

1. Introduction

1.1. PROBLEM STATEMENT

The problem being addressed is designing a radar device for object detection using ultrasonic sound waves. The radar will be able to determine an object's distance and direction from the radar. This is done through the use of ultrasonic transmitters lined up side-by-side a fixed distance away from each other, this is known as a phased array, these transmitters send an ultrasonic wave that is then reflected back to the ultrasonic receiver. Distance from the radar and object can be found by using the time delay, from when the signal is sent and then received. The direction of the object can be found using phase delay. The system will provide a learning opportunity for ultrasonic object detection, which can further be used in various applications (collision detection, water level determination, airspace scanning, ect.).

1.2. INTENDED USERS

Client (Professor Song):

Our client is an Electrical Engineering Professor at Iowa State University and has run projects in the past dedicated to designing ultrasonic radars. Our client is likely often busy planning for his classes, but intends to guide us to develop a more effective radar implementation than past projects. Our client needs our team to develop an ultrasonic radar system that can detect object distances and directions, and the implementation must improve upon the accuracy of past implementations. Our client intends to provide a learning experience to our team by giving us experience with embedded systems and determining areas of improvement by viewing past designs.

Theoretical Purchaser:

While there are not plans to release this design after we complete it, there are many commercial uses for a sort range object detector, some of these include: checking blind spots on cars, such as making a beeping noise if there is an object behind you while in reverse, or to check if there is a car to the side of you while driving, this is useful for changing lanes. Another use case could be a security mechanism, this could detect if someone walks through a door or if an object was removed from a pedestal.

Designers (group members):

This user group consists of the student engineers working on the project, each starting with different levels of knowledge in software and hardware integration. One key need is for the project to offer learning opportunities in both the software and hardware aspects. Additionally, the project will present technical challenges as the team integrates both of the aforementioned sectors. The benefits of meeting these needs include gaining valuable hands-on experience, with the skills learned being applicable to future software and hardware development careers.