Contextualization/Design Check-In

Ultrasonic Object Detector
sdmay25-36

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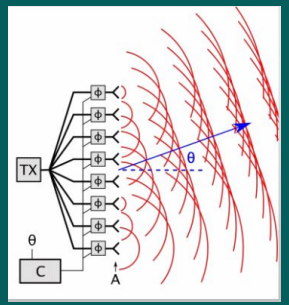
Project Overview

- Design an ultrasonic radar



- Array of transducers
- Rely on reflected sound waves to determine object distance
- Use of time-delay (phase) to control scanning direction and location

Problem Statement

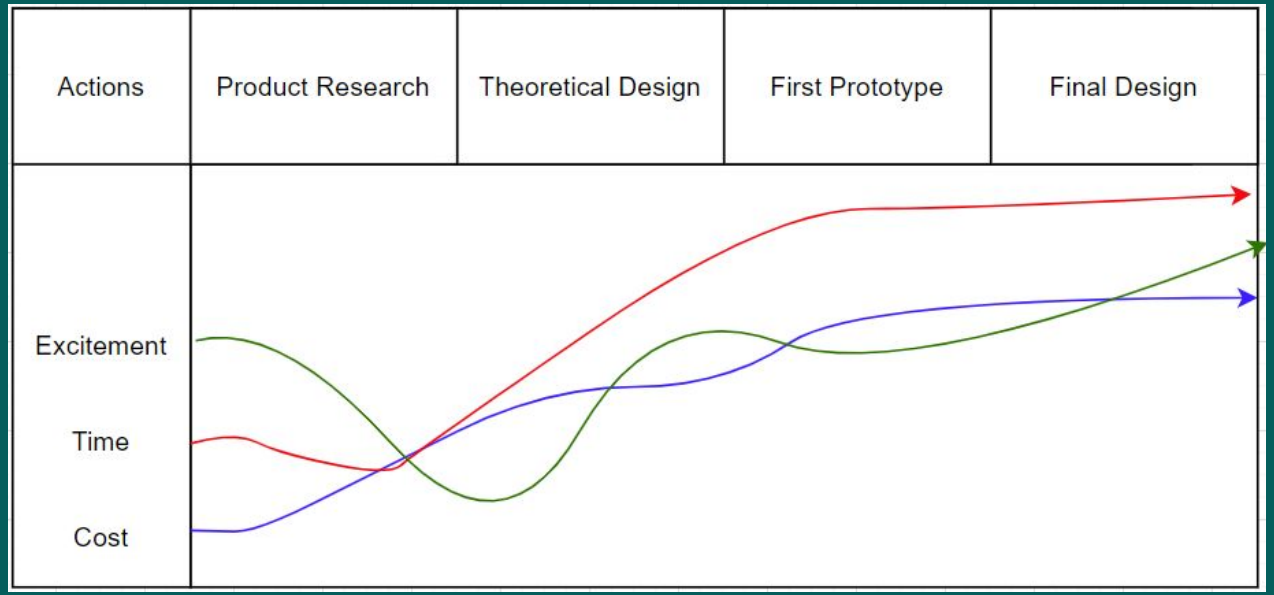
- Design an Ultrasonic Radar System which can detect small objects
- Accurately detect two side-by-side objects
- Effectively convey an image through the use of an intuitive display

Functionality

- Our radar can be used for simple object detection
    - The transducer we picked cannot be used for military or security purposes, and it is not rated for outdoor use.
- The user will get the location of the object on a on the radar display
    - They can decide what they what further analysis is needed, depending on their use case.
- The radar will be able to detect two or more separate objects in close proximity
- The radar will be accurate up to a range of 1 meter.

Journey Map -

Designer Persona



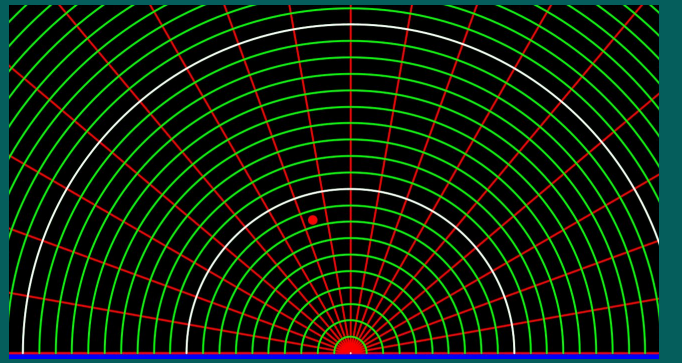
Pro/Con Table

Multi Receiver VS. Single Receiver System

Pros	Cons
• Increased accuracy (can combine data) • Increased effective range (combined FOV of multiple receivers)	• More expensive (requiring more receivers) • Increased components may increase risk of damage • Higher complexity for necessary calculations (particularly for phase delay)

Human Needs / Area

- This design accomplishes the user need of detecting 2 separate objects.
- A clear and readable interactive Display
    - Display must not be muddy (if it is depicted with a heat map the streaks should not be exceedingly large)
- The decibel level should not be damaging to human or animal ears.
- Radar will accurately send and receive a signal for a range of 1 meter to viewable.
- The device should be easy to set up with the provided components



Economic Area

- Our design plans on improving on previous designs by will remaining affordable, one of our biggest considerations other than performance when choosing parts is the price.
- Our design also plans on improving on the documentation of previous designs allowing future implementations to search for cheaper substitutions.
- We will need to ensure that our design is functional and will not lead to any parts being destroyed (having to replace transducers could become expensive)
- The MCU is very affordable at $15.00, but it still has very high performance statistics which should prove sufficient for the this project.

Technical Area and Complexities

- Phase delay must be calculated an applied to scan in a particular direction/angle. With a high number of transducers this can become very complex.
- The distance will need to be determined with time delay. This will provide complexity by needing to track the time a pulse is sent and received. This should be a very short time period.
- The calculations need to determine the distance angle should be very quick to prevent delay in detection processing.
- The ESP32-S3-DevKitC-1-N8R8 MCU should provide ample processing power, but will need to be properly programmed.
- Transmitters should be placed in way such that the signal to noise ratio is as high as possible.
- Filtering of pulse inputs is necessary to reduce noise and interference.

Technical Area and Complexities

- The data will need to be sent over wifi to a Raspberry Pi, which should provide a stronger connection to the computer for final processing.
- Upon receiving the data the display program will need to continuously receive data and parse it.
- The display will need to continuously refresh to prevent a high number of data points, and making the current points more relevant based on recency. (Potentially points could fade based on the time since being detected)
- The display must clearly depict the difference between two close objects an one singular larger object.
- Object groupings should be clear, and the display should be interactive allowing for zooming for improved readability.

Questions?