VHF Antenna Proposal Presentation

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Introduction

- Goal 1: Design and model a low-cost VHF antenna for radar fence posts to detect low flying objects.

- Goal 2: Create prototype and test plan for the antenna.

Qualitative Requirements

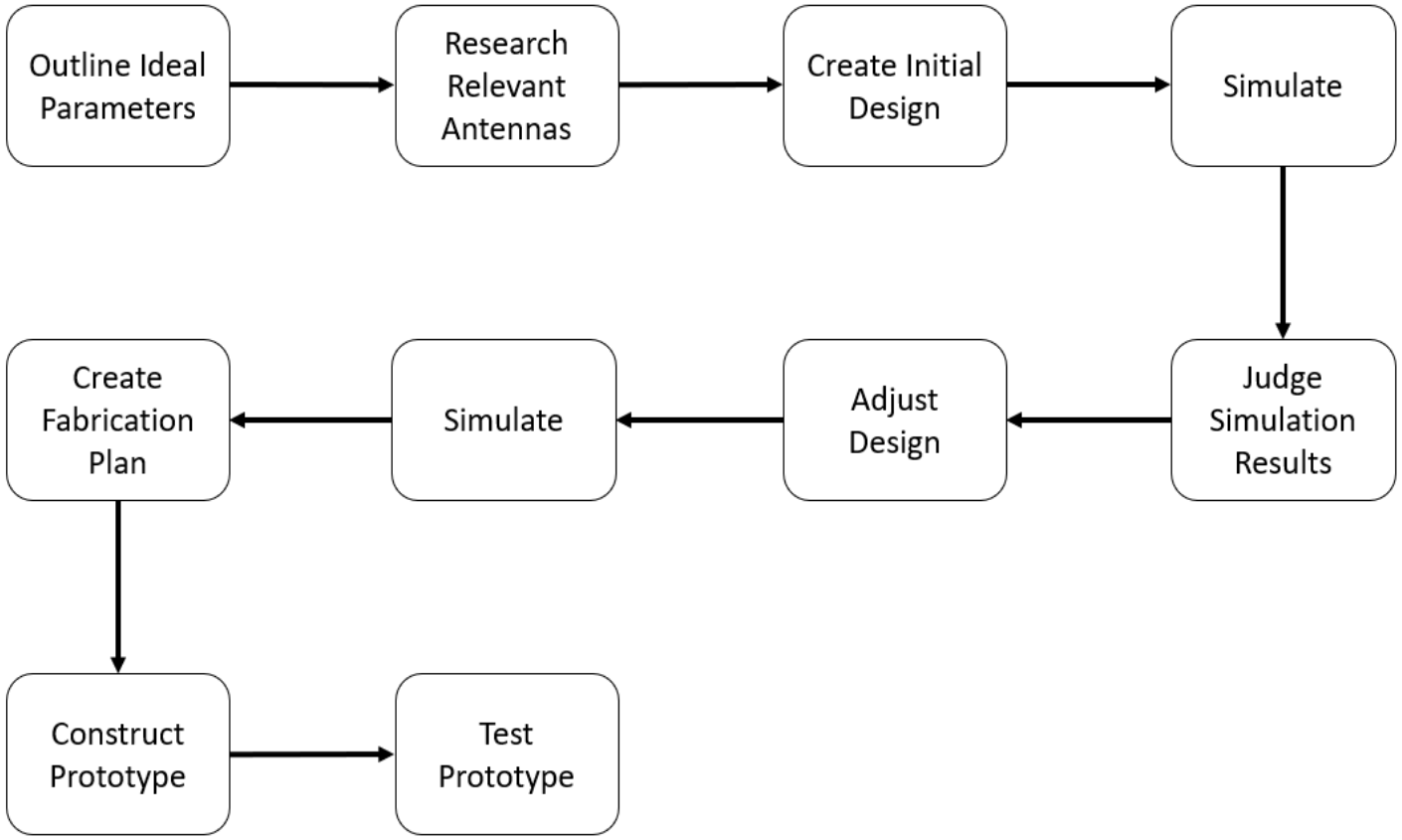
- Low Cost
- Operate in VHF Band
- Detect low-RCS Targets
- High Reliability and Low Maintenance

