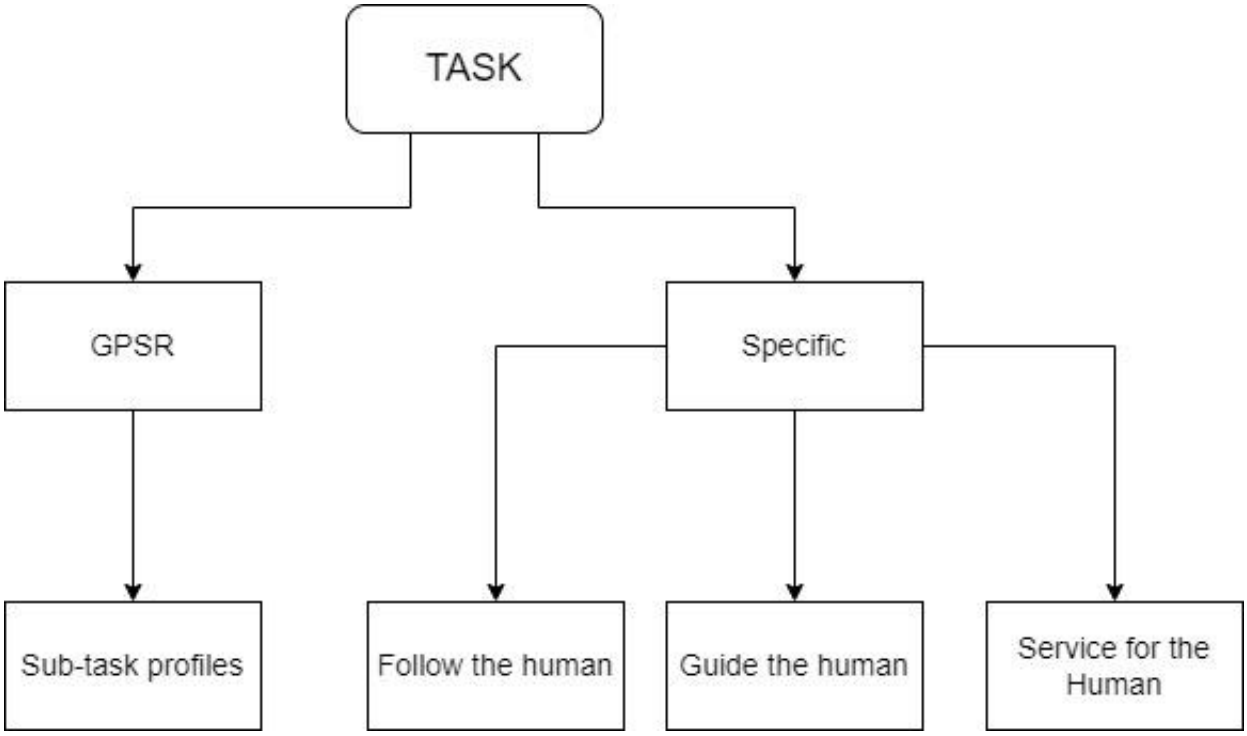

GPSR Profiling

DESCRIPTION:

GPSR (General Purpose Service Robot): The robot is tasked to understand and execute three commands given by an operator.

Focus: The test emphasizes task planning, object and people detection and recognition, object feature recognition, and object manipulation.

Procedure:
* Test start: The robot moves to the Instruction Point when the arena door opens.
* Command execution: The operator issues a command, and the robot performs the task.

* Return to the Instruction Point: After completing a task, the robot returns to the Instruction Point and waits for the next command

Command Template: https://github.com/johaq/CompetitionTemplate

Optional goal(s): Understand a command given by a non-expert operator.

Setup

Location(s): - Task location: The task occurs inside the Arena, but some commands may require the robot to go out. The Arena is in its nominal state for this task.
- Start location: The robot starts outside the Arena. When the door opens, the robot moves towards the Instruction Point.
- Instruction point: The robot moves to the Instruction Point at the beginning of the test and after finishing the first and second commands.

