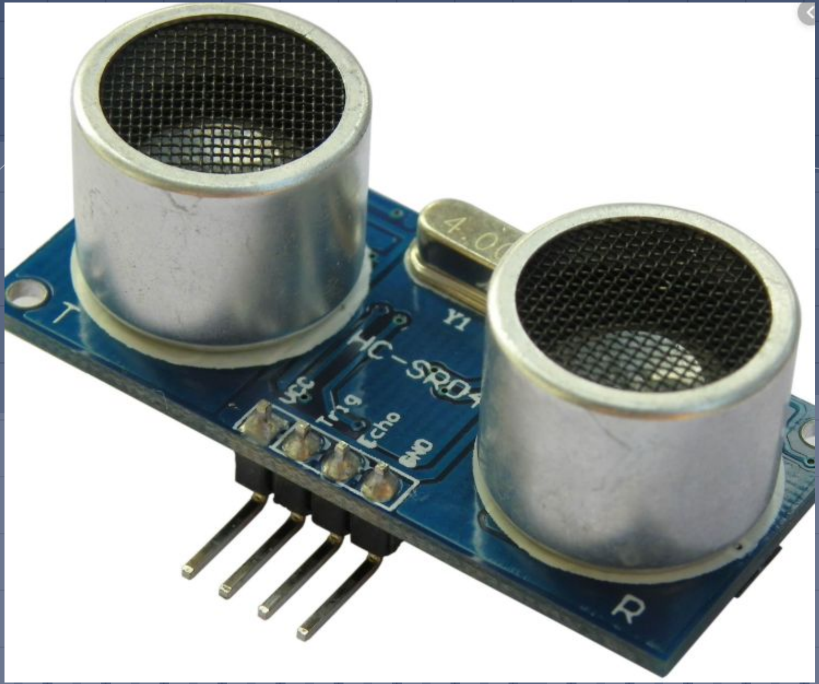
Sonar Direction Finding System



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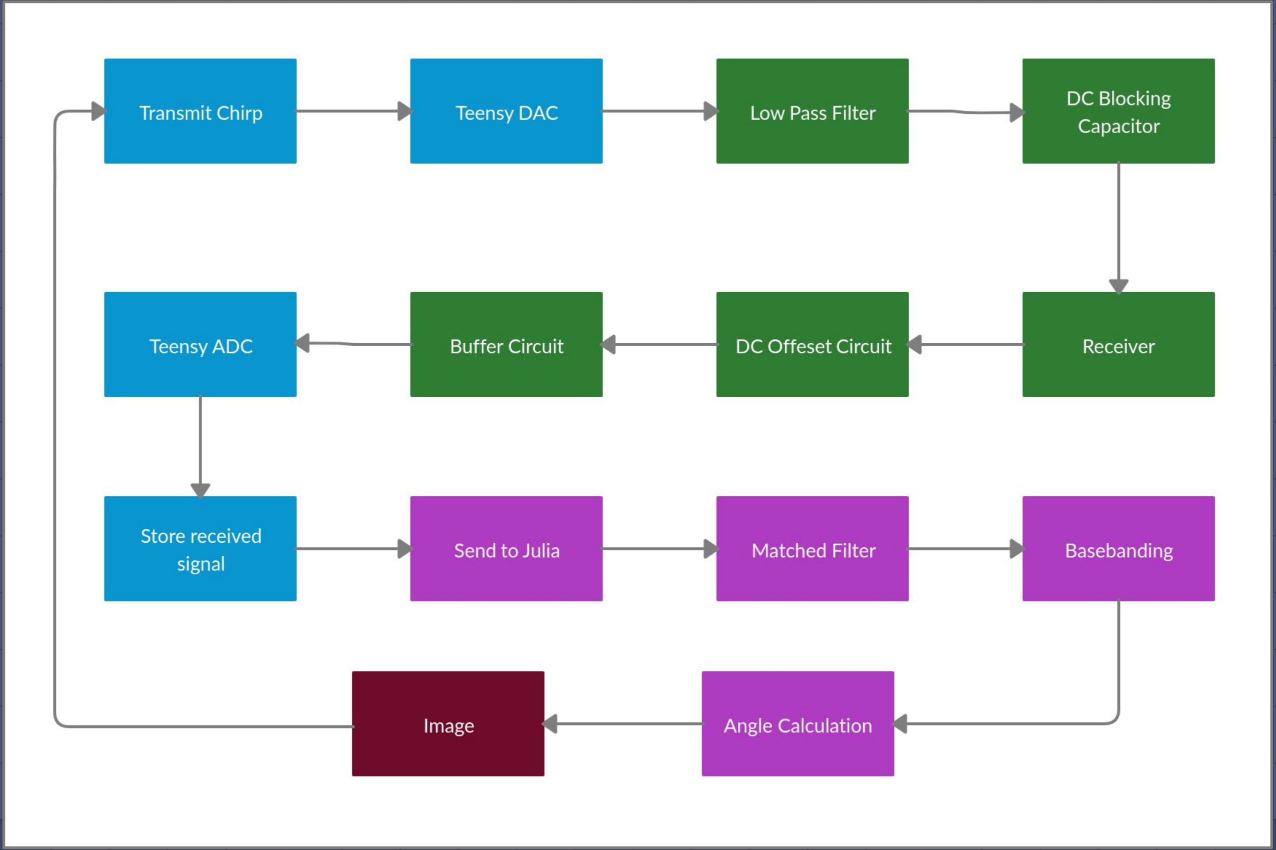
Hardware developed by:
Mahmoodah Jaffer and Tatenda Mugadza

