B4: Ride-AR

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Use-Case - The Problem

- Over 40,000 bicycle accidents and 800 deaths occurred in the US in 2019
- A large number of bicycle accidents occur because they fail to yield or see a bicyclist and end up colliding with them.

Our Solution

- Improve biker’s situational awareness using sensors
- Use glasses with mini HUD to inform user

Requirements

- Camera and LIDAR > 120 degree field of view
- LIDAR detect car within 12m*
  - Distance to car within 1m
- Object recognition detect car within 60m
  - <10% error rate

Requirements

- Calculate speed of car within 5mph
- Process inputs and alert user within 0.3 seconds of detection
- Battery life of 6 hours
- <3lbs
- <0.5ft^3

ECE Area Coverage

- Software Systems

  We plan to program a jetson in order to process data received from the LIDAR and camera in order to send an alert to the cyclist

- Hardware Systems

  Combining the LIDAR with the camera and the speaker with the Jetson for audio alerts

- Signals and Systems

  We will be using a lot of data from sensors to determine the danger of the situation

Technical Challenge: Object Recognition

Object Detection

- Don’t want to notify the user when irrelevant objects such as trees are detected by the LIDAR
- Need to be able to selectively detect cars
- Latency of detection

Night Use

- During night time, using a camera for object detection could become obsolete
- Need a backup strategy to deal with night time detection

Technical Challenge: Ranging

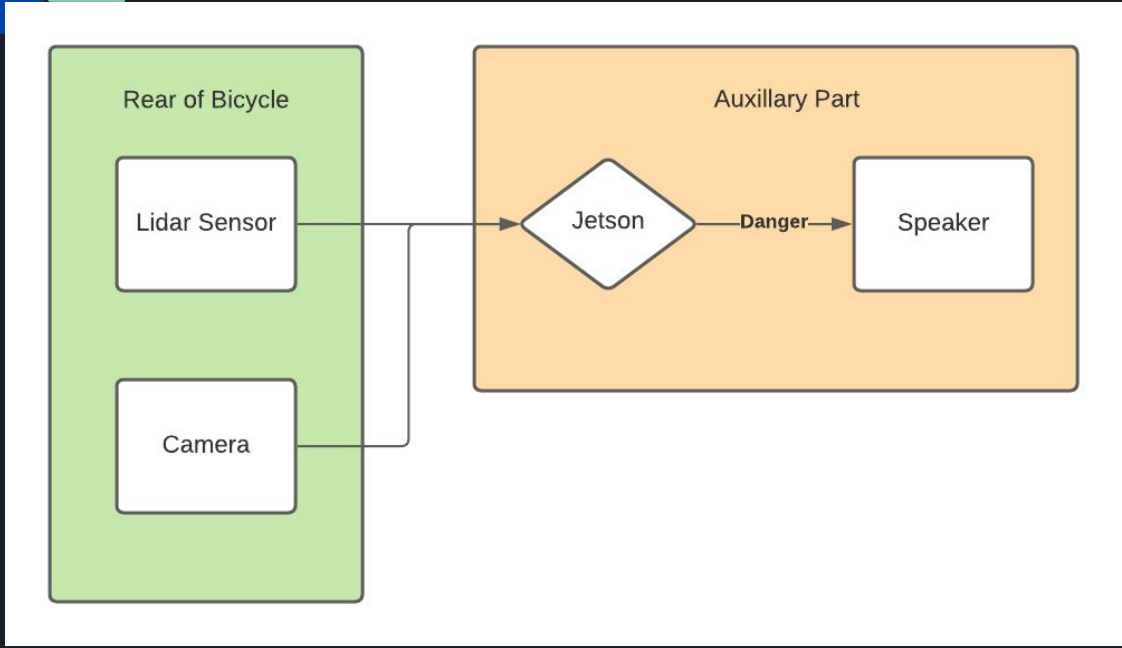
Ranging

- Need to accurately judge distance to car
- Processing LIDAR data and filtering noise
- Reliable operation in different weather conditions

Integration with Object Detection

- Need to overlay distance information with object detection information to determine distance to cars

Implementation



Testing, Verification, Metrics

Use Case 1: Car Recognition

- Enter empty space and perform numerous trials placing vehicle in front of camera at a number of different orientations
  - Measure both the percentage of accurate car detection as well as the time needed to recognize the vehicle. Also change visibility to see camera how camera reacts

Use Case 2: Distance Detection

- Move car or like object near lidar to see if accurately collecting data 12m maximum range with a margin of error 1m through console output

Use Case 3: Danger Detection

- Two step approach. Either use preset speed and timings and use basic kinematic to determine speed from different distances from bike or use large space drive car at slower speeds and read calculations from sensor

Use Case 4: Latency Testing

- Move objects closer and farther from the sensors and measure the time it takes to signal user

Tasks

Fayyaz:

1. Integrate camera and lidar together with jetson such that they can speak to each other
2. Design and implement circuit to integrate speaker to alert user when the algorithm determines danger

