

# Lego Mindstorm EV3-Based Pick-and-Place System

Sergey Mikhailov<sup>\*†</sup>

<sup>\*</sup>ITMO University, St.Petersburg, Russia

<sup>†</sup>SPIIRAS, St.Petersburg, Russia

mikhaylovsergeyandreevich@gmail.com

**Abstract**—Presented pick-and-place system is based on smart space technology, which allows providing information for sharing between different services of the system. This technology aims in the seamless integration of different device by developing of ubiquitous computing environments, where different services can share information with each other, make different computations and interact for joint tasks solving. The open source Smart-M3 platform has been used for organization of smart space infrastructure for robots self-organization. Usage of this platform makes it possible to significantly simplify further development of the system, include new information sources and services, and to make the system highly scalable. The key idea of this platform is that the formed smart space is device, domain, and vendor independent.

The system consists of two types of robots: pipeline robot and manipulating robot. The robot form the first type is stationary and has a pipeline that moves objects from the location to the destination. It has a color sensor that determines the color of the moved object. When the robot is moving the object, the pipeline velocity is shared with the smart space. When the object is moved to the destination point and it is ready for manipulation by the manipulating robot, the related triple is shared with smart space by pipeline robot.

The second type of robot has possibility to load an object from pipeline at the location, move to destination, unload the object, and return to the initial location. The manipulating robot subscribes to the information in smart space that an object is ready for manipulation. When the pipeline robot moves the object to the destination point and shares with the smart space appropriate information the manipulating robot gets notification and moves to the object location. It shares with the smart space the movement velocity. Then it takes the object using the onboard gripper. When the gripper is taking the object the robot shares with the smart space gripping velocity. The manipulating robot queries information of object color from the smart space to determine the place where the object has to be unloaded (see Fig. 1).

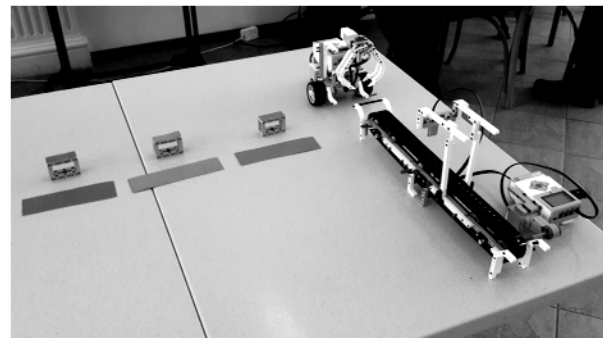


Fig. 1. Pick-and-Place System Scenario

Then the robot moves the object to the place that is corresponded to the object color got from smart space.

For the robot constructing the Lego® Mindstorms EV3 kit is used, which allow to design and built robots from modules. Lego® Mindstorms (<http://mindstorms.lego.com>) is one of the most popular sets in robot constructing education. A standard Education EV3 Core set consists of the following components (shows only control block with available sensors and motors):

- Control block called Brick (ARMv9 core CPU 300 MHz, 64 Mb RAM, 16 Mb flash memory and microSDHC port, USB host, WiFi through USB dongle, Bluetooth, speaker, LCD display and 6 hardware buttons).
- Motors (one medium motor and two large motors).
- Sensors: ultrasonic sensor, touch sensor, gyroscopic sensor, light sensor.
- More than 550 Lego parts.

In the future we plan to add support for multiply manipulating robots in scenario. When information about start of manipulation appeared in smart space, manipulating robots try to decide who will pick the object and unload it in correct place.