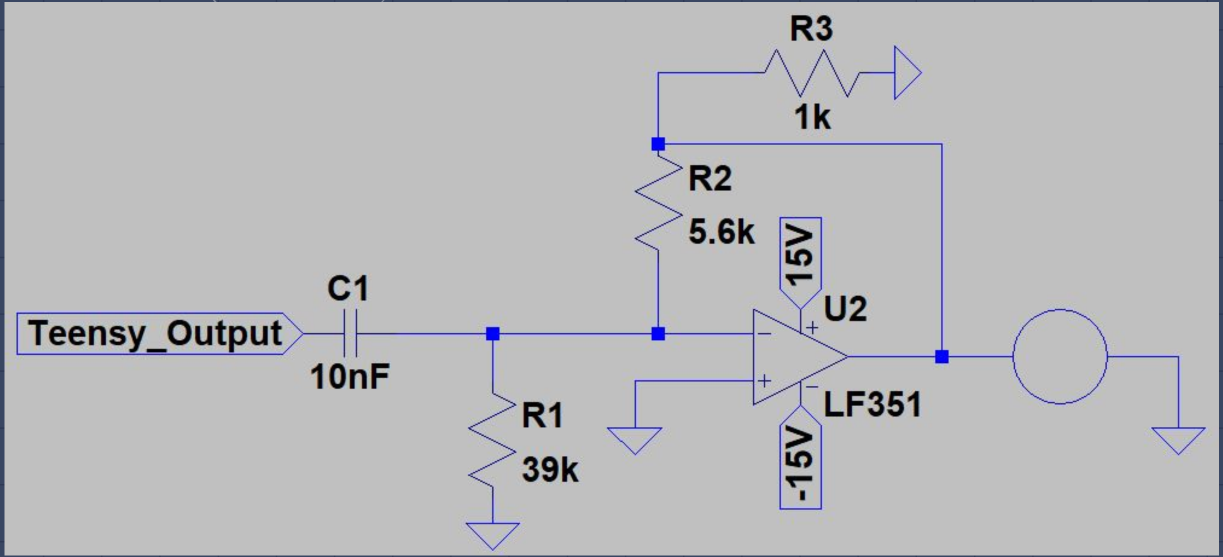
System Specifications

- DAC Frequency : ~2MHz
- ADC Sampling frequency : 500 kHz
- Transmitter gain : -5.6
- Receiver gain : -15
- Field of view: 10 degrees
- Range: 10 meters
- Receiver buffer size: 30 000
- ADC and DAC resolution: 12 bits