PROFILE

1. **Instruction point**:

   Components involved: N/A
   Quality Attribute(s): The instruction point is a recognized waypoint
   Robot Constraints: N/A
   Operational Constraints: N/A

2. **Test start:**

   Components involved: Camera, LIDAR
   Quality Attribute(s): Recognition of door opening
   Robot Constraints: The robot can navigate to the waypoint
   Operational Constraints: Waypoint is within mapped area

3. **Command execution:**

   Components involved: List follows
   Quality Attribute(s): Handle a variety of tasks as instructed, which may require different capabilities

Perform the task independently without further human intervention

Robot Constraints: Record the command given in its entirety clearly
Correctly interpret and decide actions to be taken for the command given by the operator

Operational Constraints: Background noise should be low enough for the microphone to record commands properly

A) Count the objects of a specific type in a location

Components involved: Camera
Quality Attribute(s): Object type is recognised correctly
Robot Constraints: Able to recognize and count objects of same type even with different visual attributes (e.g colour)
Operational Constraints: Ambient lighting is sufficient for object detection

*) Count the number of people in a waypoint using either color or arm gesture or body posture or none of this parameters. This action has a result to tell.

*) identify, look for, search for or find one object in a waypoint using a size or weight or or item name or category to which it belongs

B) Get, fetch, grasp, pick, or take an object in a location

Components involved: Camera, Arm/Gripper, LIDAR
Quality Attribute(s): Object is correctly identified
Object is held properly with correct grip
Robot Constraints: Able to adjust grip and pressure for different object types
Operational Constraints: Ambient lighting is sufficient for object detection

C) Place, or put an object in a location

Components involved: Camera, Arm/Gripper, LIDAR
Quality Attribute(s): Placement location is correctly identified

Robot Constraints: Able to navigate autonomously to the location waypoint

Able to assume proper pose to place and orient object at desired location

Object is within payload capacity of robot

Camera can resolve objects well enough for identification

Operational Constraints: Location is a reachable area within robot's capability

D) Deliver, offer, or bring an object to a person in a location

Components involved: Camera, LIDAR, Arm/Gripper

Quality Attribute(s): Correct identification of object

Correct identification of person's location

Robot Constraints: Able to identify and grasp object

Object is within payload capacity of robot

Camera can resolve objects well enough for identification

Able to perceive depth i.e distance to object for precise grasping

Operational Constraints: Location is a reachable area within robot's capability

E) Identify, look for, search for or find a person in a waypoint using a colour or a human sign or pose

Components involved: Camera, LIDAR?

Quality Attribute(s): Person at the waypoint is correctly identified

Robot Constraints: Waypoint is a recognized label

Dress colour / gesture / pose of the person is in defined types

Operational Constraints: Ambient lighting is enough for image and feature recognition

*) describe or obtain the body posture or name or the arm gesture of a person in a waypoint. This action has a result to tell.

F) Walk behind a person from a location to another location

Components involved: Camera, LIDAR
Quality Attribute(s): Tracking the correct person until final location is reached
Robot Constraints: Able to locate person based on recognition feature
Location waypoints are recognized and localized
Navigation plan not in conflict with the person's chosen path
Operational Constraints: The person stays within range of camera

G) Take, escort, lead, or guide a person from a location to another location

Components involved: Camera, LIDAR
Quality Attribute(s): Able to correctly establish path to final location
Maintain good pace
Robot Constraints: Able to identify person by feature in initial location
Able to maintain a good speed to be followed by
Able to correctly recognize destination location
Able to establish most efficient path between the two locations
Operational Constraints: Person is at the specified start location

H) Answer a quiz to a person in a location

Components involved: Camera
Quality Attribute(s): Correct response to give question
Robot Constraints: Able to locate person
Able to understand the question
Able to generate response to the question
Operational Constraints: Ambient noise low enough to clearly register voice

I) Speak, or tell something to a person in a location

Components involved: Camera
Quality Attribute(s): Clear communication to the correct person
Robot Constraints: Able to identify person at given location
Operational Constraints: Ambient noise low enough for conversation

J) Move from a location to another location

Components involved: Camera, LIDAR
Quality Attribute(s): Navigation to and from correct locations
Robot Constraints: Able to localize start and destination locations
Operational Constraints: Locations are recongnized waypoints

4. **Back to the instruction point:**

Components involved: Camera, LIDAR

Quality Attribute(s): Able to return to the Instruction Point autonomously after completing a task

Robot Constraints: The robot can navigate to the waypoint
Operational Constraints: Waypoint is within mapped area

5. **Pausing the timer:** The referee might pause the timer as soon as the robot reaches the instruction point to give time to setup the arena for the next command. The timer resumes as soon as the referee steps back in front of the robot for the next command.

