

# Robotics REU in Undergraduate Engineering Research

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## Abstract

The Robotics REU program funded by National Science Foundation (NSF) brings together a dynamic and creative group of undergraduates from UW-Stout and regional universities to create an interdisciplinary research site at UW-Stout.

## Introduction and Objectives

The REU program collaborates with Stout Vocational Rehabilitation Institute (SVRI) to create interdisciplinary research and innovative professional development. Students study the advances in the design of human-interactive assistive robots, and apply robots in enhancing the quality of life for people with disabilities and the elderly.

Long term, we hope to create an extensive social network of students who have participated in REU research, gone on to graduate education, and pursued a career in this field. The main objectives of this REU effort are to:

- (1) Increase participation in interdisciplinary research by first-generation, female, underrepresented minority students, and persons with disabilities.
- (2) Empower students to pursue graduate education and prepare them for success in graduate and professional engineering programs.
- (3) Generate and share new knowledge regarding the practical applications of robots in assistive technology, manufacturing engineering, computer engineering, and mechanical design.

## Targeted Student Participants

Our primary target population includes underrepresented groups (women, minorities, and persons with disabilities), and first-generation (FG) college students. The REU site provides research opportunities for students from academic institutions without an extensive robotics infrastructure, and to enable them to both successfully compete for graduate positions and bring back robotics "culture" to their home institutions. We work with Stout McNair Scholars program to attract underrepresented students, and provide a series of workshop and research training activities that help students have a complete research experience at the REU and prepare them for graduate school.

