Walking Machine 2017 Team Description Paper

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Abstract. This paper gives details about the RoboCup@Home league team Walking Machine, from ETS University in Montreal, Canada for the next competition in Nagoya, Japan, in July 2017. The robot from Walking Machine, named SARA for Système d'Assistance Robotique Autonome (in English, Automated Robotic Assistance System), is a robot entirely built by the student scientific club from ETS. The robot is used for flexible interaction with humans, navigation and mobile object manipulation. This document shows the electrical, mechanical and software properties and functionalities of SARA. It specifically emphasises on human following, object and people recognition as well as navigation, manipulation and human-robot interaction.

1 Introduction

Walking Machine's team is a young team from Montreal, Quebec, in Canada. We have been preparing our robot for the last year in prevision of the Robocup@home. Our team qualified with our robot, SARA, in the innovative design competition of Quebec Engineering Competition (CQI 2016, Polytechnic University, Montreal, Canada). The team went in many competitions in the past like the Eurobot, but made the leap for the RoboCup in the last years.

SARA, our creation, was designed for polyvalent human-robot interaction as well as efficient navigation and object manipulation. SARA is mounted on four mecanum wheels powered by Roboteq drives, has one arm mimicking a normal human arm, and sensors for communication and navigation. Our team has developed knowledge in object and people detection/recognition, as well as navigation using a laser scanner, odometry on the wheels and a XTION camera. All of these parts are interfaced through the Robot Operating System (ROS).

The next section will discuss the hardware design of SARA. Perceptions and decision making will be respectively shown in sections 3 and 4.

2 Background

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3 Software Architecture

Our software architecture is based on ROS (Robot Operating System). This allows us to build complex software in a short amount of time.

4 Perception

This year one of our new feature for our perception is an object classifier based on TensorFlow. This new approach is faster than our old method but requires some careful preparation. Our classifier is capable of classifying almost all the object found in an ordinary household.

We upgrade our robot with a second camera, a kinect v2 from Microsoft. This camera enables better point clouds and also better skeleton mesh to detect

people.

5 Artificial Intelligence

From last year experience, we made some change to the human machine interface.

The first change was to implement a state machine to reduce the number of launch file. This change permits us to reduce the time to setup the robot between task.

6 Experiments and results

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7 Conclusions and future work

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Bibliography

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Robot SARA Hardware Description

Specifications for robot SARA are as follows:

- Base: Custom base with fully holonomic Mecanum wheel platform.
- Torso: 1 vertical DoF (future implementation).
- Right arm: Mounted on torso. 5-DoF custom arm made of Kinova motors.
- Neck: Tilt unit using one Dynamixel MX-64R servo actuator.
- Head: Custom head made of RGB neopixels leds and Asus Xtion Pro.
- Gripper: Robotiq hand 2 fingers 85mm.
- Robot dimensions: Base : 0,61m X 0,77m Height : 1,68m.
- Robot weight: 100kg.
- Additional sensors: Hokuyo UTM-30LX on base.
- Microphone: Rode microphone
- Batteries: 1x 24V 8 cells Lithium-ion battery
- Computer: 1x Lenovo p50 with 32GB RAM and nVidia Quadro M2000 4GB, 1x BeagleBone Black

Fig. 1. Robot SARA

Robot's Software Description

For our robot we are using the following software:

- Platform: Robotic Operating System (ROS) Indigo
- Navigation, localization and mapping: RTAB-Map, Gmapping, AMCL, DWA
- Face recognition: Cob people detection
- Speech recognition: Pocketsphinx
- Speech generation: Espeak
- Object recognition: Object recognition kitchen
- Arms control: Moveit and Kinova API
- Task executors: SMACH