

RADOE-Robot Application Development and Operating Environment

Principal Investigator: Professor Chen I-Ming
Email: MICHEN@ntu.edu.sg
Office: N3.2-02-23
Tel: (65) 6790 5941 (Office)

PROJECT DESCRIPTION:

Motivation & Objectives

This project aims to develop a Robot Application Development and Operating Environment (RADOE). RADOE is developed based on ROS and it is an incorporation of high-level robotic software that has been developed in the A*STAR industrial robotics program for diversified robotics application development. RADOE is typically meant for industrial robots used in manufacturing sector but can be used for other robotic applications. It has a user-extensible software library and APIs (Application Programming Interfaces) for users to use to build applications.

Methodology

Currently, development of robot software is lagged behind hardware. Due to the complexity of handling robots, potential users would rather do things the usual way rather than learning a new robot programming language. RADOE is a software for developing robotic applications and operating robotic systems. It allows easy, convenient and interactive access to controlling robots. It has a graphical user interface for task definition, robot setup, configuration and registration (including calibration), robot programming, supervisory monitoring and control user actions, including corrective actions and error recovery. The user interface allows access to software libraries for rapid robot application development with appropriate APIs. RADOE will also include device drivers for communication and control of different robots, peripherals (such as conveyors, mobile bases, etc), actuators and sensors. It is capable of communicating with different industrial robots for accomplishing prescribed tasks.

Advantages of RADOE

- A friendly user interface with easy graphic programming capability.
- Ability to easily learn, develop a robot program and operate the robotics system.
- Ability to communicate with most of industrial robots (ABB, KUKA, DENSO, Fanuc etc) due to intermediate language
- Users will have the option of developing the program using a graphical programming environment and developing the software using high level programming languages (C++, Python) through the RADOE APIs in the portable controller.
- It has open source ROS to allow rapid and flexible architecture of API for further development of value-added robotic modules and customized applications.

- Due to its simple interface, RADOE is suitable for rank and file workers such as welding operators or technical staff involve in manufacturing processes.

Results / Progress

- A user-friendly and intuitive Graphic User Interface (GUI) has been developed for RADOE application developers and end-users by using Qt. This GUI has been successfully integrated into RADOE 3.0 version. In addition, the GUI is capable of launching other packages developed by WP3 & WP4, and integrated into the works of WP7 in SIMTECH side. It is also capable of integrating research works from other work packages
- A demo has been built to illustrate a simulation of an automated robot taping process, taping trajectories generation and verification purposes as a benchmarking for RADOE applications.
- Another demo of robot bin-picking system has been built as shown in Fig.1.a) The software of RADOE integrates research works of other A*STAR industrial robots namely task planning, object recognition and pose registration, real-time motion planning of manipulator and grasping planning of the robot gripper. The robot participated in ICRA2015 Amazon Picking Challenge and is under development as shown in Figure 1.b). There is current collaboration with 2 local e-commerce companies to develop an enhanced version of it.
- While leveraging on RADOE, the Nextage dual-arm industrial robot is programmed in three different ways, they are: i) small parts sorting, ii) dual-arm assembly and iii) dual-arm packaging as shown in Fig.2, which is targeting for 3C small parts assembly application.
- 4 conference papers have been presented in different international robotics conferences (IFTOMM world congress 2015, Meder2015, ISRM2015 and IROS2016).



(a)



(b)

Figure 1: a) The First version for APC; b) The second version under development



Figure 2: Sorting out of small parts based on the color features with a dual-arm

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PERSONNEL:

Name	Title	E-mail
Prof. Chen I-Ming	Professor, School of Mechanical & Aerospace Engineering, NTU	MICHEN@ntu.edu.sg
Dr. Conghui LIANG	Research Fellow	chliang@ntu.edu.sg

PUBLICATIONS:

Refereed Journal (Published/In Press): Nil

Refereed Conference (Published/In Press):

1. Liang, C., Zou, Y., Chen, I.-M. and Ceccarelli, M. Development and Simulation of an Automated Twistlock Handling Robot System, In Proceeding of the 3rd IFToMM Symposium on Mechanism Design for Robotics, Springer Mechanism and Machine Science 33, Aalborg, Denmark, pp.145-153 2015.
2. Liang, C., Yan, H., Li, R., Chen, I.-M., Marcelo, H. Jr. and Huang, Z., An Integrated Software Package for Advanced Industrial Robot Applications, In Proceedings of the 4th IFTOMM International Symposium on Robotics & Mechatronics, ISRM2015, 23-25 June, Poitiers, Paper No. 25, 2015.
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