

AC 2010-968: PARTNERSHIP WITH INDUSTRY TO OFFER A PROFESSIONAL CERTIFICATE IN ROBOTIC AUTOMATION

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Partnership with Industry to Offer a Professional Certificate in Robotic Automation

Abstract

The Electrical Engineering Technology program in the School of Technology at Michigan Technological University is collaborating with Fanuc Robotics to offer a professional certificate in Robotic Automation. This certificate represents a good model of collaboration between industry and academia. Robotic automation is on the leading edge of manufacturing today and FANUC Robotics is the industry leader. Also, the demand for electrical and computer engineering technologists who are equipped with skills in robotic automation continue to rise. To effectively meet the next generation's workforce needs of skilled robotic automation technologists, the electrical and computer engineering technology curriculum must be current, relevant, and teach skills that is widely needed in industry. To meet this goal, the School of Technology is stepping up to this challenge and collaborates with Fanuc Robotics to develop robotic automation curriculum and offer industrial certificate in robotic automation. The electrical engineering technology program will utilize Fanuc Robotics certified education robot training program (CERT) which is available to qualified university with a goal and commitment to the development of the engineering knowledge base and attracting young people to the robotic automation field. The Certified Education Robot Training (CERT) program is a new certification available to qualified high schools, community colleges, and universities. The program will certify faculty member to train our students to program FANUC robots. The School of Technology purchased two industrial robots utilizing the significant educational discount available through Fanuc CERT program. This paper describes the development and implementation of a new professional certificate in robotic automation at the electrical engineering technology program in collaboration with Fanuc Robotics. The development includes course material in industrial Robotics and establishing robotic automation lab in partnership with Fanuc Robotics CERT program.

Introduction

Recent advances in robotics have revolutionized our personal and business lives. Today, commercial and industrial robots are in widespread use, performing jobs more cheaply and in some cases with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, dangerous, or dull to be suitable for humans. Robots are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research, safety, and mass production of consumer and industrial goods. Robots play significant roles in our personal life as well by serving humans and performing everyday tasks such as cleaning, cooking, repairing, etc. Intense involvement of these artificial helpers in everyday life requires human-specialists with up-to-date knowledge to maintain and monitor

existing robots, as well as to develop new, more advanced, smart, and safe machines. To meet this need, educational institutions must adequately respond to the high demand for specialists in the field of robotics by developing and offering appropriate courses and/or certifying workers involved in the industry of robotics and automation.

Motivation

During the last decade, popular interest in educational exploitation has increased significantly^{1,3}. Robotics in education is seen as an interdisciplinary, project-based learning activity drawn mostly on math, science, and technology and offering major new benefits in education at all levels². Robotics implements 21st century technologies and can foster problem solving skills, communication skills, teamwork skills, independence, imagination, and creativity⁴. Taking into consideration that students have a better understanding when they express themselves through invention and creation⁵, robotics activities are considered to be a valuable learning tool that can contribute to the enhancement of learning and to the development of students' thinking².

Some specialized robotics jobs require new skills, such as those of robot installer and robot integrator. While universities have long included robotics research in their curricular offerings and tech schools have taught industrial robotic arm control, new college programs in applied mobile robots are under development at universities in both the United States and Europe, with help from Microsoft, FANUC Robotics America Inc., MobileRobots Inc., and other companies encouraging the growth of robotics. Robotics is a naturally compelling subject for engineering, engineering technology, and computer science undergraduates, but never more so than when coupled with hands-on lab work. Robots have recently become a popular tool used to raise interest in computing among middle and high school students.

Undergraduate study of robotics is fairly common, although few universities offer specific robotics degrees or certificates. For instance, Worcester Polytechnic Institute (WPI) offers a Bachelor of Science in Robotics Engineering. Universities that have graduate degrees focused on robotics include Carnegie Mellon University, MIT, UPENN, UCLA, WPI and the South Dakota School of Mines and Technology (SDSMT). Academic programs in the School of Technology at Michigan Technological University are designed to prepare technical and/or management-oriented professionals for employment in industry, education, government, and business. The School of Technology's educational programs include significant hands-on laboratory components to prepare students for practical design and production work. For the past few years, the School of Technology has experienced rapid growth as an educational unit and as an interdisciplinary research team. From an educational perspective, this has been driven by the high industrial and government demand for technically skilled graduates.

