Robotics Assignment Presentation
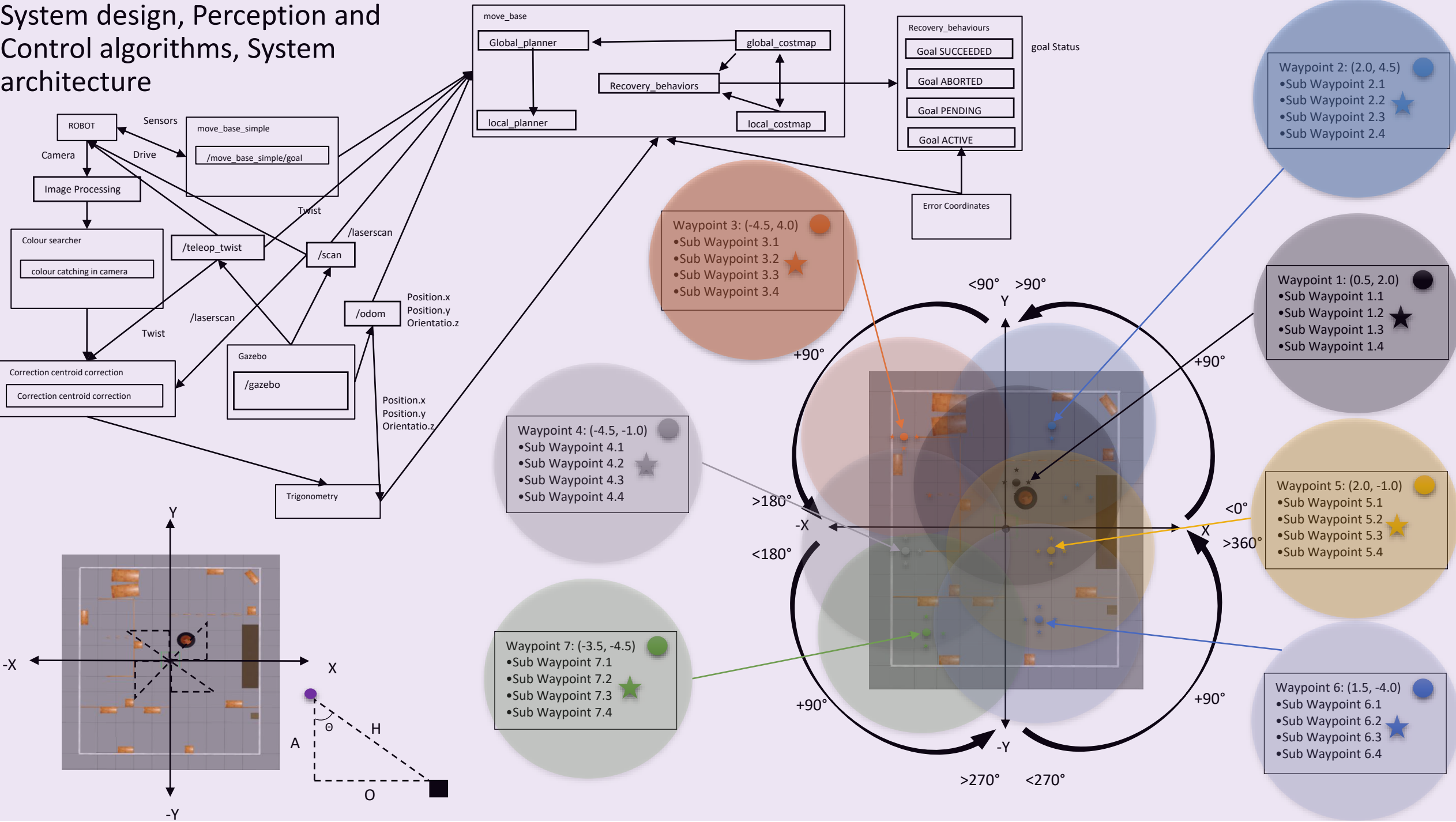
Contents:

