Photon Team Description
for RoboCup Humanoid KidSize League 2017

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Abstract. This paper describes the RoboCup Humanoid KidSize team Photon from TUSUR University, Tomsk, Russia. Common architecture of the system, software development of individual modules: computer vision, movement, communication are considered in this paper.

1 Introduction

The team Photon consists of students from Laboratory of robotics and artificial intelligence of TUSUR University.

The laboratory of robotics and AI was founded in 2008. The laboratory main objective was robot soccer implementation.

At the starting the main point was robot soccer according to FIRA association. We developed software for SimuraSot simulation soccer league and MiroSot wheeled robots league.

In order to promote this practice and stimulate students activity we organized competition between universities of Russia, according to SimuraSot and MiroSot rules. The RoboBall competition became an annual event from 2008 to 2014. Students of TUSUR University, Siberian Federal University (Krasnoyarsk), Tomsk Polytechnic University and Novosibirsk State Technical University participated in this event. For teams training we have created support materials and built playing field for MiroSot league competition. We developed software for MiroSot playing field: computer vision system, communication system, examples of team strategies in C++ language. Therefore, the main task of participants was development of their own strategy program for MiroSot soccer league. As a result due to RoboBall competition students obtained experience in software development for robot soccer.
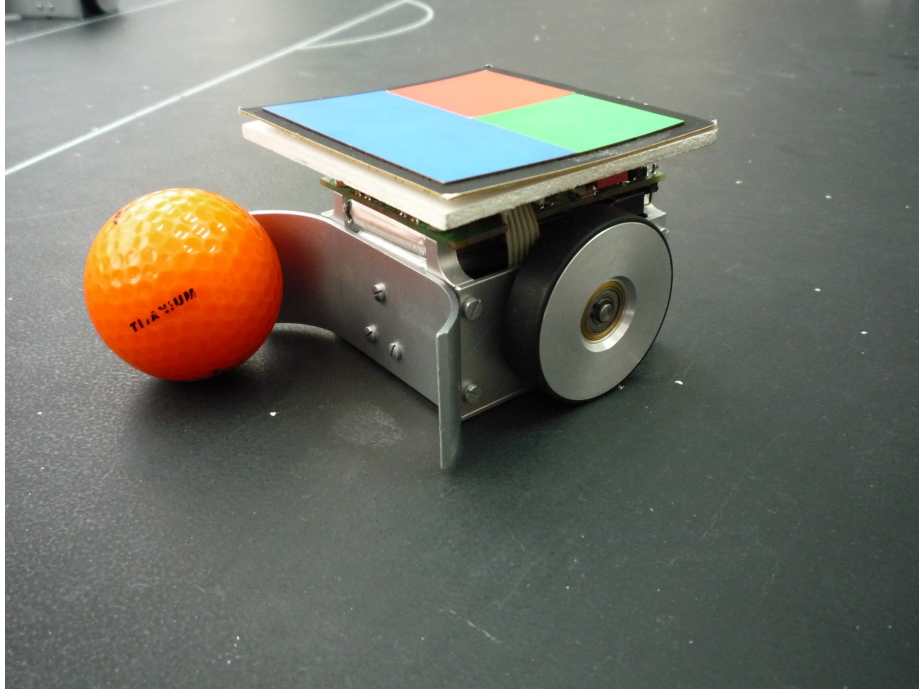
Fig. 1. Robot for MiroSot soccer league

In 2012 we decided to particiate in RoboCup [1]. Because we didn't have hardware equipment for creation team of soccer robots, we started working with simulation soccer in 3D Simulation league.

Our software was based on framework Magma-2011, developed by magmaOffenburg, Hochschule Offenburg. We used functions of Magma for implementation of robot walking on the field. Nevertheless we developed absolutely unique strategy of players behavior on the field, including separation of field on the players responsibility areas, dynamic changing of roles of the players during the game, modification of strategy according to current game result.

In May 2013 the team Photon participated in RoboCup Japan Open 2013 in Tokyo, for the first time and won the 1st place in 3D Simulation Soccer league. And then we took part in RoboCup 2013, Eindhoven. It was quite important for us to obtain new experience.

In 2014 we were able to buy new equipment: DARWin-OP robots. We started software development for Humanoid KidSize Soccer league. In 2015 there were significant changes in rules of the league: the ball and playing field surface were replaced. In April 2015 Photon team participated in RoboCup German Open and won the 2nd place in KidSize Soccer league [2].

