Robot Modeling and Programming

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Nowadays, with increasingly complex applications, robotics is continuously evolving and stay a vast, complicated, and often, expensive subject. Therefore, the corresponding research and development departments have to change too. It is why it is necessary to surround the development with the appropriate tools. One of these essential instruments is simulation.

Simulation is a fundamental tool increasingly used in robotics research and development workflows, to design, test and validate robotics systems. It permits to speed up development time, reduce costs, test the algorithm's behaviour, and validate systems in a completely virtual environment. Nevertheless, it is rare to find good robotics simulators that meet all the criteria for simulating reality as faithfully as possible.

RobMoSys desires to make robot design simpler and closer to the required use. Indeed, it provides the robotic structures and methodology necessary for this European ecosystem for open and sustainable industry-grade software development for robotics. It also aims to establish Quality-of-Service properties, enabling a composition-oriented approach while preserving modularity. The RobMoSys approach relies heavily on simulations: all the industrial pilots integrate various simulation models.

This project aims at integrating the Webots robot simulator into the RobMoSys framework called the SmartSoft world to provide additional capabilities to users. Developed by the company Cyberbotics in which I realized this Master's thesis, Webots is a high-end, cross-platform robot simulator which has been developed for the past 20 years and was fully open-sourced recently. This simulator is complementary to the ones currently used in RobMoSys and will bring several advantages such as reproducibility, predictability, support of Windows, Linux and macOS, high-fidelity rendering, sensor accuracy and stable physics engine.

For the project purpose, I have implemented new components to be able to use Webots simulator in SmartMDSD Toolchain, which is a graphical interface with drag-and-drop composition to build robotic applications faster. To evaluate them and prove their compatibility and efficiency with the existing components, a pilot use case was used as a reference. The result is that the behaviour obtained with the previous simulators and Webots is the same as can be seen in this video. Other existing systems have also been tested and have all been successful. The new Webots components for SmartMDSD Toolchain are available on the Cyberbotics github repository under AROSYS.

I noticed that my work had been adopted by another RobMoSys project development team (MiRON) as you can see in their system. It proves that the developed components are easy to integrate and work with other developments.

Before this, I modeled the entire range of Pal Robotics' TIAGo robots and Festo's Robotino 3 in order to be able to reproduce these systems, and models are available in Webots. In addition, some of Sharp's infrared sensors have also been added so that Robotino 3 can detect its environment as well as a conveyor platform for possible future work.

Fig.1 : The pilot use case in Webots simulator. A TIAGo Iron robot moves in an apartment while avoiding obstacle using its lidar sensor.

With the time remaining, I improved and created some ROS2 nodes and packages compatible with Webots. I could use previously developed robot to promote these new features to Webots users wanting to upgrade to ROS2 in this video at time code 1:27.

Finally, I wrote all the documentation for ROS2 packages, robots, sensors and the conveyor platform as well as the one for the new SmartMDSD components. A Wiki with tutorials is available to ease the transition to Webots.