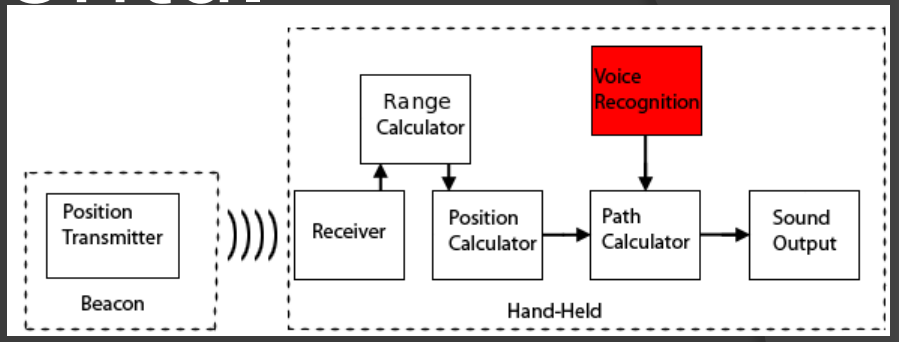



- Popular amongst AI and game programmers
- Determines the quickest (least-expensive) path by taking the most direct route and fan out on obstacle collision or forks
- Keeps track of path cost in each iterative step of the search to select an optimal path after arriving at the destination

# System Overview Cntd.

Voxforge, HTK, Julius

(accuracy problems)

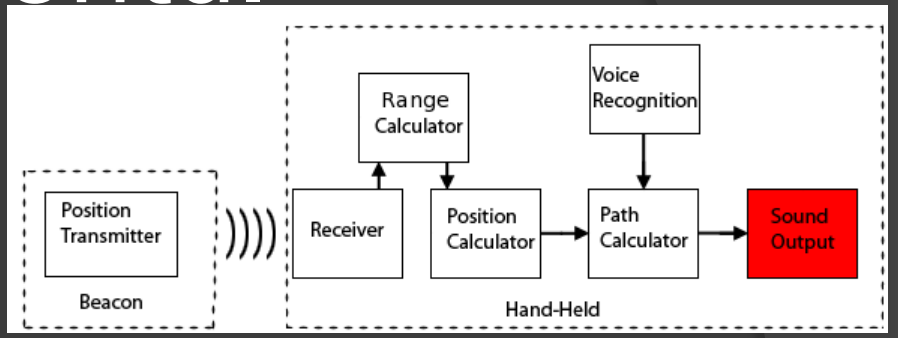



- Voxforge allows creating an acoustic model – to statistically associate words with sounds
- Hidden Markov Model Toolkit (HTK) quantizes sound samples and matches them to the elementary sounds of words (phonemes)
- Julius is the brain that does the dictionary lookup and determines grammatical correctness