System Block diagram

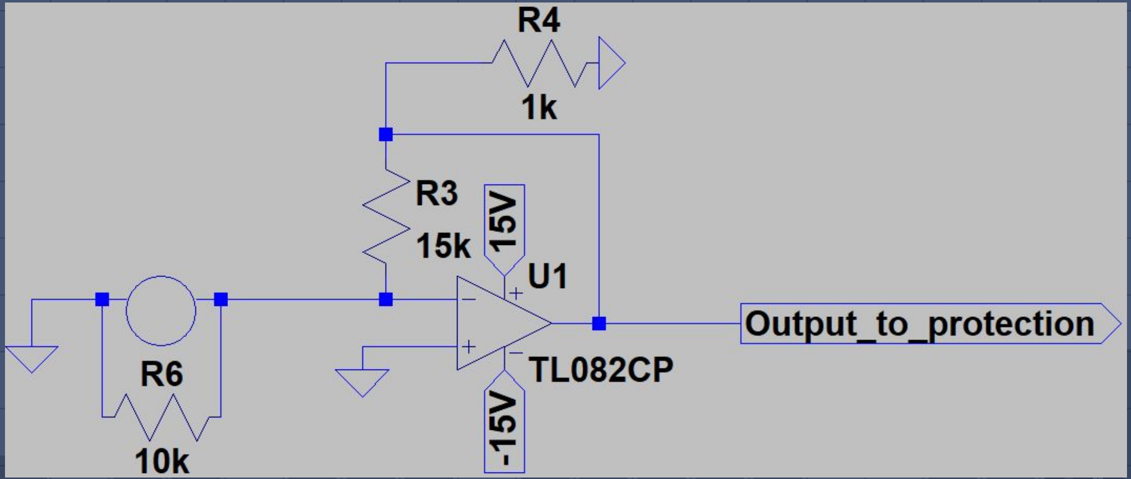


Transmitter



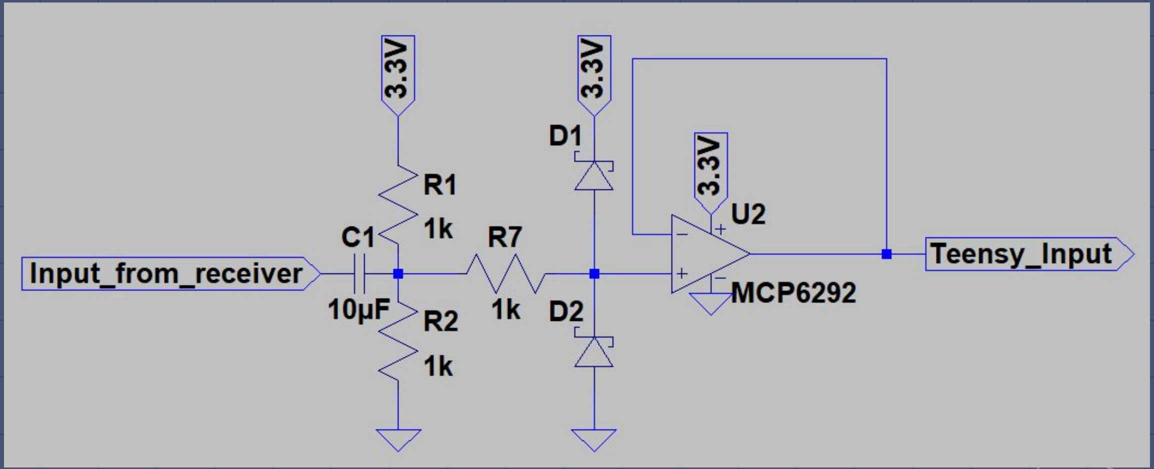
- The signal will be transmitted from the Teensy board through the DAC to the transmitter transducer
- Vout/ V in = - Ri / Rf, at the output of the transmitter
- Made with a gain to be able to still receive signal in the receiver

