THE DEPARTMENT OF
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AI Smart Belt to Guide the Visually Impaired: ROS-based navigation methods for seamless movement in diverse environments

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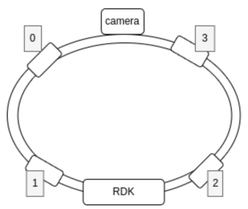
Introduction

Problem Statement

There is limited technology when it comes to indoor navigation for the visually impaired due to absence of GPS signals.

Solution

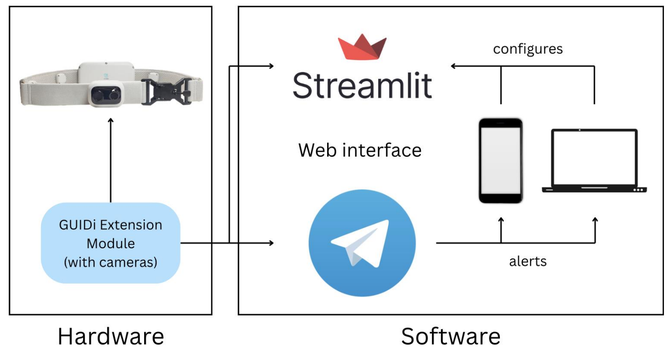
The GUIDi—a wearable smart belt that provides directional instructions through the use of vibrating motors.



Objectives

- Create a pathfinding system that detects fiducial markers to establish paths for the user to follow.
- Develop and fine-tune an object detection system to prevent unwanted collisions.
- Incorporate a haptics feedback system to provide the user with immediate feedback during navigation.
- Build a web interface that allows system managers to interact and configure the device for clients, with a built-in path planning system.

System Architecture

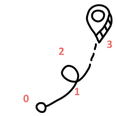


Implementation

The belt helps guide the user along a path comprised of fiducial markers.

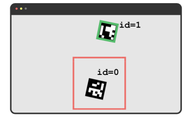
A front-facing camera detects obstacles and immediately alerts the user.

General Workflow

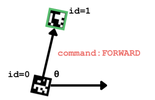


The user first decides on a path (a sequence of numbers)

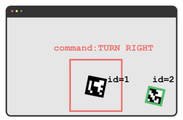
The down-facing camera initializes by starting at the marker with the first ID in the sequence.



Once the current marker is within range (red box), it starts looking for the next marker in sequence.



The angle θ between the previous and current marker is measured, and prepares a signal to turn left/right until θ is close to 90 degrees, telling the user to move forward



The current marker is updated to the next ID in sequence once the previous marker is in range.

Additional Features

An emergency alert system via Telegram in case the user moves astray from a route.

A path planning feature that uses breadth-first search for generating optimal routes.

Easy-to-configure interactive graphs with nodes representing markers in the environment, with a save system included.

Conclusion

- A working prototype for a smart belt utilizing marker-based guidance was successfully constructed.
- A fisheye camera is suggested for a wider field-of-view for future implementations.