# System Overview Cntd.

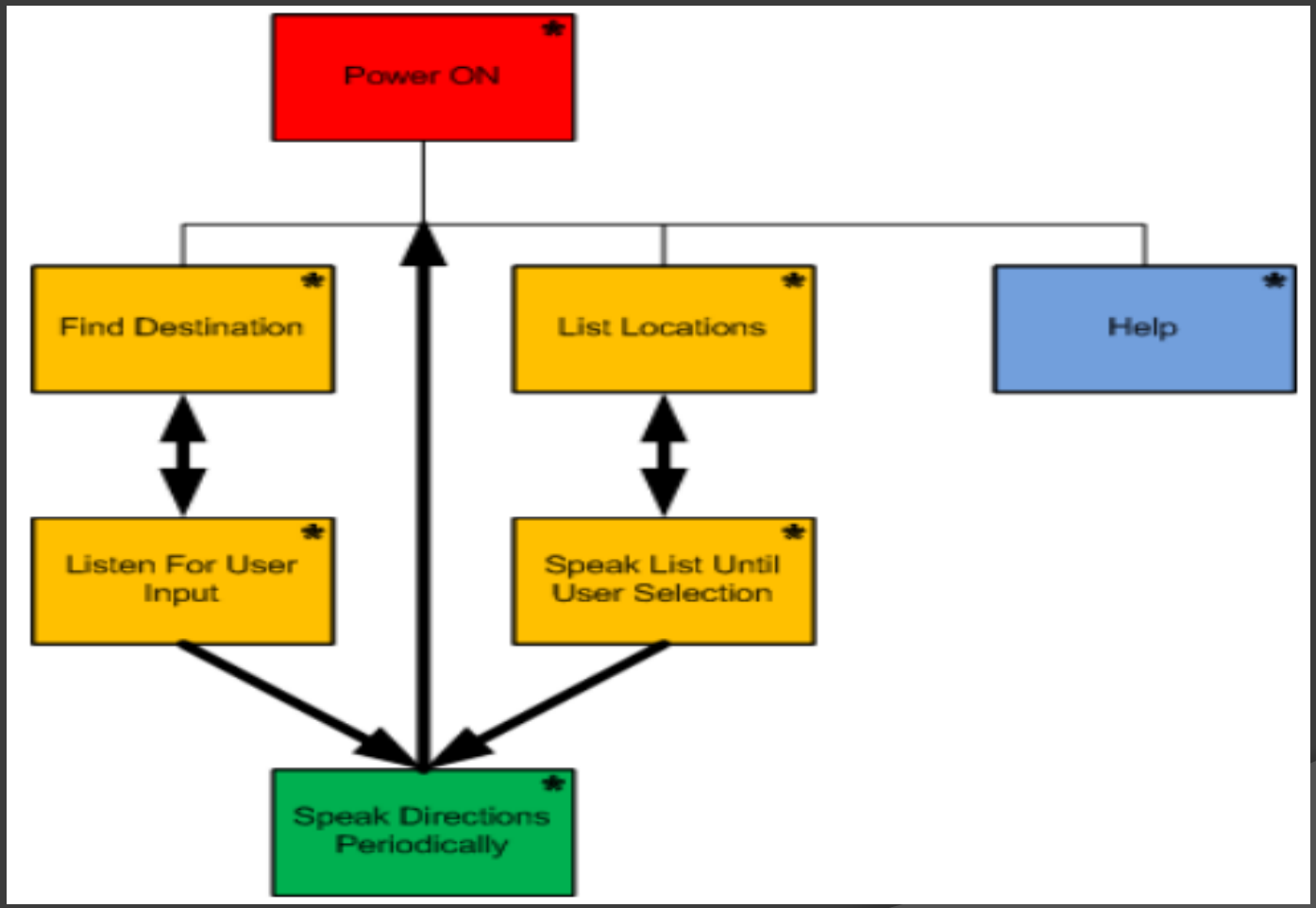
Raspberry Pi / USB soundcard

(unused in current prototype)




- The built-in sound producing chip is so poor of quality that it is disabled by default
- The use of a USB sound card helps but that also introduces the requirement of external power for it

# UI State Tree



# Business and Marketing

- Visual Impairment
  - Number of affected people will double up over the next 20 years!!
- Market alternatives
  - GPS
  - Indoor-enhanced A-GPS

