ITAndroids Humanoid
Extended Abstract for RoboCup 2022

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Abstract. ITAndroids is a robotics competition group associated with the Autonomous Computational Systems Lab (LAB-SCA) at Aeronautics Institute of Technology (ITA). ITAndroids is a reference team in Latin America, having won 56 awards in robotics competitions in the last 10 years. In 2017, the team developed the Chape humanoid robot, and built four units to participate in RoboCup Humanoid KidSize for the first time. Since then, the team has been evolving the robot's hardware and software while participating in many competitions, especially RoboCup and Latin American Robotics Competition (LARC). The team also designed the Chape G2 robot, the second generation of Chape, which is currently under construction and testing. This work describes our recent development efforts for RoboCup 2022.

1 Lessons learned in Previous Competitions

We highlight some lessons learned in RoboCup 2021 and Latin America Robotics Competition (LARC) 2021:

1. The robots did not always follow the Game Controller states. In simulated environments, this causes a lot of fouls.
2. In some games, the robot's localization would flip sides when being teleported by the automatic judge. This caused it to score goals against our team.
3. Previously, we used a custom convolutional neural network architecture adapted from YOLOv2 for computer vision. However, we found out that using "off the shelf" implementations of object detectors typically provide better performance while requiring less development effort from our team.
4. We found out that our robot frequently loses the ball and has trouble finding it again. So we need a better behavior for searching the ball and to improve the neck scanning motion.

5. While trying out different models in Webots, we had to adjust many parameters by hand to make sure it works best. A tool to ease this process would make it take way less time.

2   Solutions being implemented

We highlight some solutions already implemented or being implemented in our robot team:

1. We have fixed the Game Controller issues by updating the code. Previously, as the code was outdated, the messages were being read incorrectly.
2. We are improving the field boundary detection algorithm to help with localization. Instead of using Graham's Scan implemented by us for finding the convex hull of green pixels, we are changing our code to use OpenCV's convex hull algorithm. We are also improving the line detection algorithm that uses Hough Transform. We hope to improve the localization with these modifications.
3. To make our decision-making more efficient and harmonic with state-of-the-art agent behavior architectures, we are refactoring it with an open-source behavior tree framework [1], developed by our team.
4. We are looking into ways to improve the neck's scanning motion to keep up with the position of the ball by comparing the motions of different teams and adapting it to our robot.
5. We have designed a new generation of robots, which will have 65 cm of height (our current robots have 53 cm), stronger servos (XM-540), and a faster main computer (Intel NUC i7).
6. The CAD of this new generation is now finished and we have already manufactured arms, legs, torso, camera support, and feet. Only the parts that will be welded or that are used as connectors for robotic joints are missing.
7. A Webots model of the new generation is almost done and will be used in RoboCup Humanoid League Virtual Season 2021/22. The code will have to be adapted to this new robot and will be tested during the competition. Then, we will transfer the adaptations to the real robot.

Acknowledgment

References

1. Gustavo L. Silva, Marcos R. O. A. Maximo, and Lourenço A. Pereira. A minimalist open source behavior tree framework in c++. In *2021 Latin American Robotics Symposium (LARS), 2021 Brazilian Symposium on Robotics (SBR), and 2021 Workshop on Robotics in Education (WRE)*, pages 306–311, 2021.