Quantitative Specifications

Antenna Parameters	Specifications
Transmit Power	$0.01 - 1\ W$
Operating Frequency	$30\ - 300\ MHz$
Input Impedance	$50\ \Omega$
Operating Temperatures	$-63 - 50\ °C$
Cost	$\$1{,}000\ - \$10{,}000$

Target Parameters	Specifications
Radar Cross-Sections	$0.01 - 1\ m^2$
Altitude	$200 - 1000\ m$
Speed	$400\ m/s$

Design Approach

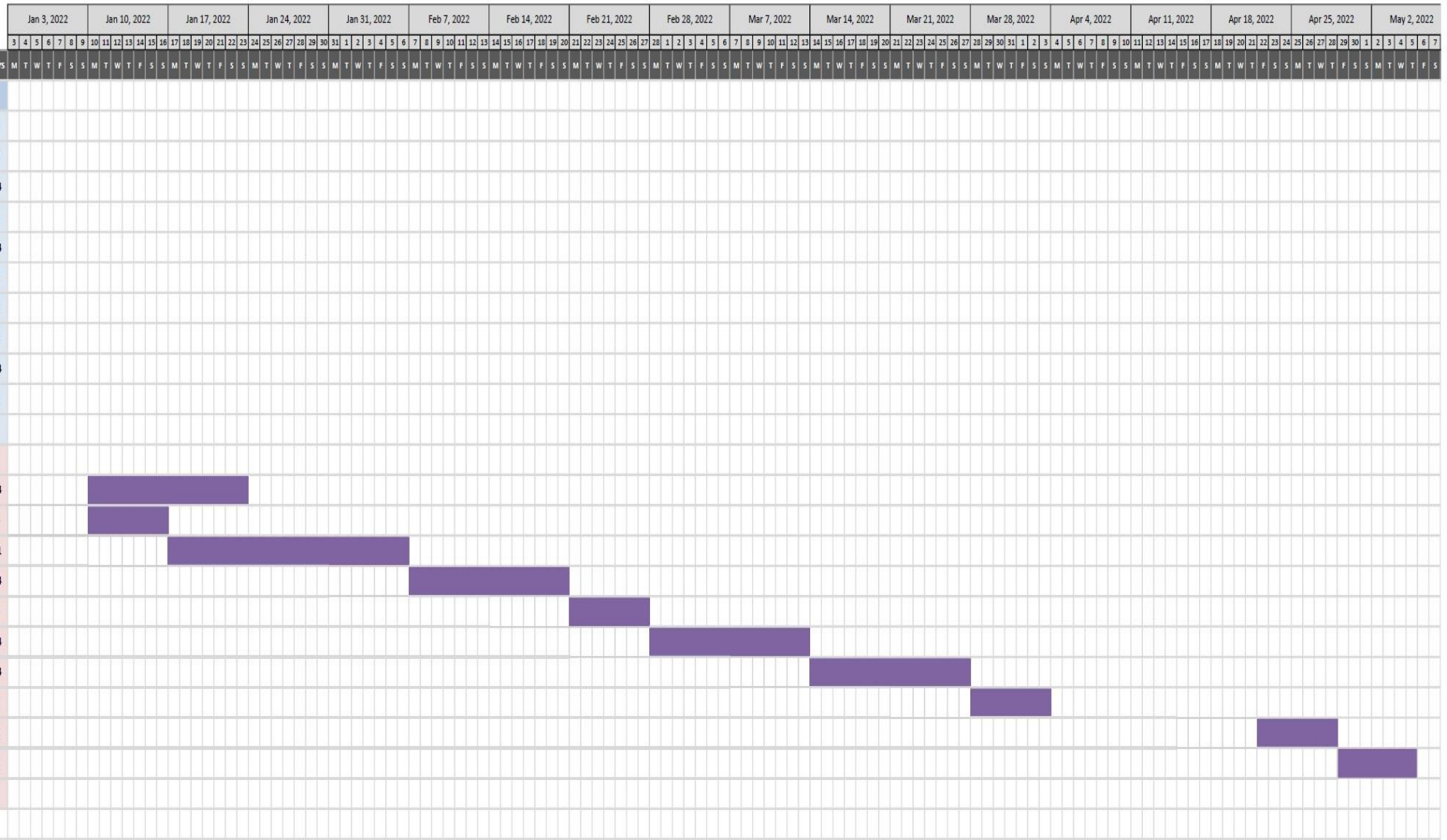


Schedule

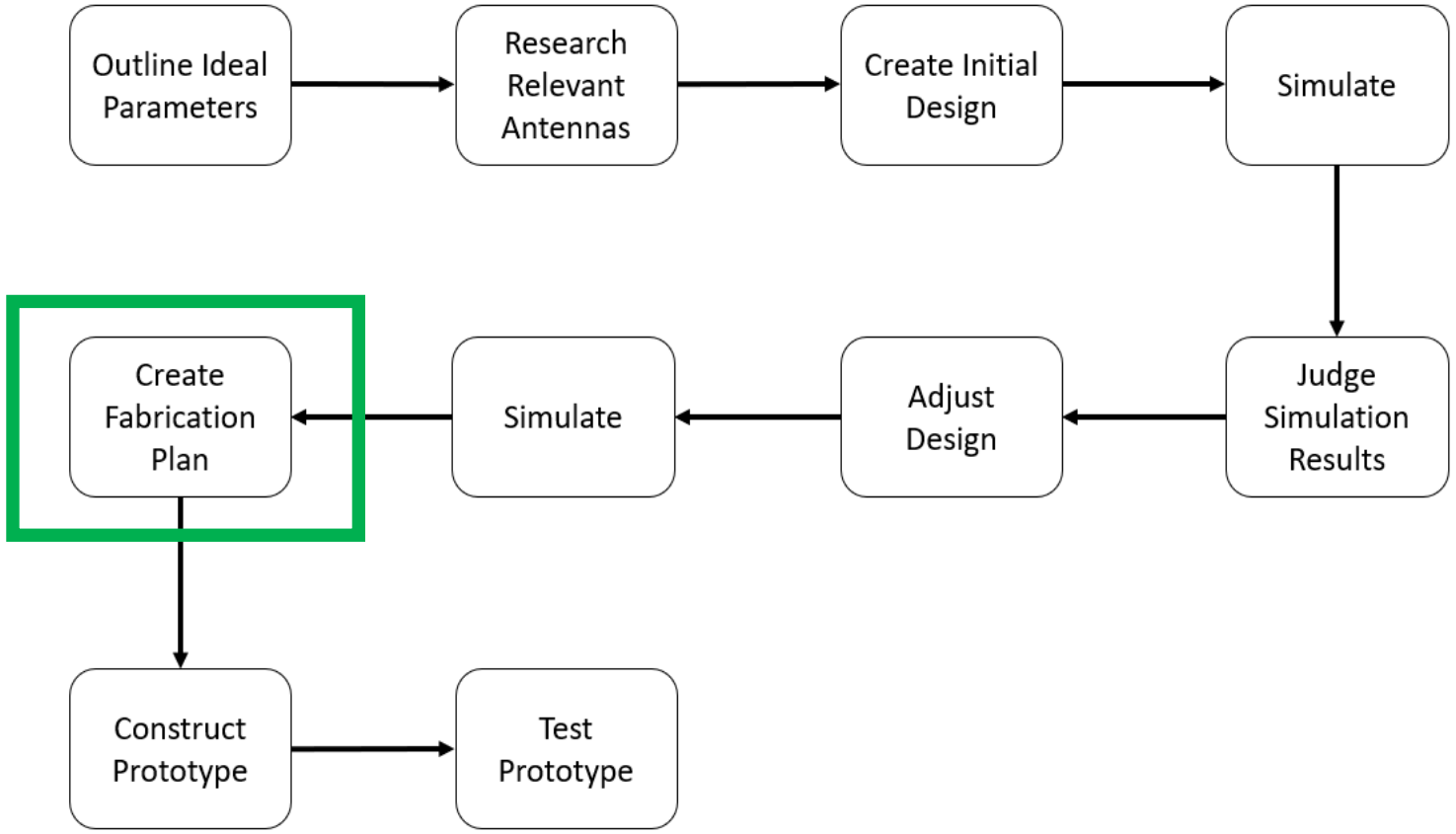
ECE 4871 Special Topics
Mohammed Deafalla, Kenneth Holder, Seidi Kartal, Seunghwan Lee, Sanket Sane