# Business and Marketing

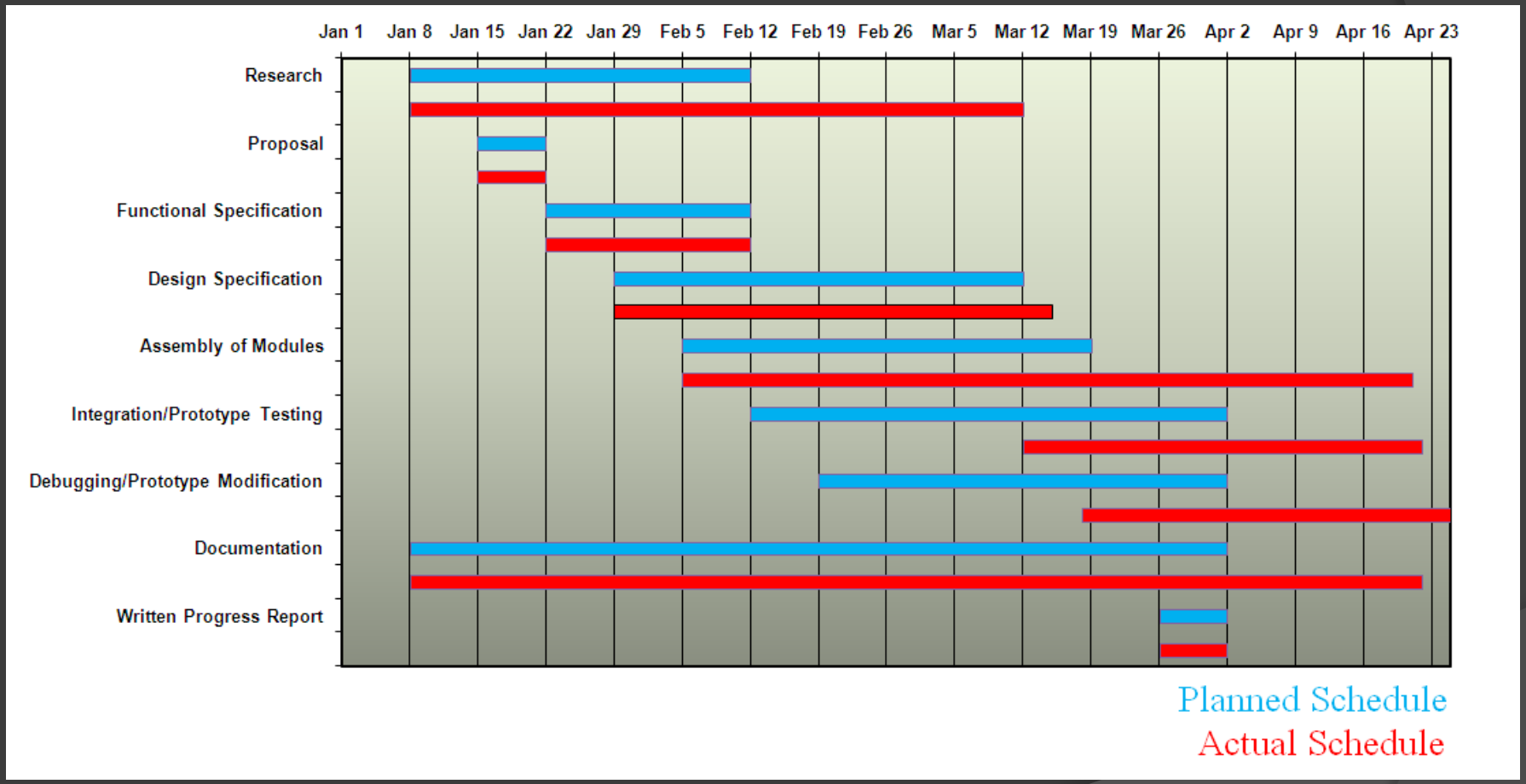
| Component | Budget |
|---|---|
| Wi-Fi Receiver | $30 |
| Wi-Fi Transceiver | $40 x 4 |
| Audio | $50 |
| Battery (rechargeable) | $20 |
| Microcontroller | $50 |
| Sensor | $40 |
| Handle | $40 |
| Magnetometer/Accelerometers | $30 |
| PCB Board | $50 x 4 |
| 20% Contingencies | $120 |
| Total | $740 |

Projected Budget

| Component | Actual Expense |
|---|---|
| 4 *Raspberry Pi | $156.8 |
| 3 * Arduino | $94.91 |
| Battery (inc. charger) | $36.9 |
| Ultrasonic Transducer | $28.83 |
| IC Chips | $60.12 |
| Wifi adapter | $14.55 |
| Miscellaneous | $366.66 |
| Total | $758.77 |

Actual Expenditures

# Project Timeline



# What We Learned

- Path Finding Algorithm
- Voice recognition
- Data Transmission
- Analog to Digital, Digital to Analog
- Frequency modulation (FSK)
- Team Work

# Future Work

- Needs a design overhaul to strip excesses & optimize
- Include RF processing for long range signal transmission