System design, Perception and Control algorithms, System architecture

move_base

Global_planner

local_planner

global_costmap

Recovery_behaviors

local_costmap

Recovery_behaviours

Goal SUCCEEDED

Goal ABORTED

Goal PENDING

Goal ACTIVE

goal Status

Error Coordinates

ROBOT

Sensors

Drive

Camera

move_base_simple

/move_base_simple/goal

Twist

Image Processing

Colour searcher

colour catching in camera

/teleop_twist

/scan

/laserscan

/odom

Position.x
Position.y
Orientatio.z

Gazebo

/gazebo

/laserscan

Twist

Correction centroid correction

Correction centroid correction

Position.x
Position.y
Orientatio.z

Trigonometry

Waypoint 3: (-4.5, 4.0)
•Sub Waypoint 3.1
•Sub Waypoint 3.2
•Sub Waypoint 3.3
•Sub Waypoint 3.4

Waypoint 2: (2.0, 4.5)
•Sub Waypoint 2.1
•Sub Waypoint 2.2
•Sub Waypoint 2.3
•Sub Waypoint 2.4

Waypoint 1: (0.5, 2.0)
•Sub Waypoint 1.1
•Sub Waypoint 1.2
•Sub Waypoint 1.3
•Sub Waypoint 1.4

Waypoint 4: (-4.5, -1.0)
•Sub Waypoint 4.1
•Sub Waypoint 4.2
•Sub Waypoint 4.3
•Sub Waypoint 4.4

Waypoint 5: (2.0, -1.0)
•Sub Waypoint 5.1
•Sub Waypoint 5.2
•Sub Waypoint 5.3
•Sub Waypoint 5.4

Waypoint 7: (-3.5, -4.5)
•Sub Waypoint 7.1
•Sub Waypoint 7.2
•Sub Waypoint 7.3
•Sub Waypoint 7.4

Waypoint 6: (1.5, -4.0)
•Sub Waypoint 6.1
•Sub Waypoint 6.2
•Sub Waypoint 6.3
•Sub Waypoint 6.4

$<90°$ $>90°$

$+90°$

$>180°$

$<180°$

$+90°$

$<0°$

$>360°$

$+90°$

$>270°$ $<270°$

Y

-X

X

-Y

Y

-X

X

-Y

Θ

A

H

O

Test Analysis on Cylinder Detection, with Calculated Completion Time & Obstacle Collision Count:
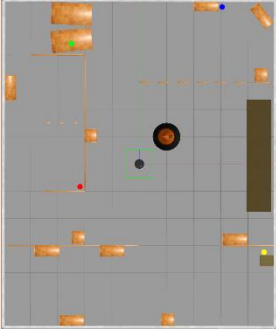
Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:19

Colour Information:
Colour RED; (Test: Valid) : FOUND
- No. waypoints used to find colour: 2
Colour GREEN; (Test: Extreme) : FOUND
- No. waypoints used to find colour: 2
Colour BLUE; (Test: Extreme) : FOUND
- No. waypoints used to find colour: 2
Colour YELLOW; (Test: Valid) : FOUND
- No. waypoints used to find colour: 1

Time delay from No. waypoints - 4 x 7 secs:
Delay: (3x7) = 21 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:19

Colour Information:
Colour RED; (Test: Valid) : FOUND
- No. waypoints used to find colour: 1
Colour GREEN; (Test: Extreme) : FOUND
- No. waypoints used to find colour: 1
Colour BLUE; (Test: Valid) : FOUND
- No. waypoints used to find colour: 3
Colour YELLOW; (Test: Extreme) : FOUND
- No. waypoints used to find colour: 2

Time delay from No. waypoints - 4 x 7 secs:
Delay: (3x7) = 21 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:04:04

Colour Information:
Colour RED; (Test: Valid) : FOUND
- No. waypoints used to find colour: 3
Colour GREEN; (Test: Extreme) : FOUND
- No. waypoints used to find colour: 2
Colour BLUE; (Test: Extreme) : FAILED
- No. waypoints used to find colour: N/A (4)
Colour YELLOW; (Test: Valid) : FOUND
- No. waypoints used to find colour: 3

Time delay from No. waypoints - 4 x 7 secs:
Delay: (8x7) = 66 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:05

Colour Information:
Colour RED; (Test: Valid) : FOUND
- No. waypoints used to find colour: 1
Colour GREEN; (Test: Valid) : FOUND
- No. waypoints used to find colour: 1
Colour BLUE; (Test: Valid) : FOUND
- No. waypoints used to find colour: 2
Colour YELLOW; (Test: Valid) : FOUND
- No. waypoints used to find colour: 1