Project Start: Mon, 10/11/2021
Display Week: 1

TASK	ASSIGNED Time in Weeks	PROGRESS	START	END	DAYS
Fall 2021 Semester					
Establish Baseline Antenna Propertie	1	0%	10/11/21	10/17/21	7
Draft Project Summary	1	0%	10/18/21	10/22/21	5
Familizarization with Design Tool	2	0%	10/23/21	11/5/21	14
First Design	1	0%	11/1/21	11/7/21	7
First Simulation	2	0%	11/8/21	11/21/21	14
Project Proposal	1	0%	11/15/21	11/21/21	7
Second Design	0.5	0%	11/22/21	11/28/21	7
Second Simulation	1	0%	11/26/21	12/2/21	7
Create Fabrication Plan	2	0%	11/20/21	12/3/21	14
Order Parts	1	0%	11/28/21	12/4/21	7
Spring 2022 Semester					
Shipping Parts	2	0%	1/10/22	1/23/22	14
Oral Project Presentation	1	0%	1/10/22	1/16/22	7
Assemble Parts	3	0%	1/17/22	2/6/22	21
Antenna Testing 1	2	0%	2/7/22	2/20/22	14
Test Feedback	1	0%	2/21/22	2/27/22	7
Antenna Testing 2	2	0%	2/28/22	3/13/22	14
Senior Design Expo Preparation	2	0%	3/14/22	3/27/22	14
Website	1	0%	3/28/22	4/3/22	7
Expo	1	0%	4/22/22	4/28/22	7
Final Project Summary	1	0%	4/29/21	5/5/21	7



Status


Outline Ideal Parameters
Research Relevant Antennas
Create Initial Design
Simulate
Judge Simulation Results
Adjust Design
Simulate
Create Fabrication Plan
Construct Prototype
Test Prototype

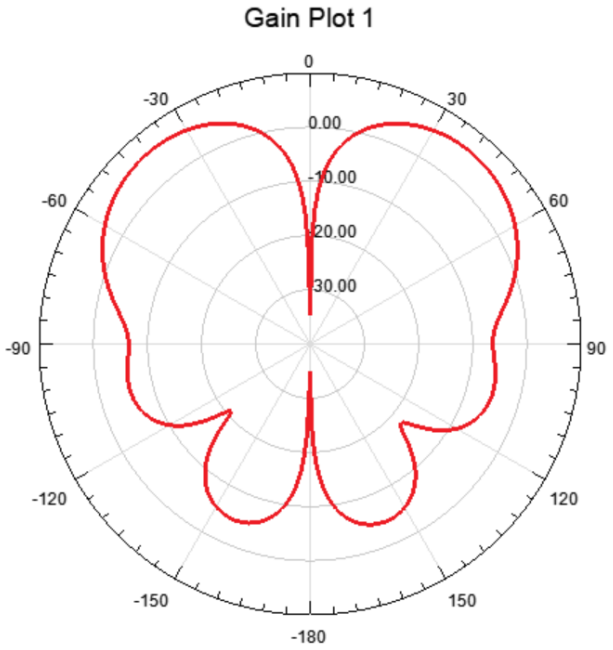
Antenna Design Geometry

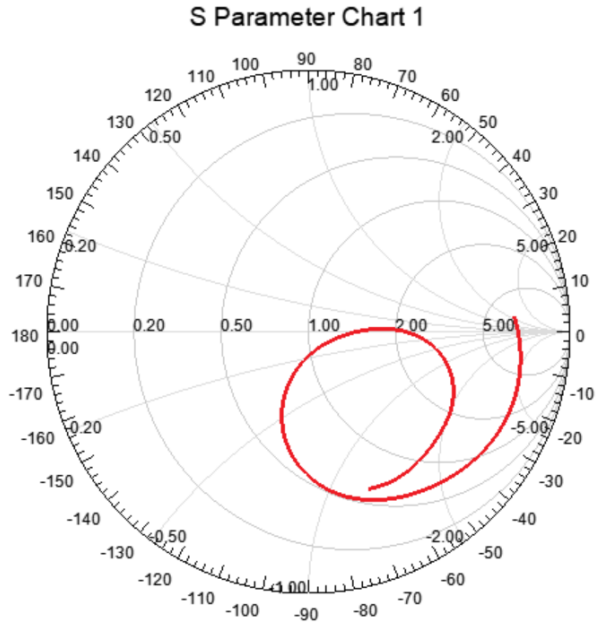
3/4 Monopole Specs – Ver. A	(λ)	(mm)
Length	0.71	950.9
Gap Height	0.01	13.39
Radius	0.015	20.09
Ground Plane Length	1	1339