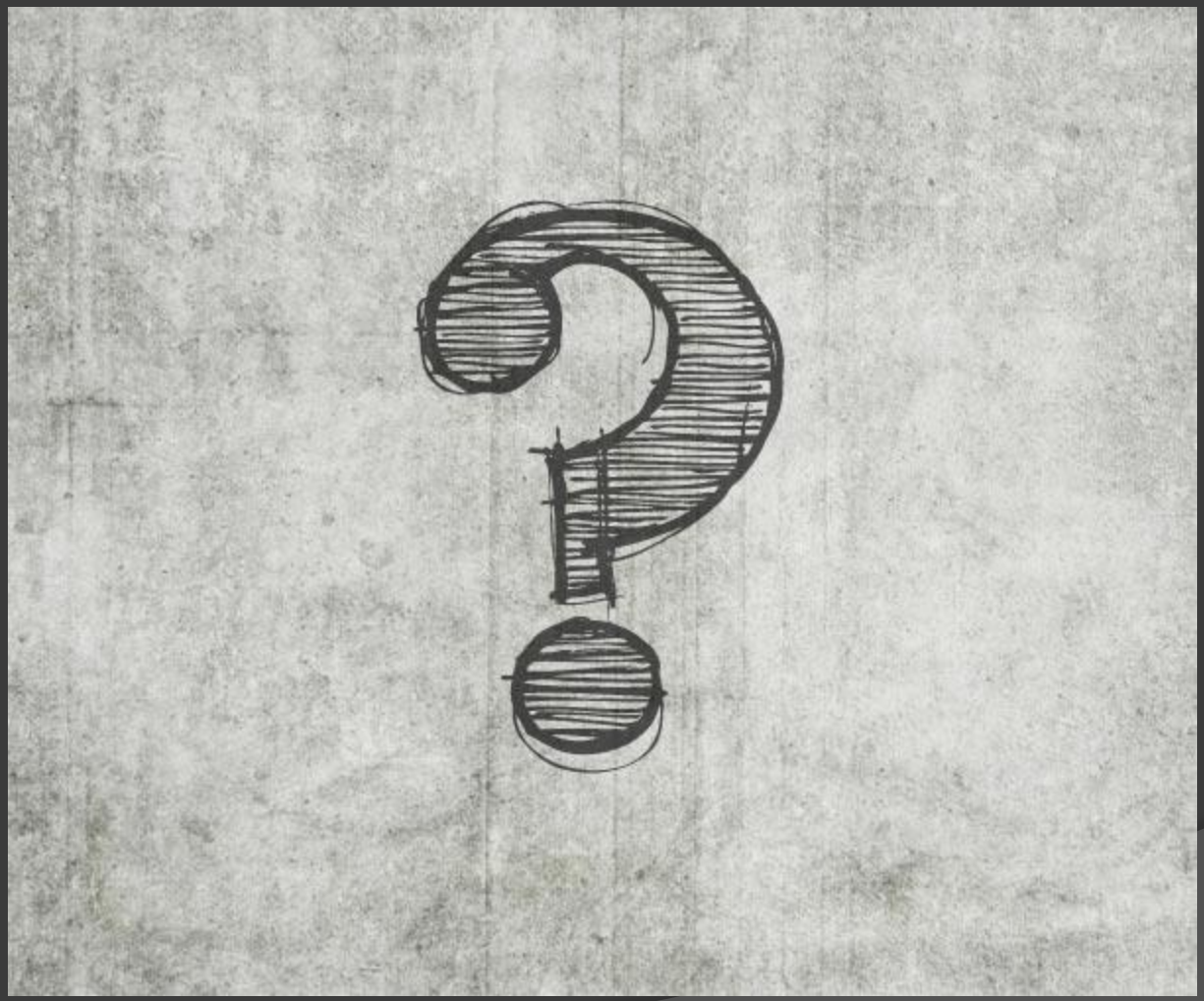
# Conclusion

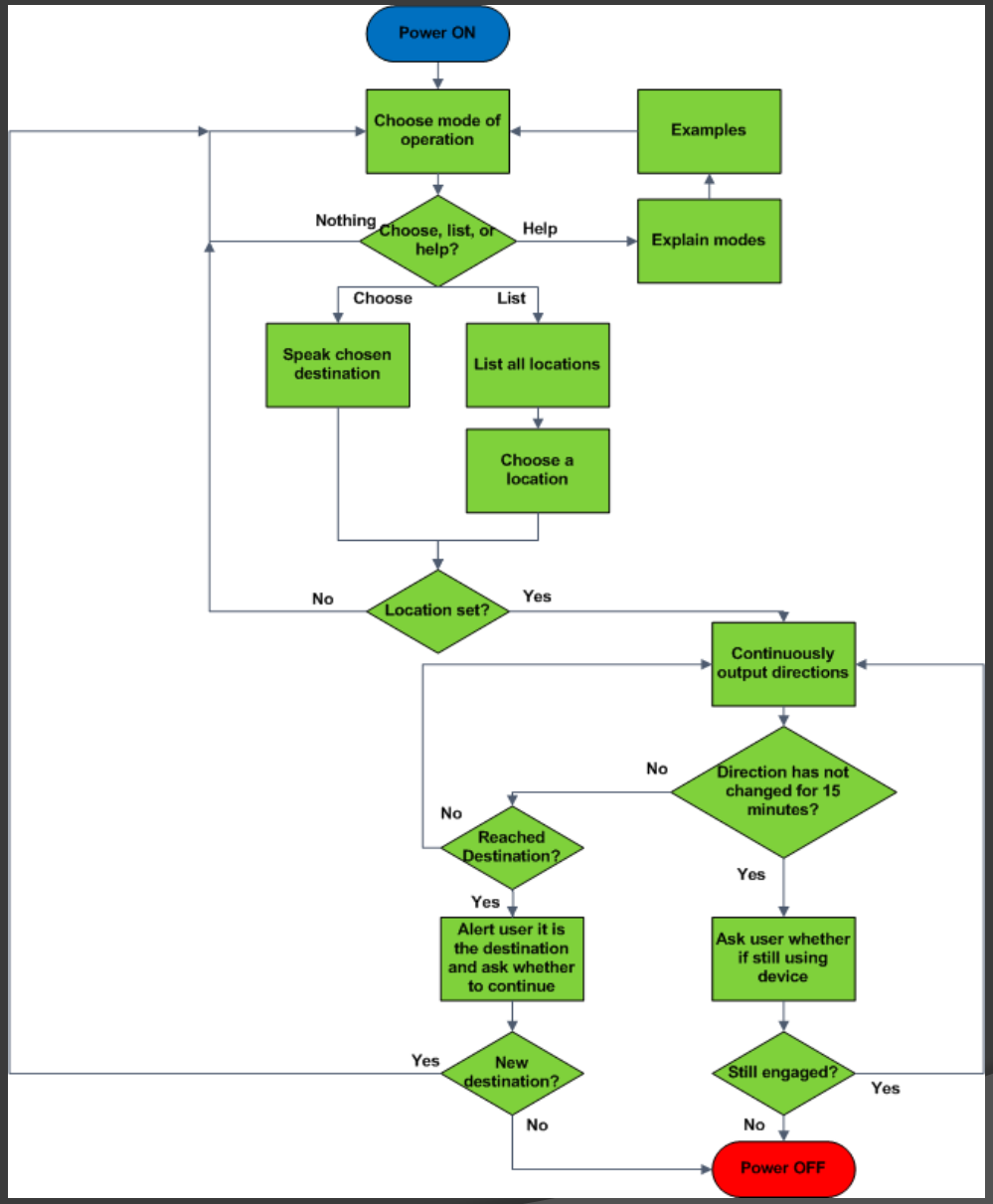
- Overambitious project
- Schedule slippage countermeasures of simply dedicating more time did not magically solve problems
- Unforeseen difficulties in hardware-software signal transfer broke project into two distinct pieces