Receiver

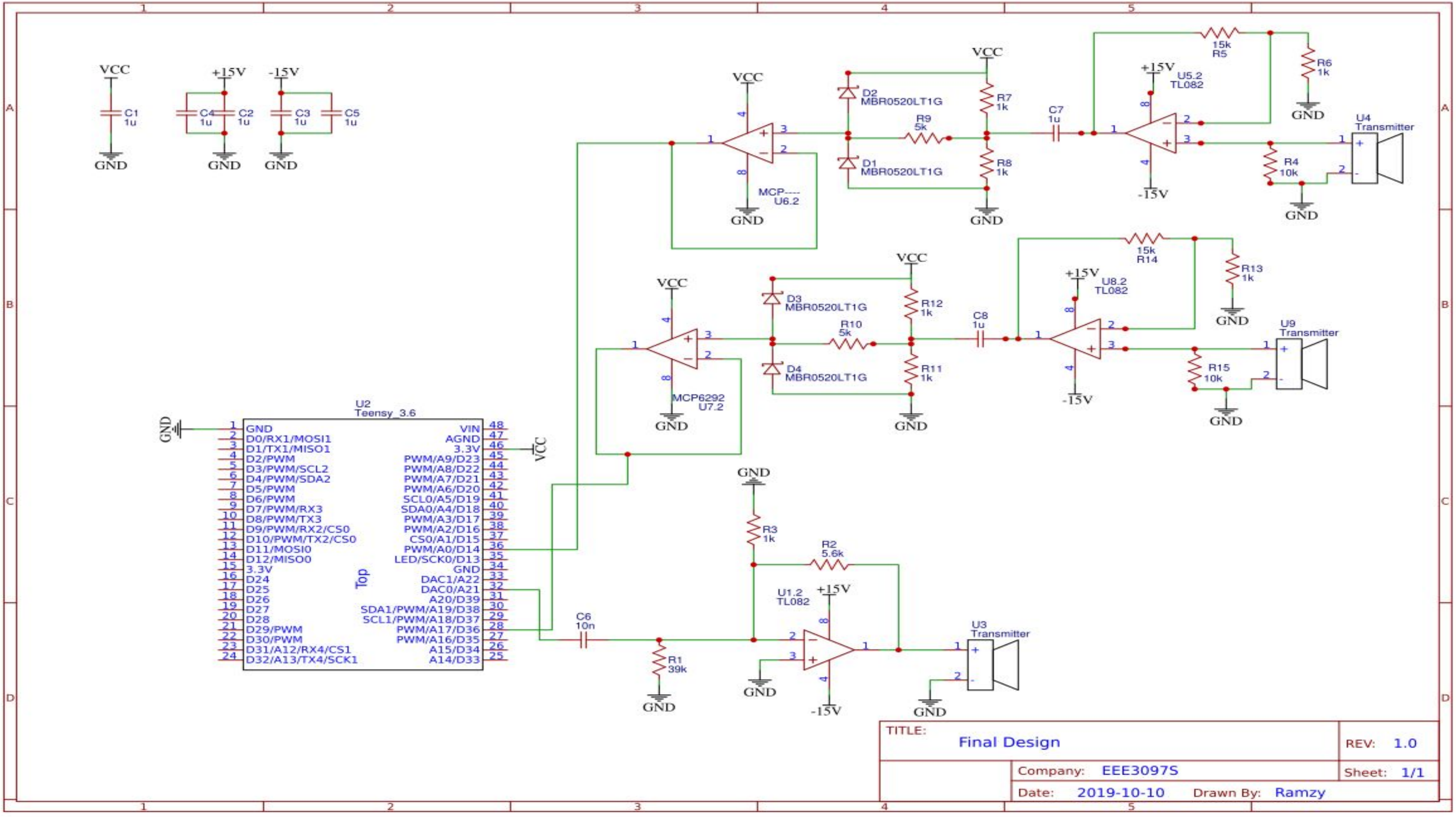


- Receiver feeds into protection circuitry before Teensy ADC
- Same as the transmitter, the receiver has a gain but of a different value of -15
- The opamp used is the TL082CP - dual opamp
- 10k resistor for noise