To effectively meet the next generation's workforce needs, the electrical and computer engineering technology undergraduate curriculum must be up-to-date and relevant. It must effectively teach the rapidly changing technology that is widely used in industry. In order to meet

these needs, and further enhance the educational programs in the School of Technology, the authors are developing and implementing a program that will certify in robotics the students and representatives from the industry. This will be done by developing an Industrial Robotics course and adding an up-to-date robotics laboratory in the Electrical Engineering Technology program in the School of Technology. In addition to broadening the skill set of our School of Technology's graduates, our efforts are interdisciplinary and will generate a high impact on the university as a whole as well as across the industry.

In this project we intend to integrate advanced concepts in robotics into the curriculum by:

- 1) Developing Industrial Robotics course.
- 2) Building a robotics laboratory equipped with state-of-the-art training tools that will provide students with extensive hands-on experience installing the equipment currently used in industry.
- 3) Offering the Fanuc Robotics industrial certificate in robotics and automation.

Learning Outcomes

There are rigid requirements in place to obtain certificate in robotics. Each participating student must complete series of tasks including: the theoretical part of the industrial robotics course, multiple simulation projects, laboratory assignments, web-based quizzes. Upon successful completion of web-based quizzes for each topic of the course material, the involved student will need to successfully pass a comprehensive HandlingTool Operations and Programming exam.

Upon successful completion all of the requirements the students should have the knowledge to:

- Discuss the CERT Cart Safety.
- Explain different frames that uses robotic arm.
- Describe different inputs and outputs and how to configure them
- Understand and apply various program instructions and macro commands.
- Be able to modify the program in different levels.
- Explain how to setup a robot for production using teaching pendant.
- Describe how to manipulate files: copy and delete programs, backup all or specific types of files to a specific device.
- Learn how to load program from the backup device and how to do an image backup and restore
- Demonstrate proficiency simulating operation of the robot via ROBOGUIDE simulation software.
- Demonstrate proficiency manipulating robotic arm and successfully complete the assigned tasks.

Proposed Course

The course "Industrial Robotics" will reflect the new generation of robotics developments and systematize the current expertise of industrial robotics and its forthcoming capabilities. It will

include a discussion of scholarly and practical robotic topics ranging from kinematics and programming to practical application areas and economic concerns. This course will be specifically developed with the intent of being very practical and will offer easily applied guidance to personnel involved in manufacturing with the current robotics systems on site or who may exploit robotic systems in the near future. The stand-out topics that will be covered in this course include: the development of industrial robotics; an overview of the mechanical design, control, programming, and intelligence; organizational and economic aspects; robotics in progress; robotics in operation and various applications. Robotics terminology commonly used in the industry will also be covered in this course. Due to the very practical content, this course will be a part of Fanuc Robotics industrial certification in robotics and automation. The hands-on experience is an essential part of this course and will occupy 70% of its time. The lab exercise will be devoted to practical aspects of programming the FANUC Robotics mini robots. The course “Industrial Robotics” will be offered as week- long course totaling 35 hours with the first 10 hours be devoted to the theory of robots and covering important safety considerations related to manipulating the robot. The remaining 25 hours will be used to provide extensive hands-on experience working in the lab. The course will be culminated by a two-hour exam in which the participants will have to demonstrate an understanding of theoretical background as well as the ability to program the robot for a task given by the instructor. Upon successful completion of the course, the participants will receive the FANUC robotics certificate issued by the FANUC certified faculty of the Electrical Engineering Technology program in the School of Technology. Due to the nature of the course, it will be offered on demand and may be conducted during winter and spring breaks or anytime in the summer. This flexibility will help to attract students from not only the University, but also participants from industry and students from other institutions.

Partnership with industry

Electrical Engineering Technology program has established collaboration with FANUC Robotics America Inc., the leading company specializing in the development and production of innovative and intelligent robotic solutions. FANUC Robotics deeply supports educational mission of the School of Technology and the Michigan Technological University as a whole, providing a significant educational discount on educational mini robots. In fact, the Electrical Engineering Technology program has purchased two LR Mate Training Carts MH1 & Certification Package totaling 63,754 dollars. However, the company list price for the same product and services is 648,080 dollars. Given that, the FANUC robotics has already provided an educational “Gift in Kind” valued at 584,326.