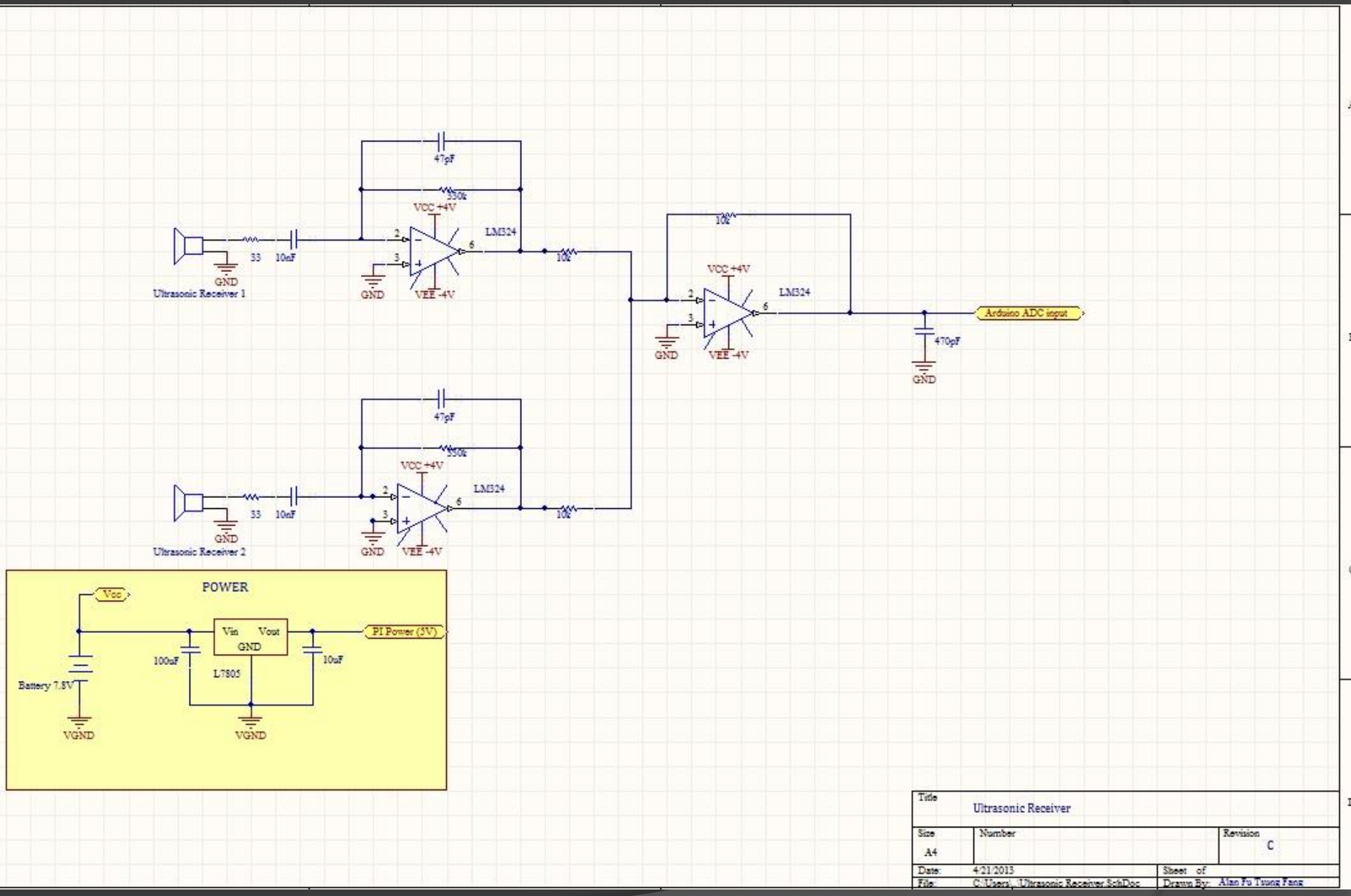
# Acknowledgements


- Dr. Andrew Rawicz
- Mr. Steve Whitmore
- Mr. Lukas-Karim Merhi
- Mr. Ali Ostadfar
- Mr. Lakshman One
- Professor Rodney Vaughan

# Questions?




Power ON
Choose mode of operation
Examples
Nothing
Choose, list, or help?
Help
Explain modes
Choose
List
Speak chosen destination
List all locations
Choose a location
No
Location set?
Yes
Continuously output directions
No
Direction has not changed for 15 minutes?
No
Reached Destination?
Yes
Yes
Alert user it is the destination and ask whether to continue
Ask user whether if still using device
Yes
New destination?
Still engaged?
Yes
No
No
Power OFF