Protection Circuitry

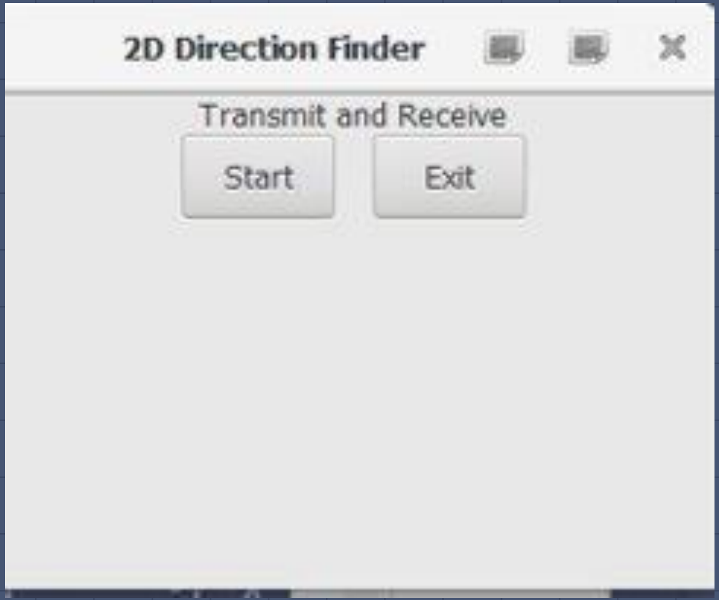


- Done in two stages to ensure that ADC is within pin range
- Stage 1 using two diodes
- Stage 2 using a buffer in a rail to rail op amp



VCC
C1
1u
GND
+15V
C4
1u
C2
1u
-15V
C3
1u
C5
1u
MCP----
U6.2
D2
MBR0520LT1G
D1
MBR0520LT1G
R7
1k
R8
1k
R9
5k
C7
1u
15k
R5
R6
1k
U5.2
TL082
R4
10k
U4
Transmitter
MCP6292
U7.2
D3
MBR0520LT1G
D4
MBR0520LT1G
R12
1k
R11
1k
R10
5k
C8
1u
15k
R14
R13
1k
U8.2
TL082
R15
10k
U9
Transmitter
U2
Teensy_3.6
GND
D0/RX1/MOSI1
D1/TX1/MISO1
D2/PWM
D3/PWM/SCL2
D4/PWM/SDA2
D5/PWM
D6/PWM
D7/PWM/RX3
D8/PWM/TX3
D9/PWM/RX2/CS0
D10/PWM/TX2/CS0
D11/MOSI0
D12/MISO0
3.3V
D24
D25
D26
D27
D28
D29/PWM
D30/PWM
D31/A12/RX4/CS1
D32/A13/TX4/SCK1
VIN
AGND
3.3V
PWM/A9/D23
PWM/A8/D22
PWM/A7/D21
PWM/A6/D20
SCL0/A5/D19
SDA0/A4/D18
PWM/A3/D17
PWM/A2/D16
CS0/A1/D15
PWM/A0/D14
LED/SCK0/D13
GND
DAC1/A22
DAC0/A21
A20/D39
SDA1/PWM/A19/D38
SCL1/PWM/A18/D37
PWM/A17/D36
PWM/A16/D35
A15/D34
A14/D33
Top
C6
10n
R1
39k
R3
1k
R2
5.6k
U1.2
TL082
U3
Transmitter
TITLE:
Final Design
REV: 1.0
Company: EEE3097S
Sheet: 1/1
Date: 2019-10-10
Drawn By: Ramzy

