RADAR Data Collection Robot

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Presentation Overview

Project Overview

Context

- Undergraduate research assistant during my final year
- Looking for a challenge to apply and extend my skills
- A PhD student needed a physical system to validate simulations

Project Goals

1. Mechanical and Electrical design of a rotating platform for a RADAR sensor
2. Control speed of platform, accurate measurements of angular position
3. Design and implement a software system to control a mobile robot and rotating platform

Mechanical and Electrical Design

Problem

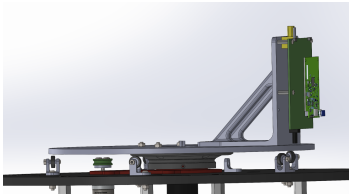
- Rotate a RADAR Sensor (power + Ethernet + USB) between 1-10 Hz

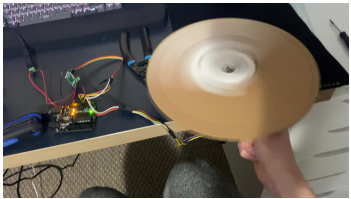
Solution

- Leverage my experience and network - ask questions and trust myself
- Iterate quickly and thoughtfully - find issues earlier and find solutions

Impact

- Inexpensive, in-house manufactured solution





Control and Tuning

Problem

- Unstable system, no tachometer, unrealistic conditions during initial programming/tuning

Solution

- Apply first principles
- Balance platform weight - adjustable counterweight
- Speed up control loop - optimize code
- Tune PID controller - accurate weight, battery level

Impact

- Working platform with accurate speed control, no redesign or new equipment needed

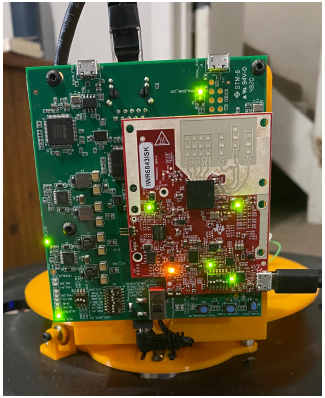
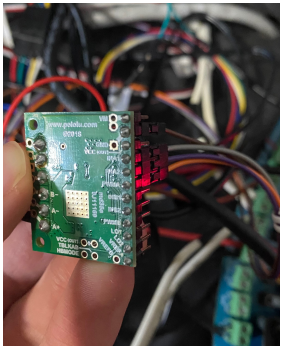
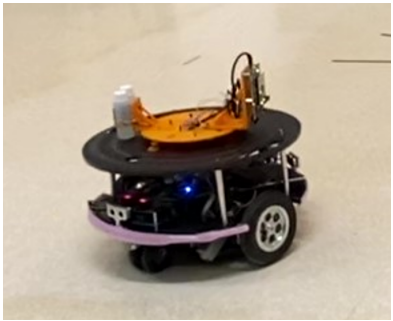


Figure 2: Sensor mounted on platform.

Control and Tuning



(a) DC motor driver.



(b) Adjustable counterweights.

Figure 3: More images.

Mobile Robot Control

Problem

- Robot drifting when given forward command

Solution

- Analysing each component from wheel to wheel-encoder to microcontroller to host PC
- Identify and replace faulty closed-loop motor controller circuit

Impact

- Lesson in validating components before testing the entire system

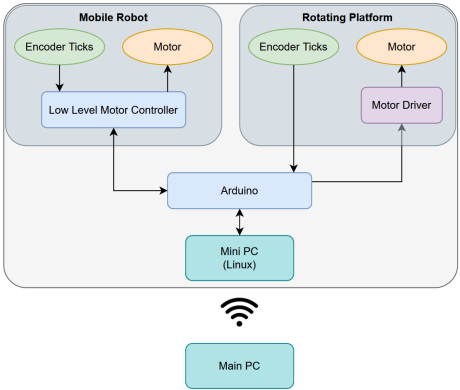


Figure 4: System architecture.

System Debugging

Problem

- Driver not working on Linux (but no issue on Windows)
- Missing RADAR data packets

Solution

- Worked in a team to debug driver software
- Faulty solder connections on ethernet cable

Impact

- Able to continue with Linux - saving development time
- Functional system, no data loss

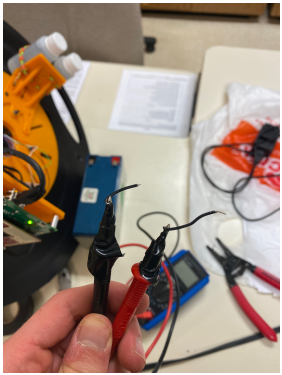


Figure 5: Creative tools.

Conclusion

- Goals achieved - working platform and mobile robot
- PhD student was able to complete their thesis
- Used first principles and creativity to solve problems
- Gained experience solving an open problem from scratch

The End

Questions?