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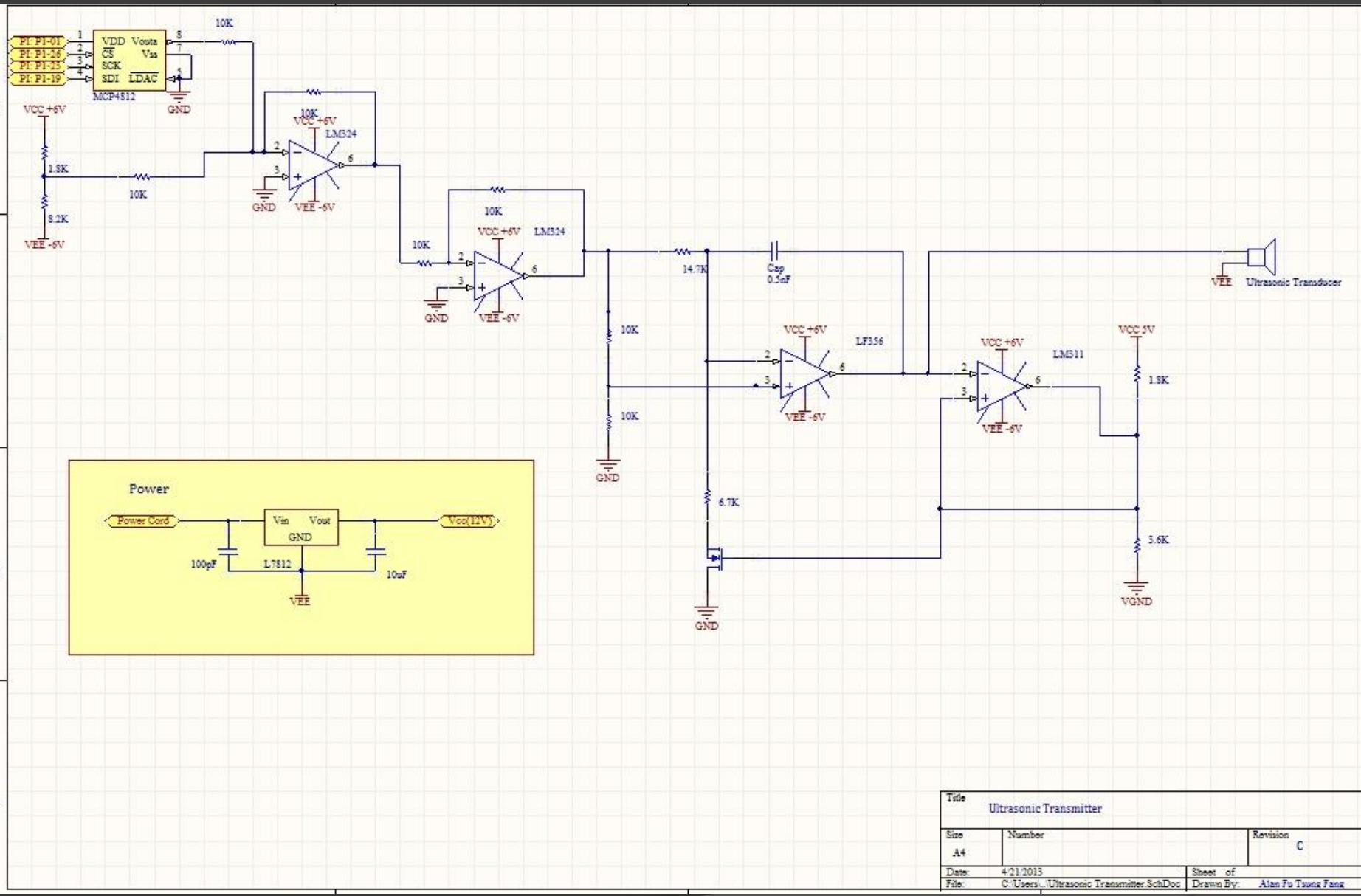
| Date: 4/21/2013 | | Sheet of: |
| File: C:\Users\...Ultrasonic Receiver.SchDoc | | Drawn By: Alan Fu Tsung Fang |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PI: P1-26
PI: P1-23
PI: P1-19
VDD Vouta
CS Vss
SCK
SDI LDAC
MCP4812
10K
GND
VCC +6V
1.8K
8.2K
VEE -6V
LM324
VEE -6V
14.7K
Cap
0.5nF
Ultrasonic Transducer
LF356
LM311
VCC 5V
1.8K
6.7K
3.6K
VGND
Power
Power Cord
Vin Vout
GND
Vcc(12V)
100pF
L7812
10uF
VEE
Title
Ultrasonic Transmitter
Size
A4
Number
Revision
C
Date: 4/21/2013
Sheet of
File: C:\Users\...\Ultrasonic Transmitter.SchDoc
Drawn By: Alan Fo Tsung Fang