User Interface



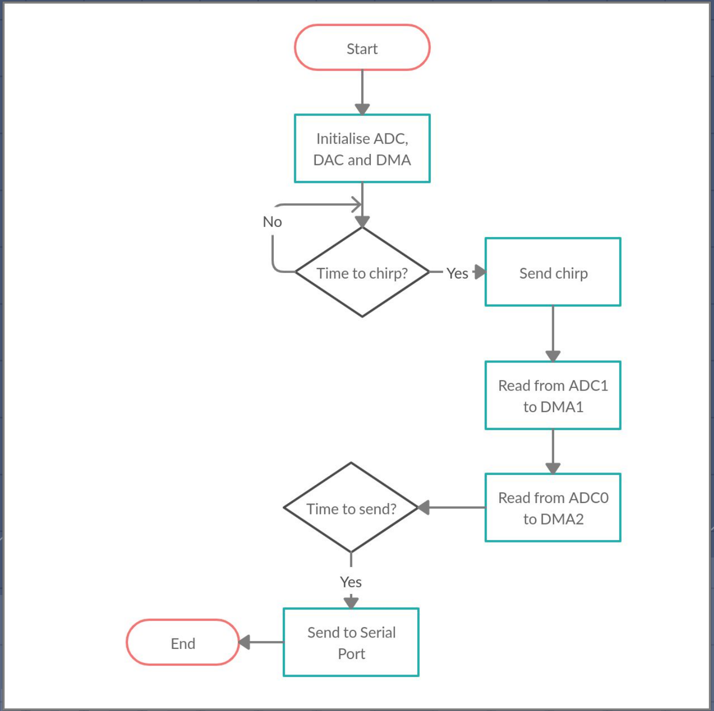
- Created in Julia
- Using Gtk package
- Start button begins transmission and plot reception

Hardware Challenges

- Unstable circuit giving a debugging challenge
- Damaged breadboards
- Buggy Transducers