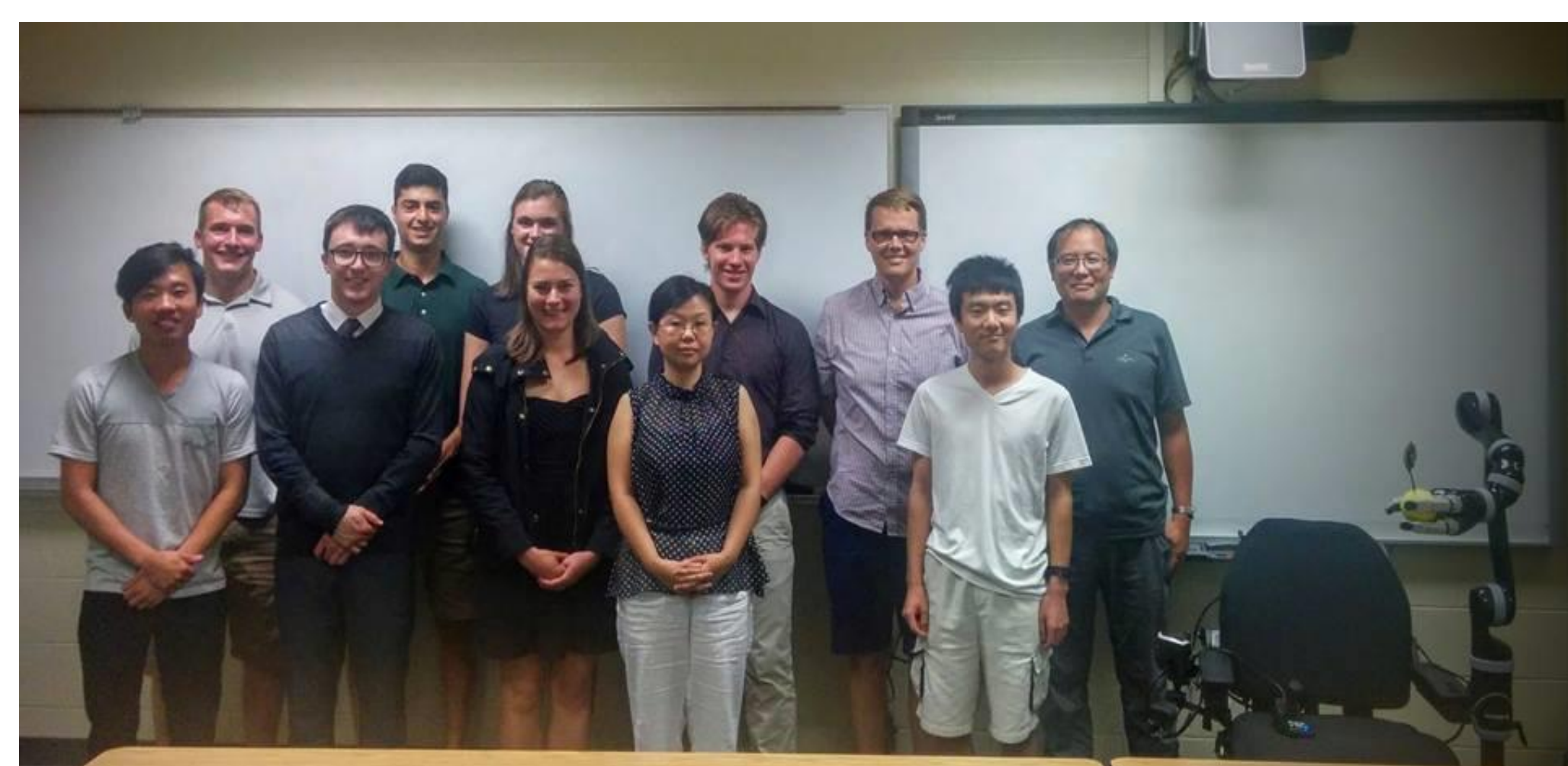


Figure 1. Robotics REU Undergraduate Researchers and Faculty in 2016 Summer.

## Research Activities

The REU program provides students opportunity to gain valuable research training in (1) robotics and control system design, (2) assistive technology and vocational rehabilitation, for helping people with injuries and disabilities find employment and improve their independent living opportunities.

Individuals who are elderly or have a disability require novel approaches for communicating efficiently with robotic-assisted services in their living environments and even unstructured environment with safety and reliability. Our design of such systems is focused on cost effectiveness, ease of control, and safe operation, in order to enhance the autonomy and independence of such individuals, minimizing at the same time the necessity for a caregiver.

A semi-autonomous robot has been developed using the Kinova JACO robot arm and tested with both able bodied users and an individual with an upper extremity disability. Users consistently expressed their preference for this autonomous meal assistance system over manually controlling the robot. They found mode switching confusing and frustrating using the joystick, and the robotic meal assistance system relieves those switches and simplifies the feeding process.



Figure 2. JACO Robot Arm.

Also, a navigation system that can be integrated into a wheelchair has been developed by our REU participant and faculty to improve steering capabilities. The wheelchair limits undesirable paths, can give the user the freedom to choose which route to take.