In 2016 the Photon team participated in RoboCup 2016, Leipzig. It was quite important experience for the team. Main effort was directed on development of computer vision and adaptation of robot's gait on the field. Our workings were described in Photon Team Description Paper, 2016.

2 Implementation

2.1 Hardware

As a robot platform we uses Robotis DARwIn-OP2, the new version of successful DARwIn-OP (Fig. 2). Our choice was based on this robot open architecture, technical specification and high repairability.

DARwIn-OP2 is an anthropomorphic robot with 455 mm height and 20 DOF. Internal computer based on Intel Atom processor and works on Ubuntu Linux. DARwIn Framework includes Motion, Vision and hardware specific C++ classes.
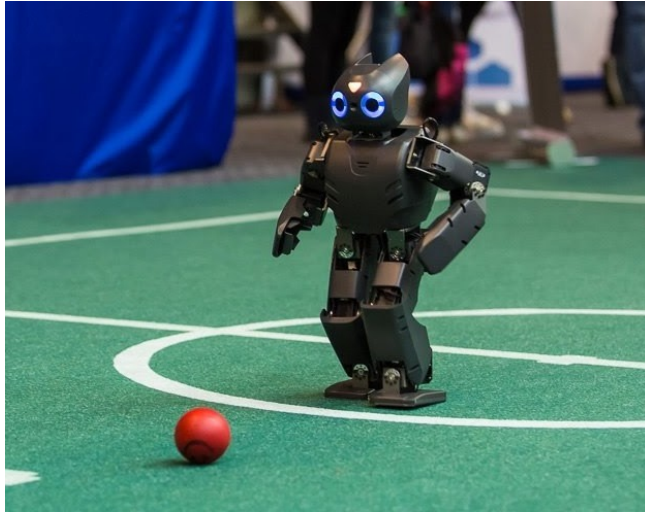

Fig. 2. DARwIn-OP robot on a soccer field (RoboCup Russia Open 2016)

Despite the obvious difficulties for the DARWin-OP2 platform with stable walking on the surface of the field (artificial grass), we did not make any changes in construction, because it may cause breaking the rules. We consider the right decision in this case as development and manufacturing our own robot, with greater height and weight. Unfortunately today we do not have enough financial resources for such development.

2.2 Software

2.2.1   *General architecture*

The software framework consist of four general modules: walking control, computer vision, communication and main control (Fig. 3). The software realized as modular, multi-threaded architecture. C++, Python and bash scripting languages using for implementation.
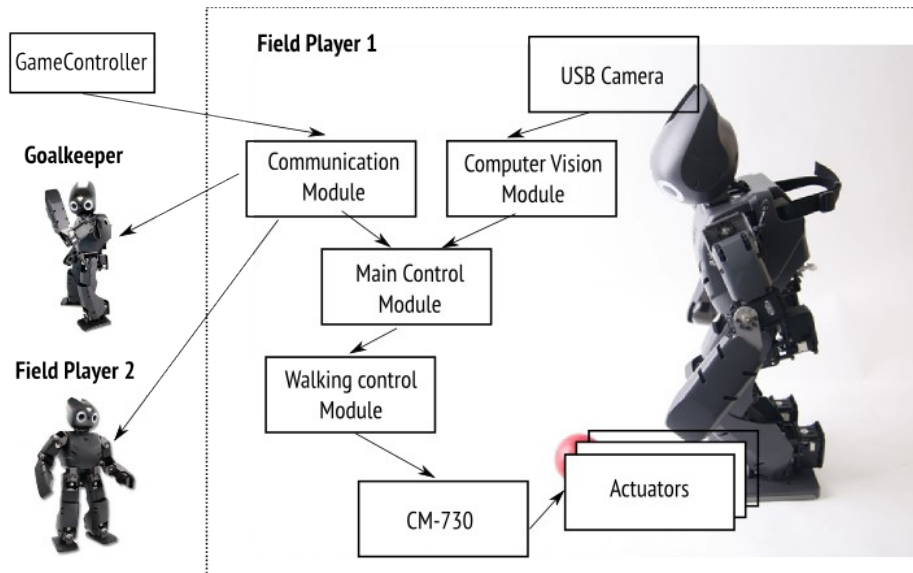
Fig. 3. Software framework

In our previous TDP we already described our software. As the result of our participation in RoboCup 2016, robot confidently found the ball and gates on the field. Therefore, we did not make any changes in computer vision module. Also, because of using basic model of walking of the DARWIn, our changes were in fine-tuning of walking parameters and modification of the basic functions of upper level movements.