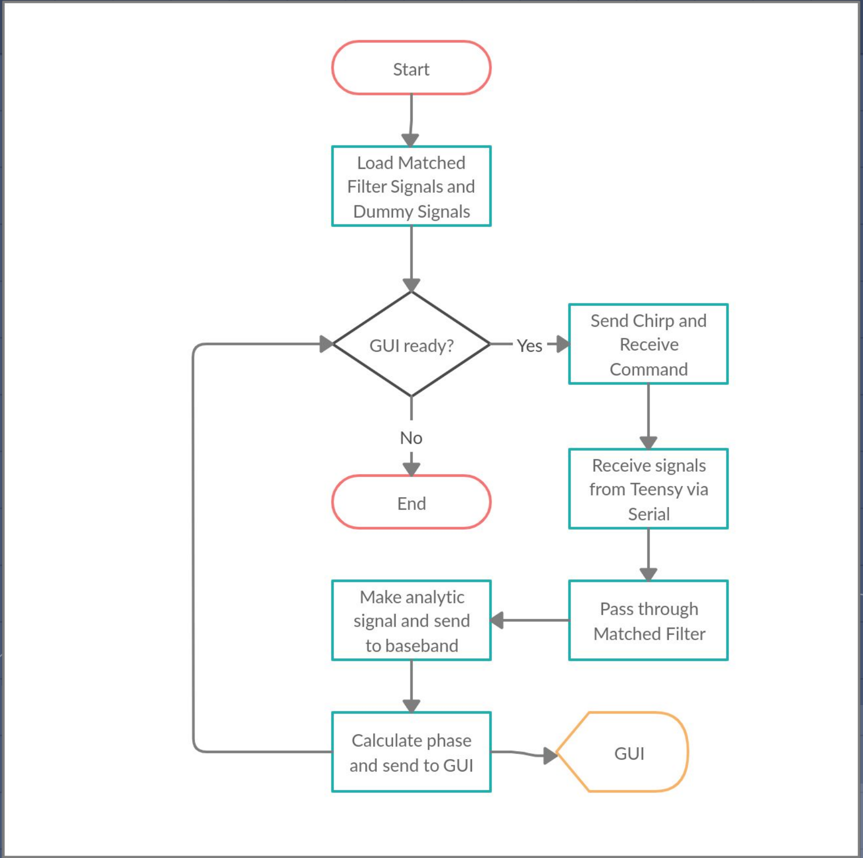
Code Algorithms: Teensy

1. Set up variables
2. Wait for command to chip and read values
3. Setup ADC,start ADC,Send chirp, read values from Receiver 1 and from Receiver 2 to their buffers
4. Wait for command to print values to buffer
5. Send values via serial to Julia through separate commands for each buffer.



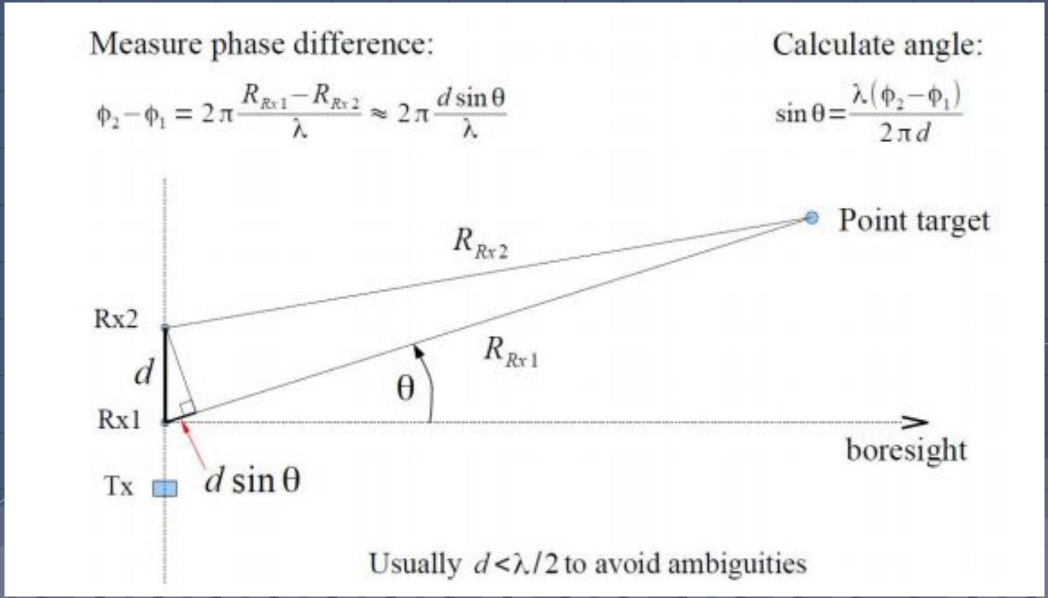
Code Algorithms: Julia

1. Load in matched filters
2. Open ports and send chirp command
3. Send receive command
4. Pass signals through matched filters
5. Make analytic signals and send them to baseband
6. Calculate angles and display image



Algorithms: Sonar Distance Estimation

- Calculate phase difference between two baseband signals
- Using different ambiguity constants, calculate angles from phase differences
- Extract peaks in signals to locate the object



Software challenges

- Cross compatibility between Operating Systems (Windows and Linux) and serial buffers
- Linking separate GUI and Processing

Going the extra mile!

1. Custom Corner reflector
2. Attempted GUI
3. 2 Working Plans

THANKS!

Any questions?

References

1] L. S. Inc, "UML Use Case Diagram," 2019. [Online]. Available: https://www.lucidchart.com/pages/uml-use-case-diagram. [Accessed August 2019].

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