FANUC Robotics Certified Education Robot Training Program

The mission of the FANUC Robotics Certified Education Robot Training (CERT) Program is to create Certified Education Robot Training that promotes an understanding of FANUC Robotics’

robotic automation solutions through the development and implementation of integrated classroom instruction and student projects. The CERT program is a new certification available to qualified universities. The program certifies instructors at educational institutions to train their students to program FANUC robots. To accompany the CERT program, FANUC robotics provides to the University a new innovative educational tooling package that includes an industrial robot, integrated vision system, and ROBOGUIDE simulation software. With this package, students will learn the fundamentals through advanced engineering and manufacturing concepts. Students will utilize the same robots and software that are most widely used in industry.

The FANUC Robotics Certification and the right to purchase the unique HandlingTool Operations and Training materials at the academic partner price requires extensive professional development of the faculty involved in the training effort. At least one instructor candidate must complete multiple on-line training sessions as well as on-site training. On-line training involves attending and passing the following on-line courses: The Robot Operations, HandlingTool Operations and Programming, On-Line HandlingPRO, On-Line Advanced HandlingTool Operations and Programming Certification. Upon successful completion of web-based courses, the involved faculty will need to attend and successfully pass a live HandlingTool Operations and Programming class as a student at FANUC's facility. The candidate also needs to provide an outline of the FANUC-related course materials. After all the requirements are completed, the faculty becomes certified by FANUC as an instructor to teach robotics-related courses and to issue the FANUC Robotics certificate. One of the authors has already completed all the required training, successfully past on-line and on-site examinations, and become certified by the FANUC instructor.

LR Mate Education Training Cart MH1 from FANUC Robotics

The FANUC Robotics LR Mate Education Training Cart MH1 shown in Figure 1 incorporates FANUC Robotics' latest generation electric, servo-driven mini robot, housed in a self contained, portable enclosure. Portability of the entire assembly is a plus and makes the system mobile, allowing training or demonstration to be performed where it is needed. The LR Mate Education Training Cart MH1 can be used to teach students how to program a real robot, in real time, in a safe, controlled environment, using FANUC's HandlingTool software supplied by the FANUC robotics. The LR Mate Education Training Cart MH1 can also be used to demonstrate Robot operations during department open house and visits, and certainly during recruiting events. The self-contained Lexan enclosure provides safety while training. With its compact size and 110 volt power requirements, it can be easily set up to provide hands-on access to a real industrial robot, with minimal risk of injury that a Robot can bring to its work envelope.

The FANUC Robotics LR Mate Education mini robot provides multiple benefits: industry-standard components that allow teaching principles of automation, compact and portable design,

affordability, safe construction, and an integrated vision system that is commonly used in the industry. The extremely powerful software solution, ROBOGUIDE developed by the FANUC Robotics, will allow students to program the robot off-line and simulate its future tasks. HandlingTool software also developed and installed by FANUC Robotics on the controller allows users to learn real-time singularity avoidance and collision protection. The FANUC Robotics LR Mate Education mini robot is a highly upgradable system and the current educational training package provided by the company will allow demonstrating the basic functions such as vision, collision guard, path tracing, insert, straight line accuracy, as well as creating more advanced hands-on laboratories.

