Interactive Robot Applications in K-16 Education: A Review of Cases and Challenges

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Abstract

Robotics technology has been considered as a key economic enabler as pointed out in a report on US Robotics Roadmap published by NSF Computing Community Consortium recently. Robotics applications have been successful in the areas of industrial robots and computer-aided surgery, and new applications are emerging in many other areas. Tremendous advancements in robotics technology have enabled a new generation of robotics products in various application area over the past 5-10 years. Although educational robot kits, such as Lego Mindstorms, have been used in K-16 education for over two decades, robots that could interact with students "humanly" have only been considered possible recently. The technology advances have made it possible for smart robots to interact with people through voice, body movement, gesture, and/or face expression, instead of traditional keyboard or pushbuttons. There are increasing interests in interactive robot applications in education to improve learning. Real world applications of robots involve various scientific and engineering problems and challenges, including sensing and perception, design and materials, communication, interfacing, cognition, artificial intelligence, and modeling and analysis, etc. Therefore it is important to study the available technologies and platforms and the current usage of interactive robots in education and to understand further challenges.

In this paper, cases of interactive robots used in mathematical, language, and engineering/technology educations will be studied. Robotics technology has the potential to provide ultimate personalized learning experience to enhance STEM learning in both formal and informal environment. The current roles of robots in K-16 education will firstly be discussed. Current available open source software and hardware platforms for interactive robot application development will also be compared. Case studies will be summarized. Challenges and obstacles that must be overcome for the development of co-robot systems that can support personalized learning will be investigated.

Biographies

JIN ZHU is currently an associate professor of Electrical Engineering Technology in the Department of Technology at the University of Northern Iowa. She earned her Ph.D. in Electrical Engineering from New Jersey Institute of Technology in 2005. Her interests include wireless sensor networks, energy harvesting and sustainability, robotics applications and embedded systems. Dr. Zhu may be reached at jin.zhu@uni.edu.