Finist RoboCup@Work 2017 Team Description Paper

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Abstract: In this paper we provide a description of the Finist team. We describe the current state of the team as well as current plans and research goals towards the 2017 RoboCup@Work tournament in Nagoya. The software is based upon a ROS-architecture and the hardware uses a KUKA youBot as a basis.

1. INTRODUCTION

We are a team of students, who are getting their master and bachelor degrees in various Universities in Russia. At the same time we are teachers of robotics, who work with schoolchildren in Robotics Center of Presidential Lyceum of physics and mathematics #239 in St.Petersburg. The head of the Robotics Center is Sergey Filippov, who is RoboCup Junior representative in Russia. In the lyceum we develop a community of children, who are keen on robotics and we spread our knowledge and experience all over our country. We thing we do it quite well, because of a list of our achievements and the growing number of children, who study robotics nowadays. As a team of roboticians weve already won Robotchallenge (2013, 2014) and the World Robot Olympiad (2012, 2013, 2016). In June-July 2016 we first time saw RoboCup and were impressed. So now we want to join the RoboCup community by participating in RoboCup@Work. More than, as teachers of robotics, we plan to spread our knowledge in RoboCup@Work to our students, who are schoolchildren nowadays.

2. HARDWARE

Our robot is based on the mobile robot KUKA youBot, that you can see on figure 1. The robot consists of a platform with four meccanum wheels and a five degrees of freedom (DoF) manipulator. The internal motherboard of the youBot is standard now, but soon it will be replaced by an Intel Core i7 based system. The hardware itself does not offer failure tolerance, but software includes all the necessary preventions.

2.1 Sensors

The youBot is equipped with commercial laser range finder (Hokuyo URG-04LX-UG01), which is located at the front of the platform. Camera Logitech is used now for computer vision and it is mounted on the wrist of the manipulator. Soon the camera will be replaced by Intel RealSense F200 camera.

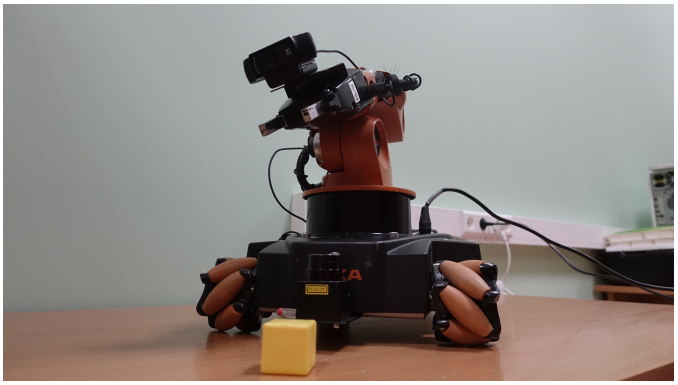

Fig. 1. KUKA youBot

2.2 Gripper

We've designed our gripper according to a huge experience of RoboCup@Work teams, but haven't printed it out yet. We made some changes in 3D models we saw on Github and try to chose the best type of plastic to print it out on 3D printer.

We understand, that original gripper has a low speed and stroke so we hope our gripper will help us to grasp all objects defined by the RoboCup@Work rule book.

3. APPROACH

We take advantage of an open source software framework called Robot Operating System (ROS). We use the Indigo release for 2016.

3.1 Overview

We are currently developing the software architecture of the project. Since it is based on ROS, different nodes are used to provide navigation, manipulator movements and computer vision. The youBot OODL driver'll be modified. Finite-state machine of the robot to control its actions is being developed entirely by the team.

3.2 Manipulation

Forward and inverse kinematics are used to proved manipulator movements. We plan to add path planning and provide path following optimization and dynamics calculations.

3.3 Navigation

The navigation is based on the ROS navigation stack. We use local and global planners to understand position and orientation of the robot.

3.4 Vision

Now we use camera Logitech and compare the image of the object with the remembered one. We have used Carmine 1.08 in our previous robot, that won Robotchallenge competition (SummerGardenBot cleans statues), but for RoboCup we decided to use Intel RealSense. Soon we'll have Intel RealSense F200 and we'll use it for object recognition, which is more appropriate for the tasks of the competition.

4. OTHER CRITERIA

Some words should be said according to the criteria listed on the main web-page of the competition.

4.1 Video file

Fig. 2. KUKA youBot grabbing a yellow cube

We attach to the following description for your interest a link with a short video of the robot playing with yellow cube. On the video the robot detects the yellow cube, grabs it and puts it on its platform. Then an operator asks it to throw the cube. It does it autonomously. Then the operator moves it to the position, where he things the camera can detect the object. First the robot doesn't see the cube and it shakes its camera, which is mounted on the top of the manipulator. It is a visible sign to the operator to move the robot to another position. When the robot sees the cube again, it grabs it with the help of inverse kinematics and puts it back on its platform.

4.2 Web-page

We will post all the information about our team and our robot on the page of our community.

www.robofinist.org/robocup_team_finist

www.robofinist.org/en/robocup_team_finist/

4.3 Criteria

- focus of research/research interest/innovative technology/reusability of the system or parts thereof
  As we are at the very beginning in RoboCup@Work it is important for us first to explore in details all the things that were already done. As we are students of best technical Universities in Russia, we hope to apply our knowledge in the subjects we were taught to solve the task. Among them were following subjects: optimal control systems, adaptive and robust control, time-delay systems, control methods for robotics applications, underactuated robots, etc.
- applicability and relevance to industrial tasks
  We don't focus on industrial tasks right now, because of educational purposes of our work. We would like to write a guide on russian for schoolchildren and students to start participating in RoboCup.
- usage of components (software or hardware) developed by other RoboCup@Work teams
  We thank LUHbots team for publishing its materials. We use it to get understand the ways we should build our program for the competition. We also use 3D model of a team from Bonn-Rhine-Sieg University of Applied Sciences when designing our own model of a gripper.

5. ACKNOWLEDGEMENTS

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