Robot Action:

A. **"name": "count_object"**
Quality Attribute(s): Object type is recognized correctly
Robot Constraints: Able to recognize and count objects of same type even with different visual attributes (e.g colour)

Operational Constraints: Ambient lighting is sufficient for object detection

B. "name": "count_people"

Count the number of people in a waypoint using either color or arm gesture or body posture or none of this parameters. This action has a result to tell.

Quality Attribute(s): Correct identification of people

Robot Constraints: Dress color/gesture/pose of the person is in defined types

Operational Constraints: Ambient lighting is enough for image and feature recognition

C. "name": "find_object"

identify, look for, search for, or find one object in a waypoint using a size or weight or item name or category to which it belongs

Quality Attribute(s): Correct identification of object property

Robot Constraints: Able to measure object identification property

Able to categorize object

Operational Constraints: Object is within the known item types

D. "name": "pick_object"

Quality Attribute(s): Object is correctly identified

Object is held properly with correct grip

Robot Constraints: Able to adjust grip and pressure for different object types

Operational Constraints: Ambient lighting is sufficient for object detection

E. "name": "place_object"

Quality Attribute(s): Placement location is correctly identified

Robot Constraints: Able to navigate autonomously to the location waypoint

Able to assume proper pose to place and orient object at desired location

Object is within payload capacity of robot

Camera can resolve objects well enough for identification

Operational Constraints: Location is a reachable area within robot's capability

F. "name": "offer_object"

Quality Attribute(s): Correct identification of object

Correct identification of person's location

Robot Constraints: Able to identify and grasp object
Object is within payload capacity of robot
Camera can resolve objects well enough for identification
Able to perceive depth i.e distance to object for precise grasping

Operational Constraints: Location is a reachable area within robot's capability

G. "name": "find_person"

Quality Attribute(s): Person at the waypoint is correctly identified

Robot Constraints: Waypoint is a recognized label
Dress colour / gesture / pose of the person is in defined types

Operational Constraints: Ambient lighting is enough for image and feature recognition

H. "name": "describe_person"

Describe or obtain the body posture or name or the arm gesture of a person in a waypoint. This action has a result to tell.

Quality Attribute(s): Correct identification of person's description details in scope

Robot Constraints: Able to determine the posture and/or gesture from the person
Able to compremend the posture and/or gesture from the person
Able to communicate to get the person's name

Operational Constraints: Ambient lighting and sound within acceptable range

I. "name": "follow_person"

Quality Attribute(s): Tracking the correct person until final location is reached

Robot Constraints: Able to locate person based on recognition feature
Location waypoints are recognized and localized
Navigation plan not in conflict with the person's chosen path

Operational Constraints: The person stays within range of camera

J. "name": "guide_person"

Quality Attribute(s): Able to correctly establish path to final location

Maintain good pace

Robot Constraints: Able to identify person by feature in initial location

Able to maintain a good speed to be followed by

Able to correctly recognize destination location

Able to establish most efficient path between the two locations

Operational Constraints: Person is at the specified start location

K. "name": "answer_quiz"

Quality Attribute(s): Correct response to give question

Robot Constraints: Able to locate person

Able to understand the question

Able to generate response to the question

Operational Constraints: Ambient noise low enough to clearly register voice

L. "name": "speak"

Quality Attribute(s): Clear communication to the correct person

Robot Constraints: Able to identify person at given location

Operational Constraints: Ambient noise low enough for conversation

M. "name": "move_to"

Quality Attribute(s): Navigation to and from correct locations

Robot Constraints: Able to localize start and destination locations

Operational Constraints: Locations are recognized waypoints