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# Introduction

## Research Question

* Describe problem: Arena with unknown layout containing “victims”
* Propose solution: Want to implement technical solution that can navigate arena and detect victims
* Motivation: Describe real world analogy of searching for survivors after disaster

## Objectives

* We want to develop a robot that solves the problem proposed in the research question - it must be able to explore an unknown arena and detect the “victims” inside it
* Requirements: Needs to be able to move around, detect obstacles and detect colors
* Evaluation of performance: Robot must be able to count the number of victims detected (should be accurate), the average linear speed (should be high) and the number of collisions (should be low/accurate)

# Equipment

## TurtleBot

* Short description of what a turtlebot is
* Why a turtlebot is useful for us and what we want to do
* Brief description of its different components

## Raspberry PI

* Purpose: Computer that is part of the turtlebot, and handles everything it does
* Runs with ubuntu as its operating system

## Lidar

* Purpose: It is used for detecting the obstacles in the arena
* Technical abilities - how does the lidar detect obstacles, and what data does it generate?
* Limitations of the lidar - how much and what can it measure?

## Colour Detector

* Functionality: Describes how much red, blue and green it is seeing
* Setup with raspberry PI
* Getting data from colour detector in python

## Robot Operating System

* Description of ROS and what it can do
* Description of publisher/subscriber architecture
* Description of how ROS will be used in our project

# Methodology and Experiments

## Obstacle Detection

* How are objects detected: How close do they have to be, and what regions are scanned?
* How is the data from the lidar treated?
  + Some data must be removed because it is faulty
* how do you decide an object is located in a region of the scannings?

## Navigation

* Description of the general navigation technique - how is the turning direction decided?
  + How do you make sure you explore many parts of the arena?
* Challenges with edge cases: What happens when a dead end is reached or you are in a corner?
* Challenges with narrow openings: Detecting whether you should go through or not

## Movement

* The robot should move in such a way that linear speed is optimized while still avoiding objects
* When should the robot start turning?
  + Cost/benefit of turning early
  + When should the robot have no linear speed?
* Dynamically setting angular and linear speed as a function of distance
* Description of how the linear speed is tracked

## Victim/Colour Detection

* Challenges of detecting specific colour
  + Setting thresholds for when a colour is found
* Challenges of running over victim too quickly without detecting it
* Making sure to only increase counter by one when victim is detected

## Collision Detection

* Challenges with lidar readings - won’t read below 15 cm
  + Couldn’t distinguish between almost colliding and colliding
* Alternative solution: Using fewer lidar readings as indicator of collision
  + Testing for threshold indicating collision
* Challenges of only detecting a single collision when colliding

# Results

## Capabilities of the Robot

* Brief and general of the robot’s abilities/final behaviour
* Test results from running different courses
  + How many victims were found?
    - How many should it have detected?
  + How many collisions were detected?
    - How many actually happened
  + What was the average linear speed?

## Errors

* Wrong behaviours we have observed in the robot
* What scenarios does it struggle with?
  + Navigation, obstacle detection and movement
  + Detection of victims and collisions

# Discussion

## Review of the Robot

* Is the robot functional?
* Have the requirements described in the intro duction been met?
  + Where have they not been met?
* What are the short comings of the robot

## Improvements

* What features needs to be improved/fixed?
* How can the robot be made better?
  + Making sure to explore the entire arena
  + Not detecting the same victim twice
  + Better collision detection

# Conclusion

* Summing up the report, with focus on the results and discussion sections

# References