3/4 Monopole Specs – Ver. B	(λ)	(mm)
Length	0.72	964.1
Gap Height	0.01	13.39
Radius	0.015	20.09
Ground Plane Length	0.5	670

Antenna Simulation Results Ver. A

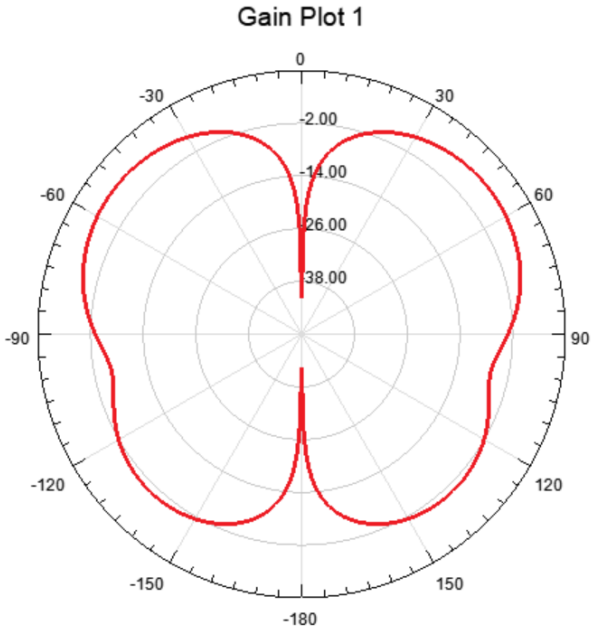
Parameters	
S_{11}	$-21.5\ dB$
Z_{in}	$57.8 - j4.74\ \Omega$
Gain	$6.2\ dB$
Bandwidth	$25.8\ MHz$

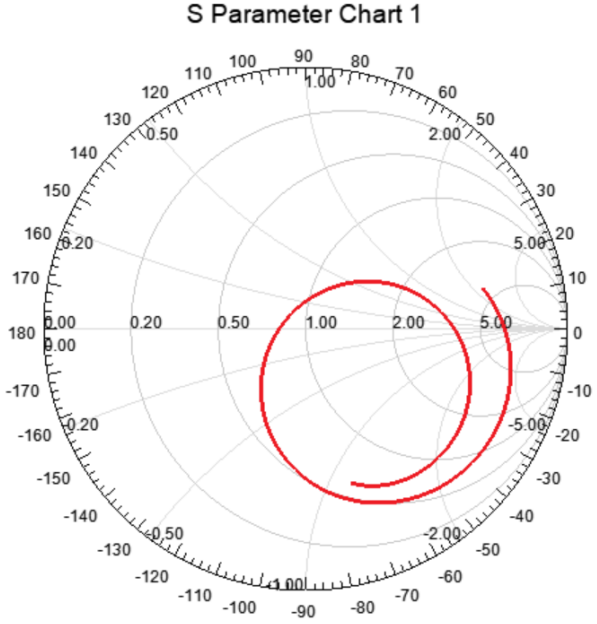




Antenna Simulation Results Ver. B

Parameters	
S_{11}	$-21.99\ dB$
Z_{in}	$44.9 + j5.58\ \Omega$
Gain	$4.0\ dB$
Bandwidth	$19.6\ MHz$





Antenna Material Cost

Product Description	Quantity	Unit Cost	Total Cost
6ft Aluminum Rod	2ea	$35.76/ea	$71.52
SO-239	2ea	$4.42/ea	$8.84
Aluminum (6061) Base Plate (6ft x 6ft, 1/32 in)	1ea	$4.32/ea	$4.32
Antenna Subtotal			$84.68
Transmission Line	2ea	$30.00/ea	$60.00
Mount	1ea	$20.00/ea	$20.00
DAC	1ea	$2.40/ea	$2.40
ADC	1ea	$4.00/ea	$4.00
Mixer	1ea	$10.00/ea	$10.00
LNA	1ea	$7.00/ea	$7.00
Ferrite Circulator	1ea	$150.00/ea	$150.00
Total Cost			$338.08

Calculations

- Radar Equation
  - Assuming...
    - Transmit Power (P_t) = 1 W
    - Gain (G) = 4.169 (6.2 dBi)
    - Radar Cross Section (σ) = .01 m^2
    - Wavelength (λ) = 1.339 m
    - $\rightarrow P_r = P_t \frac{G^2 \lambda^2 \sigma}{(4\pi)^3 R^4} = 1.57E-16\ W$