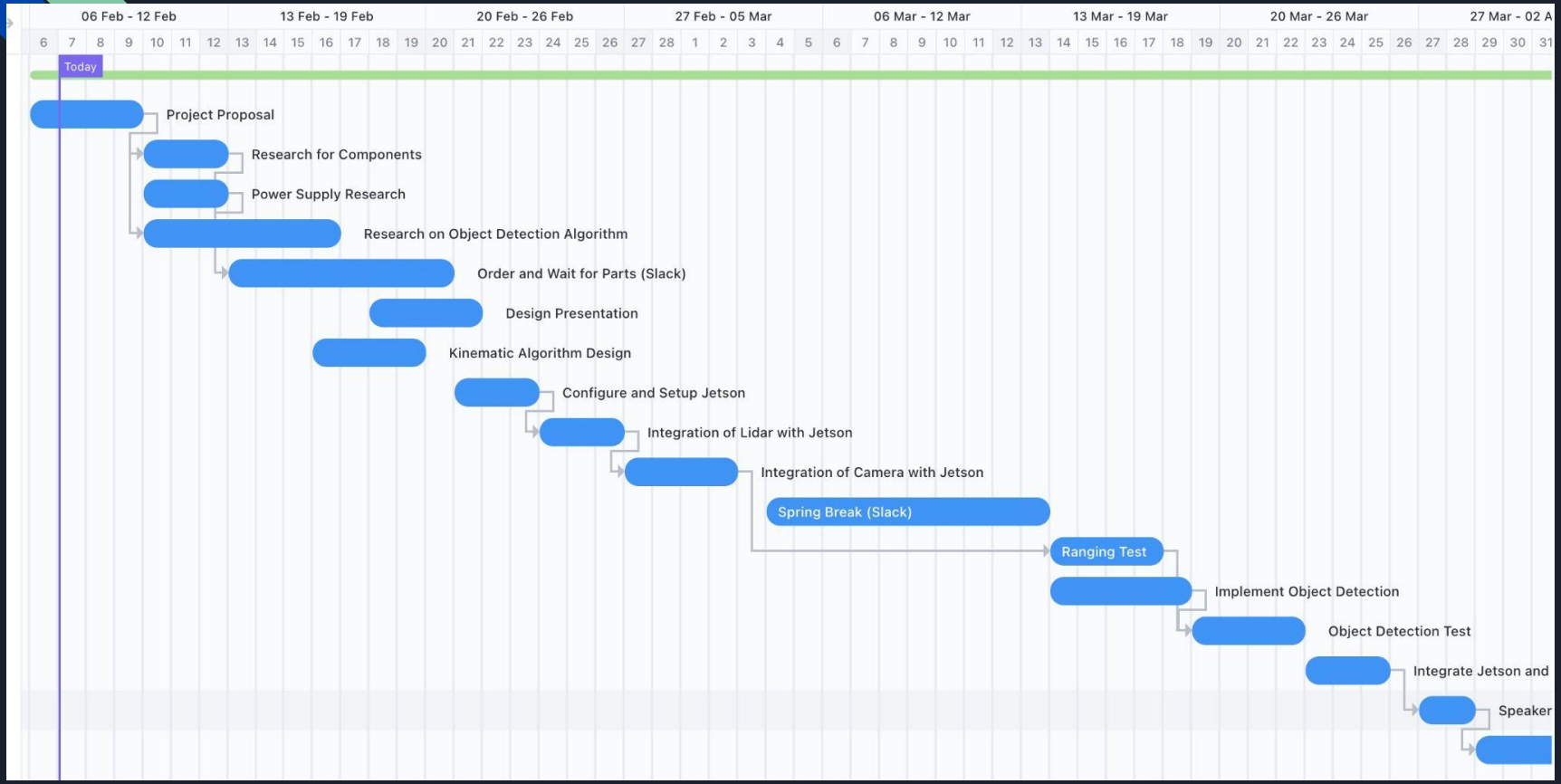
Ethan:

3. Design effective module to attach to bike
4. Configure lidar sensor to ensure that we read precise measurements:

Chad:

5. Install and implement a computer vision algorithm to detect cars
6. Create algorithm that uses kinematics, lidar output, and object detection to determine surrounding and potential danger

Schedule


06 Feb - 12 Feb
13 Feb - 19 Feb
20 Feb - 26 Feb
27 Feb - 05 Mar
06 Mar - 12 Mar
13 Mar - 19 Mar
20 Mar - 26 Mar
27 Mar - 02 A
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Today
Project Proposal
Research for Components
Power Supply Research
Research on Object Detection Algorithm
Order and Wait for Parts (Slack)
Design Presentation
Kinematic Algorithm Design
Configure and Setup Jetson
Integration of Lidar with Jetson
Integration of Camera with Jetson
Spring Break (Slack)
Ranging Test
Implement Object Detection
Object Detection Test
Integrate Jetson and
Speaker