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Robotic Applications Platform

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Summary

We have developed a cloud-based platform for distributed execution of robotic software and robot controllers. This is a three-tier system using a ROS-based cloud, a robot API/SDK, and a robotic application store for distribution and execution of apps on Linux-based robots. The platform also enables different types of robots to communicate and exchange information, and thus to learn from each other.

1 Developing software for robots: key challenges

Reducing complexity and achieving computational efficiency is key when developing software for robots.

Robot software development is a hard and tedious process. Too many components are involved, many of which are very complex, require a broad understanding of AI, Computer Vision, Speech Recognition, Localisation, and other related sub-fields of Robotics. Due to that complexity, development of even simple applications is difficult. Quite often, toy problems are addressed by entire development teams, and yet the results are not what was initially expected.

Now imagine a platform which makes a complex task easy, one which enables you to concentrate on the high-level programming of a robot. Consider how the existence of such a framework, would provide you with the software that you didn't have the time or know-how to develop. Finally, calculate how much computational power Computer Vision, Speech Recognition, and other AI-related algorithms require, in order to enable your robot with the most basic perceptive abilities.

2 Developing software for robots with RAPP

We offer a 3-tier platform that reduces complexity, saves computational power, and enables knowledge sharing among different robots.

Such a Platform now exists: the Robotics Applications Platform (RAPP) aims to deliver those key elements to students, academics, researchers and the industry:

- easy and fast development
- re-usability of robot apps
- distributed processing

The platform is a 3-tier system, aspiring to support all Unix-based Robots, wrap around existing ROS functionality, and provide APIs in C++, JavaScript and Python. Furthermore, the platform enables different robots to share information and gain knowledge.

2.1 Process Delegation

1st tier: Process delegation on the cloud frees resources on the robot.

Delegating processes is the first tier in the RAPP platform. Computer Vision processes (face detection, face recognition, object recognition), Speech-to-Text, Ontology and Knowledge sharing, environment mapping and sharing, other NLP-

related tasks, can be performed on the cloud, freeing up resources on the robot. The platform doesn't have to be an abstract entity, a server farm somewhere far away from the robot; it may in fact be near the deployment area, or on board your robot.

2.2 Distributed Controllers

2nd tier: A feature-rich API/SDK that saves you time and worries

The second tier is using distributed Robot controllers for your applications. You can develop part of an application that will execute on-board the robot (using the native OS and SDK) and another part will execute as a process on the cloud platform. We use easy to learn programming languages: JavaScript for beginners, Python for intermediate developers. You don't have to be a C++ guru in order to develop Robotic apps (although we certainly support said Gurus). A feature-rich API/SDK means that you don't have to deal with deploying, installing, setting and configuring every nut and bolt of a complex system where many things can go wrong; we've already done this for you. We hide the low-level functionality and some of the mid-level functionality (e.g., specific algorithms) and provide a high-level interface, common across all three programming languages, so that even the most inexperienced developer may use complex algorithms right away.

In addition to offering algorithm re-usability, should you develop an algorithm (ROS based, C++, JavaScript, or in Python) it can be shared on the cloud, hence becoming part of the platform. In the event that your algorithm is part of a distributed application, you can opt to keep it private (e.g., not distribute it to other users or robots) or you may make it public.

2.3 Robotic Application Store

3rd tier: A Robotics Applications store to distribute your software

The third tier is re-usability of Robotic apps (RAPPs), as open-source free software, or as proprietary non-free software (it is up to you to decide). If you develop a RAPP that has an added value, and which you wish to share or capitalise on, we will package it, and redistribute it for you. You may write robot-specific RAPPs, or general and abstract RAPPs which are platform-agnostic. For experienced developers, distributed RAPPs running partially on the platform and partially on the Robot are an added bonus, enabling a mix of distributed execution.