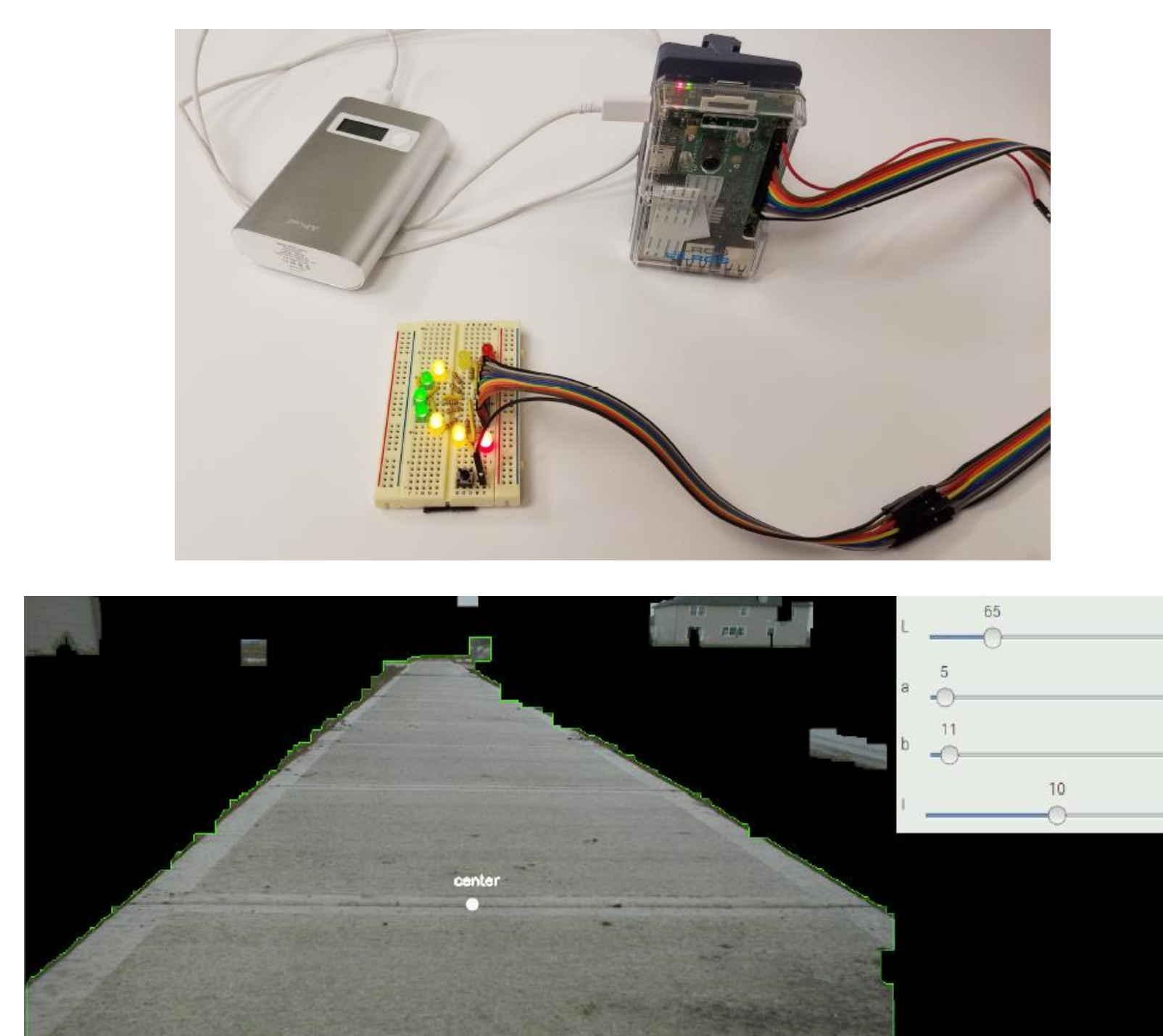


Figure 3. Wheelchair Navigation System.

Another team applied the iRobot Create 2 development platform to implement wireless technology with robotics to assist the blind. The Bluetooth technology was used to communicate between the robot and an android smartphone application.



Figure 4. iRobot Development for the Blind.

## Outreach Activities

1. Science, Technology and Engineering Preview Summer (STEPS)
2. STEM Camp



Figure 5. REU Participants in Outreach Activities.

## Conclusion

This work offers significant intellectual contributions by improving student learning and development in response to research experiences, creating innovative approaches to manage the training and professional development of students and faculty in interdisciplinary research, and understanding the advances in the design of human-interactive assistive robots, and the robotics application in enhancing the quality of life for people with disabilities and the elderly. Our efforts at synthesizing different research projects centered on a unifying theme will improve our effectiveness in collaborative problem solving and in teaching undergraduates an interdisciplinary approach to research, and furthermore encouraging them to continue their pursuit in engineering and STEM field.

## Acknowledgement

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## REU Website and Social Network

1. Robotics REU Website:  
<http://www.uwstout.edu/robotreu/>
2. Robotics REU Facebook:  
<https://www.facebook.com/Stout.Robotics.REU/>