

A Practical Interaction Between Robots and RFID-based Digital Product Memories in a Logistic Scenario

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Abstract--In this paper we describe the key concept of the “Digital Product Memory” (DPM), which is a part of the “Semantic Product Memory” (SemProM) project, and how robots can interact with such a memory. At this stage, we will introduce our two robot systems in detail, present some experiences in several use cases, and show our next steps within the SemProM project.



Fig. 1: The dual-arm manipulator with the static frame

The “Semantic Product Memory” project was funded within the IKT-2020 research program by the Federal Ministry of Education and Research. Together with the innovation alliance “Digital Product Memory” (DPM) we are developing a key technology for the “Internet of Things”. The DPM is based on the RFID (Radio Frequency Identification) technology and may contain all kinds of product information, for instance, product history or handling information. Thereby each product can be handled individually even in automated logistic processes. The key idea is to use several storage modalities to store the whole life cycle of a product for quality assurance.

The possible solutions to store such a product memory are manifold. The range is from simple bar-code systems (which store a reference ID in an eternal database), RFID tags and RFID sensors which are able to store a larger amount of data directly on the tag, to small embedded systems like smart tags or sensor motes. All those systems can be used to form a digital product memory. In automated processes, e.g. production, logistics and retail, robots are used to handle, detect, and manipulate those objects. Therefore robots have to interact directly with the DPM.

As a member of the innovation alliance, the DFKI Robotic Innovation Center is building an industrial robot which communicates via RFID with the DPM of products and is deriving movement and handling information from it. In this work, we present two autonomous robot systems which are used to interact directly with the DPM. One robot is a dual-arm manipulator, each arm with seven degrees of freedom and equipped with a gripper, a flexible head built on a static frame. This anthropomorphic design is resumed in the head where the control and vision units of the robot are located. A stereo camera as well as a 3D-camera are used for object recognition and object manipulation. An RFID reader allows the robot to interact directly with an object in a production facility and to extract handling



Fig. 2: The actual mobile robot platform

information from it. In a use case in a pill production line, the robot detects a faulty product and replaces the object. This is achieved autonomously based on vision and DPM access.

A second robot, based on a mobile platform, is also equipped with an RFID reader to access the DPM. The operator can send all kinds of predefined commands through the communication architecture to the robot and monitoring the behavior via an interface. Additionally, the operator has the option between three different navigation modi. A non-autonomous mode to control the robot directly, a semi-autonomous mode to avoid collision, and an autonomous mode. In the autonomous

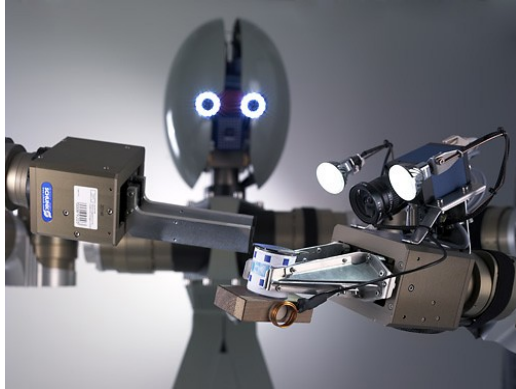


Fig. 3: The robot is grasping a product with a DPM

mode, the robot navigates autonomously along predefined waypoints and is able to locate logistic goods based on their RFID tag. By reading those tags, the robot can get all product information and transmit it to the operator, or, in a future use case, to another robot for further processing and object manipulation. To allow a 24/7 operational up-time, the mobile SemProM robot is also equipped with a docking station. The robot locates the docking station with its internal map of the area and recharges autonomously. Current work and research aims are directed towards the integration of a variety of mobile robots, using RFID-based technology for production and logistics facilities.

Finally, we will present a perspective of our next step within the SemProM project. We will merge a lightweight version of our stationary dual manipulator and a new mobile platform in order to form a mobile dual manipulator, usable for autonomous production facilities and in logistics scenarios.