2.4 Internet or Robots and knowledge sharing

+: Knowledge sharing leads to robot intelligence

We support knowledge sharing via the cloud and platform. We are strong advocates of the Internet of Things, and aspire to pioneer the Internet of Robots. Using RAPP enriches your applications because objects, faces, sounds, voices, locations, and many other things, can be shared across different robots (only if you wish too, we respect privacy!) enabling cooperation of robots in a novel manner.

3 Application Domains

Applications: www.rapp-project.eu
www.mario-project.eu

We are already applying our platform in the creation and delivery of service robotics applications for the elderly, and we seek to expand its applicability to different sectors in robotics. Currently our applications target ***social inclusion*** for disadvantaged users, and part of a ***Comprehensive Geriatric Assessment*** for the elderly. However, the application domains for the cloud platform are not limited to those aforementioned. Our solution can be used in various other domains and fields.

3.1 Medical and Clinical

+: Coordinated medical and clinical services

Care-Homes, Clinics, and Hospitals, where robots are to be deployed, can all benefit by a distributed platform which can control and monitor robots, drones, cameras, users, wearables, and much more. The fusion of big-data arising from medical data, computer vision, speech, user habits, device signals, robots and care-givers can benefit the quality of service the patients receive, as well as provide an advantage to the personnel and allow them to focus on important tasks.

3.2 Children Education and Special Care

+: Robots in education

Children and their education on robotics is a novel area, as the citizens of the future will be required to be acquainted with robots. Teaching children how to program robots can be done using JavaScript, the easiest language to learn, whilst allowing the institution (School or otherwise) to use a sophisticated platform with ease. Furthermore, special care institutions, such as those deploying robots for autistic children, can use the cloud platform, in order to enable personalised tests and educational sessions, monitor the interactions remotely, and create adaptive and unique sessions for each child.

3.3 Entertainment

+: Robots as entertainers / in gaming

Gamification for serious gaming, as well as (extra)ordinary entertainment using robots will most certainly benefit by using a cloud platform which can deploy game controllers for robots, enhance robot capabilities by providing Computer Vision, Machine Learning and a variety of other AI-related processes. The cloud-platform doesn't have to be our own global instance; you can use dedicated local servers in order to reduce latency. When deployed in business environments where privacy is important, you can use your own unique cloud-instance either as a public or as a private platform.

3.4 Research and Academia

+: RAPP as an enabler of academic research

Academics and students who wish to develop and test robotic applications can use our open-source versions or deploy High-Performance Computing (HPC) clouds locally or publicly for Academic research. The variety of programming languages that can be used (JavaScript, Python and C++) enables undergraduates to learn and get involved with robotics, as well as seasoned developers to dwell into ROS-specific development. The cloud platform enables you to develop new AI algorithms oriented towards Robotics (or drones) and submit them for publication. If you develop an algorithm you would like to share with the cloud, we can arrange licensing options and deployment. In the event that you develop a RAPP (a robot app) which you want to make available globally, you simply have to choose a licensing option (free or non-free) and we will distribute it for you.

3.5 Other Domains

+: Use your imagination!

The limit is your imagination. Other domains where the RAPP cloud platform can be used are:

- Hotels, Museums and other domains where Robot-Human interaction is needed.
- Agriculture: coordinated and precision farming, greenhouse robots, aqua-culture, and much more.

- Manufacturing and shop-floor operations: Due to the distributed and centralised RAPP approach, robot swarms can be organised and controlled dynamically.
- Drones and unmanned vehicles: centralised control and swarm applications for drones and UAVs.
- Monitoring and security: simple cheap and easy to use face recognition and face detection for your installation, combined with speech recognition. Drone security and automated patrolling systems.

4 Our company

Ortelio Ltd is a research focused company, working on cloud robotics. We are developing applications that give robots intelligence to take over human tasks.

- Web: http://robotics.ortelio.co.uk
- Facebook: https://www.facebook.com/OrtelioLtd
- Twitter: https://twitter.com/ortelio
- LinkedIn: https://www.linkedin.com/company/ortelio-ltd

Ortelio Ltd is a member of euRobotics AISBL.