ECE 445: Senior Design Lab
Individual Progress Report

Rutvik Sayankar

March 26, 2024

Contents

0.1　Terms and Keywords

- ChILD - Children's Interstitial and Diffuse Lung Disease

- PCB – Printed Circuit Board

- OWB - Three-Wheeled Omni-Wheel Bot

- UWB - Ultra-wideband is a radio technology that can use a very low energy level for short-range, high-bandwidth communications over a large portion of the radio spectrum.

- ESP32 - A series of low-cost, low-power system-on-a-chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.

- RPM - Revolutions per minute

- GPIO - General-purpose input/output

- PWM - Pulse-width modulation

- MPH - Miles per hour

- OpenCV - (Open Source Computer Vision Library) is an open source computer vision and machine learning software library.

- OpenPose - Real-time multi-person keypoint detection library for body, face, hands, and foot estimation.

- TDoA - Time Difference of Arrival

- ToF - Time of Flight

Chapter 1

Introduction

1.1 Team Project Overview

Children's interstitial and diffuse lung disease (ChILD) is a collection of diseases or disorders. These diseases cause a thickening of the interstitium (the tissue that extends throughout the lungs) due to scarring, inflammation, or fluid buildup [1]. This eventually affects a patient's ability to breathe and distribute enough oxygen to the blood. Numerous children experience the impact of this situation, requiring supplemental oxygen for their daily activities. It hampers the mobility and freedom of young infants, diminishing their growth and confidence. Moreover, parents face an increased burden, not only caring for their child but also having to be directly involved in managing the oxygen tank as their child moves around.

Given the absence of relevant solutions in the current market, our project aims to ease the challenges faced by parents and provide the freedom for young children to explore their surroundings. As a proof of concept for an affordable solution, we propose a three-wheeled omnidirectional mobile robot capable of supporting a filled M-6 oxygen tank. We plan to implement two localization subsystems to ensure redundancy and enhance child safety. The first subsystem utilizes ultra-wide band (UWB) transceivers for triangulating the child's location relative to the robot in indoor environments, this is similar to how Apple AirTags triangulate their location relative to an iPhone [2] (although AirTags use a combination of UWB and Bluetooth triangulation [3]). The second subsystem makes use of a desktop web camera which streams video to a Raspberry Pi where it will leverage open-source object tracking libraries to improve our directional accuracy in tracking a child. The final main subsystem focuses on the drive train, chassis and close range object detection of the robot.

1.2 Individual Responsibilities

My individual responsibilities are as follows:

- Overall project management

- Research, design and implementation of OWB triangulation system

- Design and Routing of PCB

- Aid in chassis design

- Aid in bumper limit switch design

- Handle all 3D printing

Chapter 2

Individual Design Work

2.1 Design Considerations

2.2 Diagrams

2.3 Testing/Verification

Chapter 3

Conclusion

3.1 Self-assessment

3.2 Plans for remaining work

Hello World! Today I am learning LaTeX. LaTeX is a great program for writing math. I can write in line math such as $a^2 + b^2 = c^2$. I can also give equations their own space: [4]

$$\gamma^2 + \theta^2 = \omega^2 \tag{3.1}$$

If I do not leave any blank lines LaTeX will continue this text without making it into a new paragraph. Notice how there was no indentation in the text after equation (1). Also notice how even though I hit enter after that sentence and here ↓ LaTeX formats the sentence without any break. Also look how it doesn't matter how many spaces I put between my words.

For a new paragraph I can leave a blank space in my code.

Bibliography

[1] "Childhood interstitial lung disease," Mar 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/childhood-interstitial-lung-diseases

[2] "Ultra wideband," Mar 2023. [Online]. Available: https://discussions.apple.com/thread/254750118?sortBy=best

[3] "Find your keys, backpack, and more with airtag and find my," Feb 2024. [Online]. Available: https://support.apple.com/en-us/109021

[4] "Ieee code of ethics," Jun 2020. [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html