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Paper title: “Future of Robotics Education: The Design and Creation of Interactive Notebooks for Teaching Robotic Concepts”

Abstract:

Within Robotics Education, there can exist a barrier in presenting coherent activities due to the disjoint nature of curriculum concepts, software platforms, and hardware devices. Due to the varied nature of all three, the strain is put on educators to become simultaneous experts in all these areas while performing the design, creation, and implementation of activities. Further, they are required to be on hand to provide real-time support during actual instruction, which then diverts necessary attention and energy away from education. With limited time constraints always present in classroom settings, instructors at all levels would benefit from easily customizable, dynamically adaptable, and highly interactive supplemental software environments that augment the already existing curriculum, programming software, and robotic hardware presently being employed.

This paper presents the concept of a digital notebook aimed at facilitating this process of robotics education through an interactive software environment that easily connects to and links together the curriculum with the programming environments and robotic hardware platforms. These electronic workbooks provide teachers with an easy curriculum development and customization setting and students with engaging learning tools, while reducing the obstacles between robotic conceptual activities at the high level and the actual physical devices in the classroom.

The environment described includes a browsing window that simultaneously contains the curriculum content as well as access to the programming software and real-time feedback from the robot system. The interactive setting allows the student to shift smoothly from activity to code generation to tangible implementation, creating a more coherent education transition and as a result providing a more engaging atmosphere for the learners. The software is designed to assist with the robotics education in three main ways: classroom management, interaction, and customization. Classroom management is supported in several ways, most notably due to the fact the book is self-guided and the activity can troubleshoot itself (both at the software and hardware level), and thus the teacher is alleviated from performing these tasks manually. Interaction is also increased, both between the student and the technology and also amongst students (interactive collaboration, either within the classroom or over the internet with other robotics classes around the world), as well as the relation between student and teacher (activity progress is tracked real-time, providing valuable feed-back to the educator). Finally, through simple customization the teacher can easily update and change activities based on personal preferences, classroom specifics, local standards, etc which ensures robotic activities are relevant to a

particular environment setup in addition to being useful for other educators, all of which will facilitate the sharing and distribution of robot educational materials.

Due to the elementary robotic-education component of this initiative, early implementations have concentrated on the LEGOTM Robotic Systems, although the technology has been created in such a way as to be universal enough for integration with many other major mainstream robot projects (and extensible all the way through graduate-level robotics programs). The design research has focused on usability investigations aimed at identifying workbook structure and layouts that facilitate students' self-confidence, overall engagement, and perceived abilities within the robotics fields, and this product evaluation through questionnaires and discussions has led to a list of general human factors design recommendations for interactive electronic workbooks to be used in the future education of robotics concepts.

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Principle Presenting Author Biography:

Dr. Ethan Danahy (StM’03, M’07) received the B.S. and M.S. degrees in Computer Science in 2000 and 2002 respectively, and a Ph.D. degree in Electrical Engineering in 2007, all at Tufts University, Medford, MA. He currently holds the position of Software Designer at the Center for Engineering Educational Outreach within the Tufts University School of Engineering, where he manages tool development projects while researching innovative and interactive techniques for assisting teachers with performing engineering education and communicating robotics concepts to students spanning the K-12 through university age range.

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