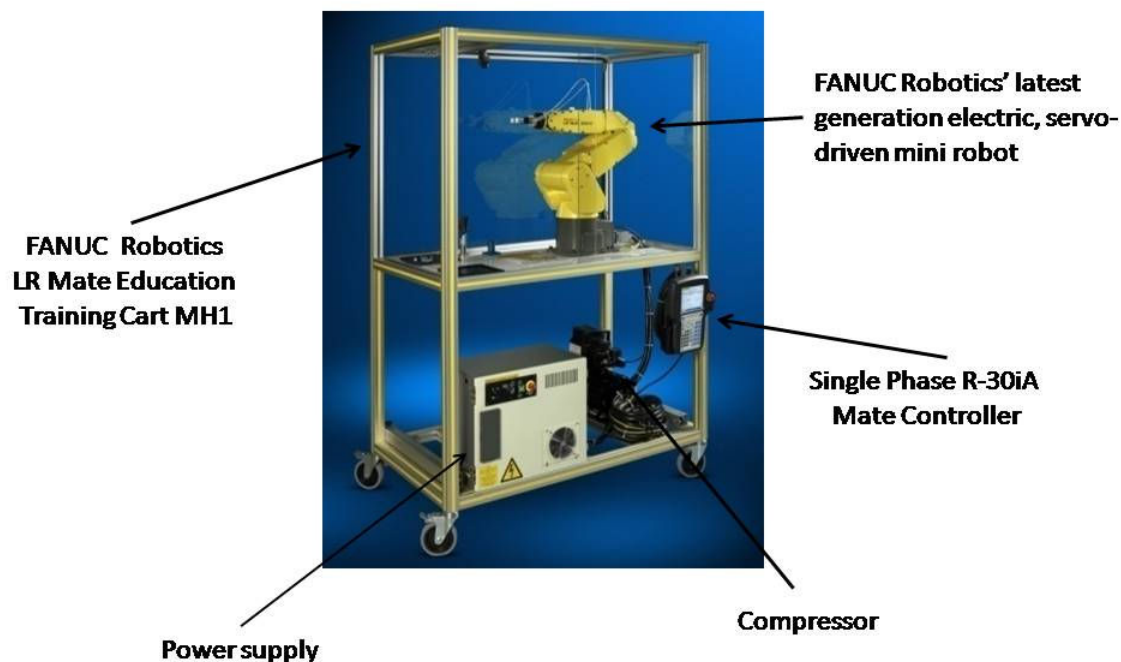


Figure 1: The FANUC Robotics LR Mate Education Training Cart MH1; incorporating FANUC Robotics' latest generation electric, servo-driven mini robot and housed in a self-contained, portable enclosure. The figure also shows the location of the power supply, the compressor, and the single phase LR Mate controller.

Facilities – New Robotics Laboratory

The School of Technology at the Michigan Technological University offers high-quality, up-to-date academic programs that endeavor to meet the immediate and future needs of industry. The

Michigan Technological University's strategic plan calls for us to be nationally recognized for programs that advance technological education through excellence in learning, discovery, and engagement. While we are a technology program, we go beyond most other technology programs by offering significant hands-on lab experiences and applied research opportunities to undergraduates. These experiences complement the classroom experience and prepare our students for careers in a wide range of industries.

The Electrical Engineering Technology program has identified present needs for a new state-of-the-art robotics laboratory, that will support a new "Industrial Robotics" course and provide students with training that meets industrial standards and provides state-of-the-art, hands-on training. Upon completion, the laboratory will be equipped with six workstations and support the class size of 30 students. A single workstation will consist of a LR Mate FANUC Robotics educational mini robot platform, shown in Figure 1, a single phase R-30iA Mate controller, and a high-end computer with installed ROBOGUIDE software package to be used for off-line training, programming, and modeling.

Conclusion

Academic programs in the School of Technology at the Michigan Technological University are designed to prepare technical and/or management-oriented professionals for employment in industry, education, government, and business. The development of new robotics-related courses and a robotics laboratory will promote robotics education and create significant impact on education in the School of Technology and the Michigan Technological University as whole. By strengthening the robotics area, the proposed program will improve the quality of STEM education for undergraduate students by creating innovative learning material and teaching strategies and by implementing advanced, hands-on expertise valuable to industry. The professional development of involved faculty members will be advanced through extensive training and industrial certification in the field of robotics and automation provided by FANUC Robotics America Inc. This partnership creates an important link between academia and industry. The appealing nature of the robotics will be used in our outreach efforts to trigger an interest among the students of the local middle and high schools. Inviting students and K-12 teachers to the organized educational workshops will introduce the current advances in technology and in the field of robotics in particular, to the participants. This will help to create an important and often missing bridge between academia and K-12 education, and ultimately, impact the future student body. The proposed robotics trend will advance undergraduate research within the School of Technology, promoting robotics-related senior design projects and allowing the students to participate in national and international robotics competitions. The robotics lab will be used to teach students to program a real robot, in real time, in a safe, controlled environment without sacrificing the opportunity to operate on the robots commonly used in industry. The proposed state-of-the-art robotics laboratory will also be capable of demonstrating the current advances in the area of robotics during department open house and visits, and will certainly serve as eye-catching demonstration during recruiting and "show and tell" events. The proposed robotics course will advance undergraduate research within School of Technology, fostering enhanced robotics-related senior design projects and allowing the students to participate in national and international robotics competitions. Such an approach to the education

of engineering technology students meets the expectations of ABET accreditation standards by connecting students to the solution of real problems.

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