Robot self-initiative and personalization by learning through repeated interactions

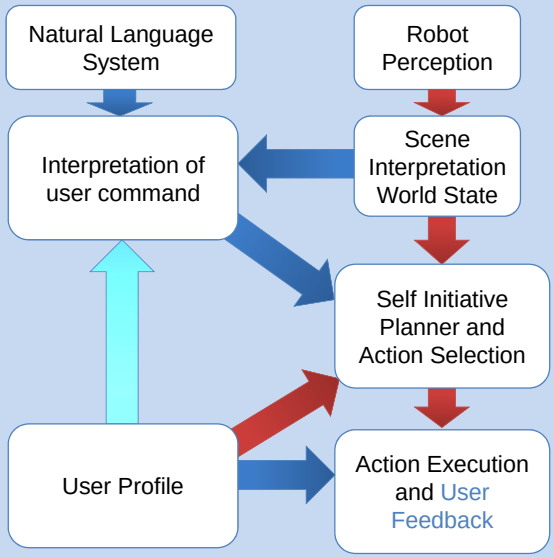
Martin Mason[1,2] [1]Mt. San Antonio College, USA, mmason@mtsac.edu Manuel Lopes[2], [2]University of Plymouth, UK, manuel.lopes@plymouth.ac.uk

Introduction

The aim of this project is to create an efficient personal, or service, robot that is able to accept commands from a user, and anticipate the user's needs. We envision a robot that comes out-of-the-box with a large set of skills to accept commands from the user, and the capability to learn and create profiles to anticipate user needs and pro-actively fulfill them.

In this work we make several contributions:
•A novel system to describe users' preferences using a feature based description of the world
•A classifier to identify good and bad world states based on the features
•A system that can pro-actively plan, for a given user's profile, how to change the world from a bad state to a good state through a sequence of steps
•Adaptation to the user through repeated interactions.

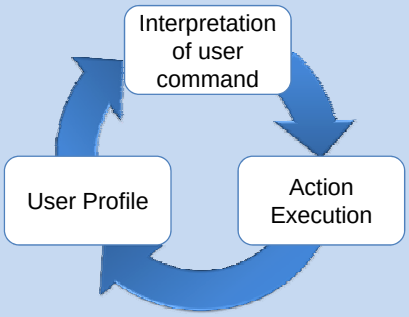
System Specification



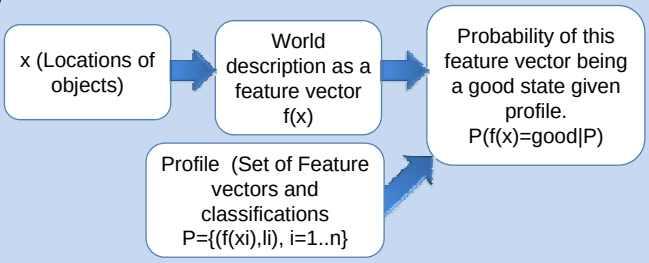
Action Selection

•User Command
•Interpreted User Command
•Initiative

User Adaptation

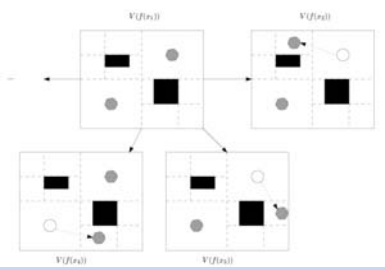


User Adaptation is developed by learning a probabilistic model that classifies each world state based on the user profile. This is done using a kernel method based on beta-binomial probability models. The technique can generalize between different environments and the number/types of objects by using a large bank of geometric and relational features. We do not restrict ourselves to copy the final state of the environment by memorizing the desired locations of objects, but learn the relational features that make up a good state.



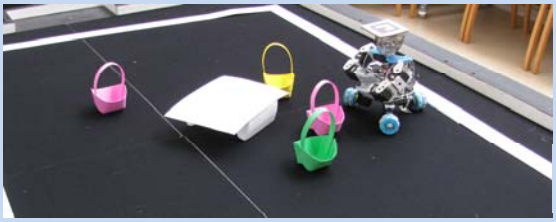
Planner

Taking into account an initial state x_i we want to find a plan that reaches a goal state. To allow for generalization, we take an optimization view and use a method that, from an initial condition, finds a realizable path by exploring the graph.

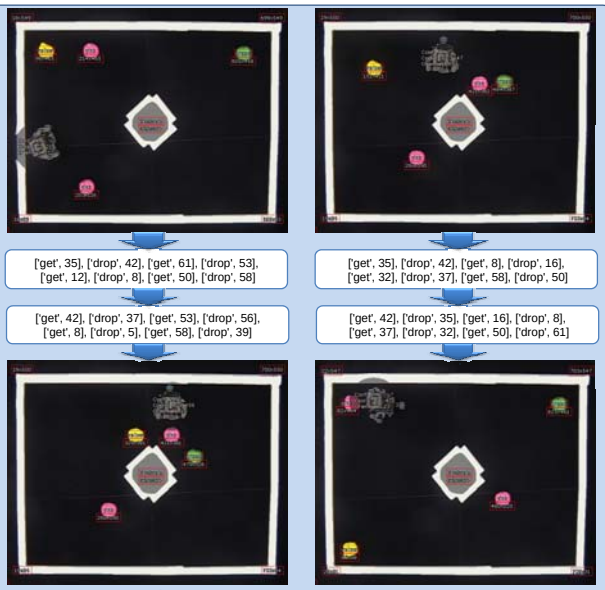


Results

The task is to tidy a room that is cluttered with different objects. The robot can receive commands from the user to clean the room. After some interactions the robot should be able to clean the room based on user preferences.
The robot consists of a holonomic base and a humanoid torso that is able to : a) Grasp, transport and release objects and b) Navigate and avoid obstacles



An online survey was used to develop two unique profiles:
•Users that preferred the objects close together
•Users that preferred the objects in the extremes of the environment.
Based on these profiles, the robot was presented with an initial world configuration and determined a plan to reach a suitable final state. The different profiles produced substantially different results that corresponded to the users' preferences.



Prefers Clusters *Prefers Corners*