Time delay from No. waypoints - 4 x 7 secs:
Delay: (1x7) = 7 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:40

Colour Information:
Colour RED; (Test: Valid): FOUND
- No. waypoints used to find colour: 1
Colour GREEN; (Test: Valid): FOUND
- No. waypoints used to find colour: 1
Colour BLUE; (Test: Valid): FOUND
- No. waypoints used to find colour: 4
Colour YELLOW; (Test: Valid): FOUND
- No. waypoints used to find colour: 4

Time delay from No. waypoints - 4 x 7 secs:
Delay: (6x7) = 42 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:19

Colour Information:
Colour RED; (Test: Valid) : FOUND
- No. waypoints used to find colour: 2
Colour GREEN; (Test: Valid) : FOUND
- No. waypoints used to find colour: 2
Colour BLUE; (Test: Valid) : FOUND
- No. waypoints used to find colour: 3
Colour YELLOW; (Test: Valid) : FOUND
- No. waypoints used to find colour: 2

Time delay from No. waypoints - 4 x 7 secs:
Delay: (3x7) = 21 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Time to Waypoints: 00:02:30 **Total Time Taken:** 00:03:24

Colour Information:
Colour RED; (Test: Extreme): FOUND
- No. waypoints used to find colour: 2
Colour GREEN; (Test: Extreme): FOUND
- No. waypoints used to find colour: 2
Colour BLUE; (Test: Extreme): FOUND
- No. waypoints used to find colour: 2
Colour YELLOW; (Test: Extreme): FOUND
- No. waypoints used to find colour: 2

Time delay from No. waypoints - 4 x 7 secs:
Delay: (4x7) = 28 seconds
Actual Time Taken - Delay + 4 x 7: 28 seconds

Amount of Collisions with objects:
0

Observations on the System Performance:
- Move_base
  - Time taken to cancel move_base

- Error handling for hard coded coordinates
  - The four coordinates around colour
  - Time taken to get to each, non efficient in choice
  - The ability for the robot to travel behind walls

- Error handling for finding colour coordinates
  - The four coordinates around colour
  - Time taken to get to each, non efficient in choice
  - The ability for the robot to travel behind walls

System Structure Observation:
- The structure of my system programmatically
- Running the system through spyder or cmd
- Image callback

Reflections on the System Performance:
- Move_base
  - /map, occupancy grid for error areas

- Error handling for hard coded coordinates
  - Increasing the number of error coordinates
  - Using the /map occupancy grid
  - Attempting to travel to the nearest coordinate first

- Error handling for finding colour coordinates
  - Increasing the number of error coordinates
  - Using the /map occupancy grid
  - Attempting to travel to the nearest coordinate first

System Structure Reflection:
- Utilising the catkin package environment
- Using a launch file, instead of singular .py files
- Utilising other functions to reduce the size of the image call back, therefore maintaining its thread speed

Test Analysis for Error Handling Within System
Sending Robot to Hardcoded Coordinates:

Coordinate:	Test type:	Expected:	Actual:
100, 100	Invalid	Next coordinate	Next coordinate
3, 3	Valid	Move 3, 3	Move 3, 3
5, 0	Valid Ex	Move 5, 0	Couldn't reach

Testing Coordinates around colours:

Coordinate:	Test type:	Expected:	Actual:
0.0, 0.0	Valid	Top; 0, 0.6	Top; 0, 0.6
4.5, 2.5	Extreme	Top; 0, 0.6	Top; 0, 0.6
0.0, 6.0	Invalid	Cant Reach	Cant Reach

Testing Laser Scanner Distance to Cylinder Objects

Colour Distance:	Test type:	Expected:	Actual:
2 Meters	Valid	2 Meters	2 Meters
5.5 Meters	Extreme	5.5 Meter	5.5 Meters
9 Meters	Invalid	Cant Reach	Cant Reach

Evaluation of Important System Features:
- Trigonometry
  - Laser scanner accuracy
- Hardcoded coordinate system
  - Not efficient for RLS (Real Life Simulation)
  - Wont reach object location behind other objects
- Error handling for these coordinates
  - Not reaching top, below, right and left coordinates
  - In turn increases time to object