UNSW@HOME

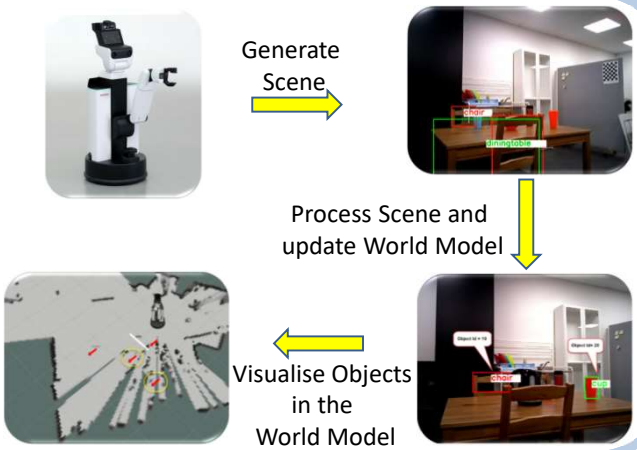
RoboCup@Home - Domestic Standard Platform League

Never Stand Still | Faculty of Engineering | School of Computer Science and Engineering

Maintaining the World Model

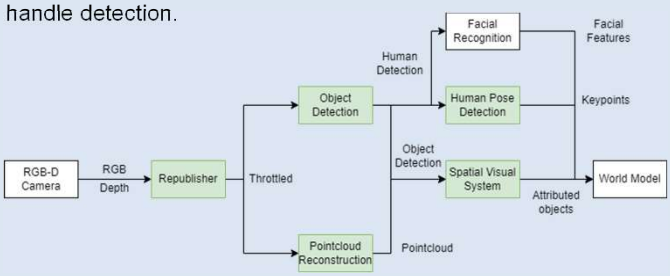
The ability of an autonomous robot to perform a task is highly dependent on how well the environment it works within can be described (modelled) and queried as well as the confidence that the various agents utilising this this data have in the of the accuracy of the model.

We developed a world model that describes unique objects with their attributes including classification, location, colour and size. The grounding of these objects in the world model is maintained by processing data (scene graphs) obtained from the spatial visual system. We also included some basic object behaviours so that the probabilities of the objects continuing to exist in the world could be updated.



Linear Vision Pipeline

Our linear vision pipeline provides a generalised image processing module. The pipeline is designed to reduce computational overhead by only processing frames with objects of interest in it. The modular plug and play approach allows for easy expansion of the pipeline enabling research and development of new perception methods. It also provides the ability to enable and disable components as required to improve resource usage. An example of a specialised component is bag handle detection.

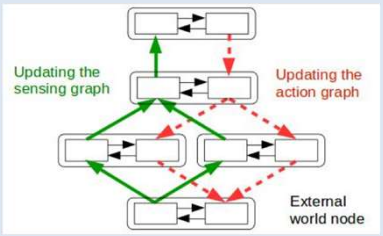


The spatial visual system implements multiple traditional methods of computer vision to annotate an object detection's colour, texture, size, shape, position etc. This provides a detailed database entry in the world model.

The person recognition node uses facial key-points, texture and colour recognition of features such as clothes and hair. These features are stored in the world model which can be used for person re-identification.

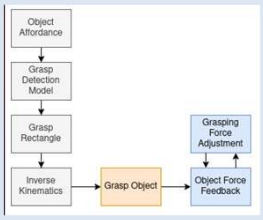
Cognitive Architecture

We wish to understand how a variety of software components should be integrated in a robot. We have developed a novel meta-model for formalising cognitive hierarchies. A cognitive hierarchy consists of a set of nodes connected in a hierarchical graph. Every node in the hierarchy has a world model and behaviour generation at a particular level of abstraction, with the lowest level node as a proxy for the external world. We use a cognitive hierarchy in the design of our software for @Home



Grasping Detection

A grasping package is currently in development to detect optimal grasping points for the end effector. This consists of creation of grasping rectangles based on object affordances. This package will be integrated with the world model on multiple levels to be able to generate accurate grasp poses. The package will also feature grasp force calculation for unknown objects.



Multi-Modal Perception and Perspective-Taking

Our cognitive architecture contains belief models for improving the human-robot interaction experience. The use of multi-modal perception and perspective taking allows us to maintain the beliefs of all agents in the world model. This provides a richer set of beliefs for engaging with individual agents. The idea is to take the perspective of the agent using a combination of modalities such as gesture, gaze and speech. The data from the modalities are fused which will generate specific signals, e.g. pointing and looking in the same direction and mentioning keywords referring to objects in the world model. This will allow the robot to infer what the agent is communicating without any objects in the current field of view.