Cognitive Interaction with Robots

Safety & Control Improvement in Human-Robot Interaction

Authors:
Alex Pardo
Marc Bolaños
Pablo Pardo

Professors:
Cecilio Angulo
Marta Díaz

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UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

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1 Introduction

This project is comprehended within the teleoperated robots area. A broad topic recently being pulled further given the increasing need of elderly attention.

The robot we were working with was MASHI, which is a teleoperated robot with the purpose of guiding in "La Bóbila" social centre in L'Hospitalet del Llobregat. The root consists in an Arduino board embedded to a wheeled structure that resembles the human figure.

The environment the robot is going to work in the main entrance of the social centre, where some temporary expositions are hold. MASHI is supposed to welcome the visitors and guide them through the exposition being able to communicate with the visitors.

Our project is focused on two different but necessary aspects:

1. **Collisions Avoidance**: We developed a simple but efficient way to avoid collisions using an RGB-D camera attached in the neck of MASHI. Our method tackles the so called *Freezing Robot Problem*.
2. **Gesture Control**: Facilitate the teleoperator control of the robot by allowing him/her to use the hands to move the robot. This feature will allow the teleoperator to manage more complex movements such as control head, arms, hands and so on.

The Section 2 is a brief compilation of related works and common problems in the area. In the Section 3 we explain with all the detail how was carried out the implementation part. The Section 4 contains the experiments with users done in order to test the acceptance and efficiency of out work. In the last section (Section 5) we expose our conclusions of this project and the possible future work.

2 Related Work

2.1 The Freezing Robot Problem

The *Freezing Robot Problem* is a classic problem in robotics and consists of finding a balance between being conservative in terms of movement and safety and reach efficiently the goal. If the robot is too conservative and the environment too complex could end up freezing because none of the possible movements would be considered to be safe enough.

A classical approach to this problem is to use a planner and try to predict the movement of the surrounding in order to decide the next move, however these approaches usually fail to find a path when the environment is too complex. There are other approaches that tackle the problem from different perspectives. Peter Trautman and Andreas Krause [3] studied and proposed a non-parametric statistical model based on dependent output Gaussian processes that can estimate crowd interaction from data. Chung-Che Yu and Chieh-Chih Wang [4] proposed a Learning from Demonstration (LfD) approach proving that these kind of methods are efficient to both avoid collisions and freezing free navigation.

2.2 Gesture Recognition

Gesture Recognition is an important topic in computer vision and an active line of research for lots of companies. The reason behind this interest in the area is because of the multiple and revolutionary applications to the world of technology, it changes completely the conventional machine input mechanisms (mouse, keyboard and even touch-screens).

This technology has being successfully applied in the game industry, changing the gaming experience to a whole new level. Its also has being applied to device control such as tv or intelligent home systems improving the user experience.

One of the greatest advances in the topic was the improvement and large scale production of RGB-D cameras which started with the Kinekt camera developed by *Microsoft* for the gaming industry. This busted the research in the area. There are countless examples of papers studying the area, a good example of them was presented by Lin Song1, Ruimin Hu, Yulian Xiao and Liyu Gong [2] in 2013 proposing a method for hand segmentation and gesture recognition in real time. Another interesting example was given by Yi Li [1] with a method capable of recognizing 9 different gestures with an accuracy between 84% and 99%.

3 Implementation

3.1 Collision Avoidance

3.2 Gesture Control

4 Test with Users

5 Conclusions

References

[1] Yi Li. Hand gesture recognition using kinect. In *Software Engineering and Service Science (ICSESS), 2012 IEEE 3rd International Conference on*, pages 196–199, June 2012.

[2] Yulian Xiao Liyu Gong Lin Song, Ruimin Hu. Real-time 3d hand gesture recognition from depth image. ICSEM, 2013.

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[4] Chung-Che Yu and Chieh-Chih Wang. Collision- and freezing-free navigation in dynamic environments using learning to search. In *Technologies and Applications of Artificial Intelligence (TAAI), 2012 Conference on*, pages 151–156, Nov 2012.