LESSONS LEARNED: REVAMPING ROBOTICS EDUCATION TO MEET 21ST CENTURY NEEDS

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Abstract - The rapid growth of robotics and automation, especially during the last few years, its current positive impact and future projections for impact on the United States economy are very promising. This rapid growth of robotic automation in all sectors of industry will require an enormous number of technically sound specialists with the skills in industrial robotics, automation, and controls to maintain and monitor existing robots, enhance development of future technologies, and educate users on implementation and applications. It is critical, therefore, that educational institutions adequately respond to this high demand for robotics specialists by developing robotic curriculum, providing opportunities for industrial certification programs in robotics, and developing software and hardware to enhance educational methodologies. Michigan Technological University in collaboration with Bay de Noc Community College secured National Science Foundation Advancing Technological Education (NSF ATE) grant to address all of the above. This sponsored project targets to impact broad student population: 2- and 4 year degree community college and university students, industry representatives, and displaced workers wishing to retool their skills in industrial robotics, automation and controls. Educators and researchers involved in this project not only developed an advanced robotic curriculum but also addressed such in high demand industrial certification in robotic, automation, and controls. In order to effectively teach concepts of industrial robotics, the curriculum needs to be supported by the hands on activities utilizing industrial robots or providing training on robotic simulation software. Nowadays, there is no robotic simulation software available to the academic institution at no cost which limits educational opportunities. As part of the NSF sponsored project, team of research faculty members and students from Michigan Tech are developing new, open source "RobotRun" robotic simulation software to be available at no cost for adaptation by the other institutions. In order of providing an additional degree of freedom in teaching emerging concepts of industrial robotics on the state-of-the art robotic hardware which is commonly prohibited for the educational institutions due to its cost, the project introduces a new concept of Teleoperated Robotic Workcell (TRW) with the available virtual robot technology to make a non-destructive remotely controlled robotic arm, to better teach students and researches about programming and control of a robotic arm. Since there is no commercially available remotely controlled robotic arm, and due to the expensive cost of robotic arms, students and researchers are often unable to test their programs on real robots. By applying the concept of a remote controlled robotic arm, the existing resources can be effectively shared with other universities to teach programming aspects of industrial robots. Using developed system, allowing the remote access to the physical robot, interested parties can develop and test their programs with a real robotic arm instead of simply working in robotic simulation environment. To broaden the impact, the project team has developed a standalone Robotic Educational Portal (REP) with in-depth educational tutorials and online lectures to complement the "RobotRun" simulation software and made it available online at no cost. This will allow current concepts related to industrial robotics to be taught even in locations without access to state-of-the-art robotics hardware. These tutorials and simulation software represent a complete training package. Thus, students from any institution, industry representatives, and displaced workers can be independently trained. This project gained significant national and international recognition and resulted in 24 articles in journals and conference proceedings and one book chapter. The project has also received significant media attention and has been covered by TV channels ABC10 and 3 Marquette, well known and read magazine Forbes has published 4 articles, and the local Upper Peninsula of Michigan, Daily Mining gazette has published 2 articles related to the overall project as well as high school teachers workshop at Michigan Tech. The main intend of the authors is to provide an overview of all the project activities and share the developed resources with educators, researchers and industry representatives. This will provide the vehicle for effective teaching methodologies to enhance knowledge base of college students and industry representatives in the field of industrial robotics, automation and controls, specialists of which nowadays are in such a high demand.

Keywords - Robotics, Automation, Controls, Simulation Software