

RoboCupJunior Simulation League Development - Stage 2

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Project Overview

This project supports the second stage of the work of developing the Rescue Simulation platform for RoboCupJunior (RCJ). RCJ has demonstrated the ability to engage students in robotics and offers a unique learning opportunity for robotics education and engagement [1][2]. One key challenge to RCJ is bridging the gap between Junior and the Major leagues to enable a progression from Junior level to the Major leagues and university-based research. Additionally, there is a significant cost barrier to many of the Junior teams because developing robots could be expensive for many, therefore developing a league requiring minimal costs has a potential to significantly widen the uptake. Use of the simulation in education provides a low cost, open-to-all learning tool that is efficient in terms of the space, resources and the initial knowledge of the instructors required, all of which are key advantages for a school-based robotics challenge [3]. To meet these challenges, this project continues the task to develop a RCJ Simulation Rescue platform to be used in the RCJ Rescue Simulation sub-league. We started the work to develop an Open Source Rescue simulation platform in 2018-2019 period, which opens robotics to many more students around the world and develop a pathway to the Major competition. The Open Source platform has been developed with collaboration with the Major Rescue Simulation league exec members, to provide a complementary solution.

There are currently limited opportunities for Junior teams to engage in simulation-based challenges. Within RoboCupJunior, there is Rescue CoSpace competition which offers some limited simulation experience. However, this has no connection to the Major leagues. All other Junior leagues require physical hardware, with the leagues demanding increasingly complex and expensive components year on year, which is a considerable barrier to entry for new teams to Junior competitions. The development of a simulation-based league encourages engagement with Major leagues and provides a low cost and low complexity entry-level to Major Rescue Simulation league, whilst also providing a potential expansion to be used as a significant research platform.

Engagement of young roboticists and scientists is crucial to solving many of the problems facing society. Through the development of a Junior Rescue Simulation sub-league, we hope to increase young students' engagement in engineering and technology helping to develop future roboticists who will help towards achieving the overall RoboCup's goal.

The second stage of the project involves members from Junior Rescue community in the development of the Junior Rescue Simulation engine and preliminary rules and plan to organize demonstration games at RoboCup 2020, Bordeaux.

Benefits for RoboCup

This project will continue to support the previous project to develop an open-source platform for RCJ which opens up RCJ to many more teams worldwide because of its low entry cost and no requirement of a physical component. This provides a link between Junior and the Major leagues, aiming to help bridge the significant gap in technical skills and knowledge between the two. This link can help retention between Junior and Major leagues and provides a way to engaging advanced Junior members into the Major competitions. Additionally, the simulation allows for virtual participation, such that it is possible for many more teams to compete at the international level without a significant financial burden.

In terms of complexity, the simulation platform developed will allow solutions of varying complexity to be produced. This will allow entry-level teams to develop simple rescue strategies, learn the basics of the software development aspects of the challenge and the algorithms required, while advanced teams to develop highly complex solutions which are high level, research-driven.

The RCF support for the second stage project will allow us to involve members of the Junior Rescue community in the development and implementation of the simulation platform as a form of a demonstration at RoboCup 2020, Bordeaux.

Proposed RCJ Simulation Platform Development

The RCJ Rescue Simulation platform/engine developed must be open source providing an easier transition from Junior Simulation to Major Simulation. Therefore, the significant bulk of this project has been focusing on the development of an open source simulation platform which aligns with the Major Rescue Simulation. Where possible we have been trying to base the new simulation engine to the one used for the Major Rescue simulation league [4]. Moreover, it has focused on making the interface approachable for Junior team members to interact with the simulation in a meaningful way.

For widescale adoption, the software platform developed must have a low complexity entry barrier, such that installation is achievable within a school environment. Additionally, the creation and use of introductory materials are critical as this will provide the underlying skills set upon which teams can develop their solutions. Alongside teaching materials, a forum system must be created to assist with technical questions, installation queries etc. This can be supported by the RoboCup community. Developing these supporting materials and infrastructure is key to the success of this project.

Bringing the Junior members into the development strengthens our capability of creating not only the simulation platform suitable for Junior team members but also the materials that teams utilize for the development of their solutions using the new simulation engine to participate in the demonstration at RoboCup 2020, Bordeaux. In addition, the Junior members involved in the development can help to organize the demonstration, get feedback from participating teams to improve the simulation platform as well as the materials developed for the use in future years.

Implementation and Budget

Project Schedule

The project will follow the schedule as shown in the table below (the majority of preparations will be through online collaborations including online Zoom meetings):

	2019		2020							
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Development of the simulation engine details for the demonstration at RoboCup 2020										
Development of the materials to support new teams										
Preparation for the demonstration										
Demonstration at RoboCup 2020										
Documentation for the improvement using the observation and feedback from the demonstration.										

* RoboCup 2020 – 2020 June 23-29 (Bordeaux, France)

Budget Plan

For the above mentioned initiatives, we are requesting to cover a total cost of US\$5,000 as travel support:

Demonstration at RoboCup 2020: \$5,000

- \$5,000 as travel support for Junior members/contributors solely coming to organize the demonstration at RoboCup 2020, Bordeaux (3 members).

References

- [1] J. Johnson, "Children, robotics, and education," *Artif. Life Robot.*, vol. 7, no. 1–2, pp. 16–21, Mar. 2003.

- [2] E. Sklar, A. Eguchi, and J. Johnson, “RoboCupJunior: Learning with Educational Robotics,” Springer, Berlin, Heidelberg, 2003, pp. 238–253.
- [3] S. Carpin, M. Lewis, J. Wang, S. Balakirsky, and C. Scrapper, “USARSim: a robot simulator for research and education,” in *Proceedings 2007 IEEE International Conference on Robotics and Automation*, 2007, pp. 1400–1405.
- [4] D. M. Budden, P. Wang, O. Obst, and M. Prokopenko, “RoboCup Simulation Leagues: Enabling Replicable and Robust Investigation of Complex Robotic Systems,” *IEEE Robot. Autom. Mag.*, vol. 22, no. 3, pp. 140–146, Sep. 2015.