However, participation in the competition has shown the requirement of advanced development of communications and the main control modules. Also we changed common architecture of the system by applying additional level, implemented on Python language.
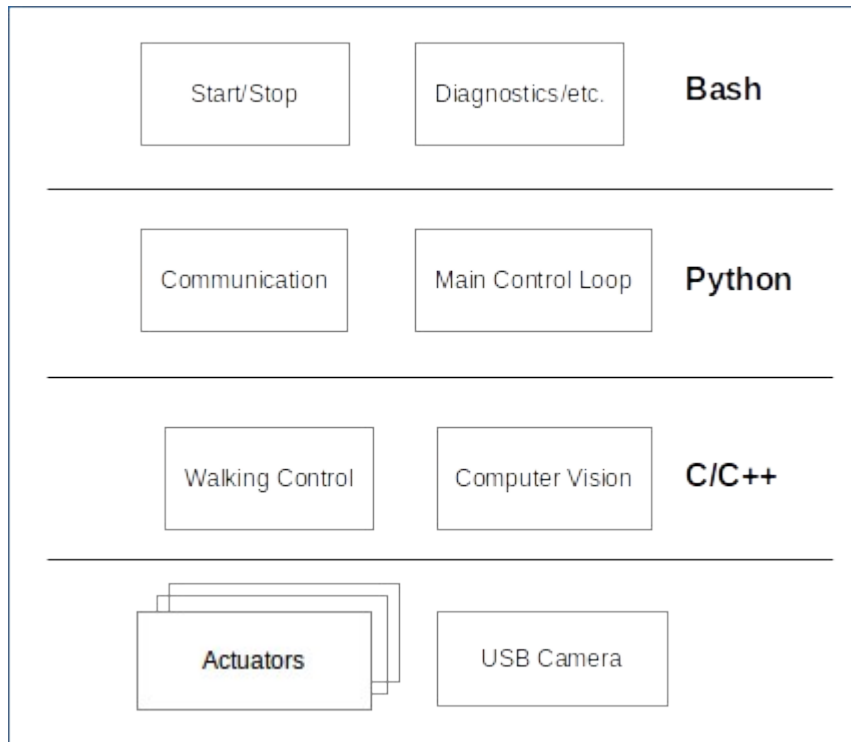
2.2.2 New software architecture

Fig. 4. New software architecture

The new architecture of software represented on Fig 4. Communication and main control modules placed outside the application and implemented with Python language. It allowed us to increase the versatility of the system. Motion control and computer vision modules developed with C/C++. These modules are implemented as independent program. Data exchange is made through robot file system.

2.2.3 Communications

We developed communication module from a scratch, using Python in order to fix found bugs and unstable work. Moreover ability to modify code without recompilation of main program should increase reliability and versatility of system. UDP communications in Python are amazing. Communication module process incoming packets from GameController and set the corresponding state of the system for the main control module.

2.2.4 Main control loop

The main control module was developed usign Python. This allowed us to change the strategy of the robot's behavior in very operative way. It would be more correct to name this model as Behavior Module.

We use the event driven programming model for the robot control. A set

of states in which the robot can be identified as:

- FINDBALL - find the ball;
- BALLFOLLOW - following the ball;
- FINDGOAL - search goal;
- KICKBALL - hit the ball;
- STANDUP - robot is fall, need to get up;
- etc.

We used different colors for robot eyes to indicate the current state.

3.2. Goalkeeper strategy

Earlier we did not paid enough attention to the goalkeeper's software. This time we decided to fill the gap.

Basic software of the goalkeeper is the same as other players have. However, there are some significant differences. Because of the high risk to damage the equipment during the fall of the goalkeeper, and fully protect the gate in the other way cannot be realized, we decided that the main position of the goalkeeper would be "seated". Goalkeeper scans the field, while looking for ball, and if ball enteres the field of view, goalkeeper tries to estimate the distance to the ball. If the ball comes near, the goalkeeper executes the protective movement with the hands.

We understand that this strategy is not optimal for complex defend of the goals, but it is main for now.

4 Conclusion

Photon team is relatively young team both in RoboCup and Humanoid Soccer league. We did not won WorldCup, but were able to perform well in regional Japan Open (1st place in 2013) and German Open (2nd place in 2015).

We are looking forward to participate in 2017 WorldCup in Nagoya, which is a great opportunity for our team to get more experiences from competition, exchange knowledges with other students and researches from all over the world.

References

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