Practical Robotics Institute Austria (PRIA)
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Review Report of the Master Thesis

Knowledge-based approach for robotic assembly of printed circuits

of

Mr. Vojtěch Janů

Through this report, I would like to express my gratitude for being a member of the examination board to evaluate the master thesis of Mr. Vojtěch Janů.

The aim of this thesis is to investigate the applicability of the knowledge-based approach for robotic assembly of printed circuits boards. The thesis focuses on the usage of an ontology to link a product model with robot skills and related manufacturing operations in a way that enables automatic reasoning and accurate and efficient robot operation. This issue tackles a very important topic in the automation field, considering that typical industrial robot systems are not flexible enough to respond to the rapidly changing demands of new production processes and their growing complexity.

The introductory chapter presents the motivation for this thesis. Chapter 2 describes in detail the devices and tools used for flexible manufacturing. Chapter 3 shows the developed robot control architecture having the code for every skill already stored in the robot. The idea behind not having a universal code for each skill stored on the server is that the setup of each robotic cell varies a lot. The robot control unit executes the functions corresponding to the sequence of elementary skills. The decision-making architecture for this approach includes ontologies, a reasoner and SPARQL as well as a planner. The used PDDL planner enables that there is no need for storing a sequence of operations for manufacturing in the product description. Mr. Janů also clearly described the limitations of his approach pointing out the necessity of presence of an expert to perform the calibration during the setup phase of such a system. However, after this first phase the unit should be flexible and a change of the manufacturing process should be at low-cost. In Chapter 4 the evaluation of the approach by assembling two different printed circuits boards is presented. The first two tests (1A and 2A) were made to try out assembly without collision. Further two tests (2A and 2B) were made to prove collision detection during planning. All four tests were performed ten times in a row with almost 100% success rate (with exception for test A1). Finally, the last chapter summarizes the results and gives a final conclusion indicating also possible future work,

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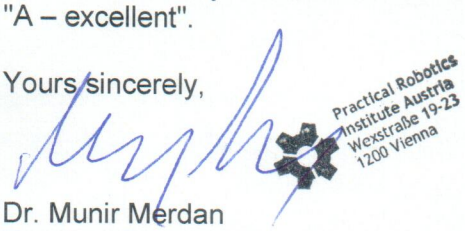
Generally, the structure of the thesis is well balanced (comprising 5 chapters) and follows the current standards for this kind of work. However, I have to notice here that the second state of the art section could analyze also other existing ontologies and summarize even more flexible robotics systems implemented by other researchers.

Summary: The thesis presents very good quality and original results from the research area, and meets the academic requirements for a master degree. The thesis scope is also aligned with the recent Industry 4.0 initiative, and the work presented in the thesis contribute to improve the state-of-the-art in the field by proposing a system architecture with the use of an ontology, which is linked to skill representation of a robotic unit enabling automated assembly of printed circuits boards and other similar products. The generated theoretical approach is specified but also tested and validated in a laboratorial environment with an LBR iiwa robot. This prototypical implementation and the achieved positive results ensure the applicability of the approach.

In conclusion, my evaluation of the thesis of Mr. Vojtěch Janů is expressed by the grade "A – excellent".

Yours sincerely,



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