Small Business Innovation Research Program Phase I NSF Proposal
Topic: Electronic Hardware, Robotics and Wireless Technologies (EW) Subtopic: Robotics and Human Assistive Technologies (RH): RH2. Robotic Applications.
Joseph Crandall - Characters: 3923 (with spaces)

Box 1: Overview, Key Words, and Subtopic Name:
The topic is Electronic Hardware, Robotics and Wireless Technologies (EW) and the subtopic is Robotics and Human Assistive Technologies (RH): RH2. Robotic Applications. The team at The George Washington University composed of Undergraduates Joseph Crandall & Karl Preisner as well as Ph.D. student's Pablo Frank Bolton & Andrei Claudiu Cosma are conduct Schuck Robotic vision research in order to develop a robotic system that can generate a point cloud of a biological sample and grasp it. The robotic research was formally started in the summer of 2016 and will continue until April 2017. The point cloud research was ongoing prior to the start of this project. This research has the potential to generate savings for agricultural products that require human labor and dexterity to harvest the item without damaging it. The system will also provide point cloud over time data for botanists working to quantitatively measure plant development. The Robotics component of the research encompasses three main technical challenges, gaining a working understanding of a prebuilt ROS package for the Schunk LWA 4P in order to drive the arm, a working understanding of the Gazebo robotic simulator in order to run a simulation of the Schunk LWA 4p, and using sensory point cloud data from an Xbox kinetic inside of a simulation world in order to give the robot arm sensory information. Once functional, the arm will be able to perceive, through the point cloud, complex geometric structures and be able to interact with them via a point cloud to mesh software currently under development by Ph.D. student Pablo Frank Bolton. The following resources are being used for the robotic component of the project and can be treated as key words, Schunk ROS Package (http://wiki.ros.org/schunk_canopen_driver), Peak-systems Linux (http://www.peak-system.com/PCAN-USB.199.0.html?L=1), ROS Kinetic Kame (http://wiki.ros.org/kinetic), ROS Control (http://wiki.ros.org/ros_control), ROS Gazebo Integration (http://gazebosim.org/tutorials?tut=ros_overview), and Yale OpenHand Project (https://www.eng.yale.edu/grablab/openhand/).
Box 2: Intellectual Merit
The hurtles to overcome are not necessarily technical in nature. They come from a lack of understanding of how to fully utilize ROS and Gazebo. This project will require the developer to become familiar with all of these packages in order to integrate them for the Schuck Robotic System. It is tempting to try to implement a function or aspects of a function on ones own to complete a single problem. However, many of these basic functions have already been implemented and refined through the robotic open source community. This research should be viewed as both a learning experience for the student, who is attempting to gain a better understanding of ROS and its community in order to drive the robotic system, and a development process to build software to interpret the point cloud data to make it usable for the robot. It is possible though unlikely that in the process of completing the capstone the student may come across a problem that has not been previously addressed, if this is the case the student may be able to contribute some new code to that repository.
Box 3: Broader/Commercial Impact:

Robotic tools for interacting with biological processes are not common place. Although automation in machining and manufacturing has been well developed, the same principles for these controlled closed environments do not always lend themselves to dynamic ones. However, many dynamic biological environments could be automated to some extent with this technology. One example is if fruit harvesting and indoor/vertical farming. The orientation of the plant sites can be controlled, and with this system a point cloud to mesh interpretation of the plant would allow the robotic arm to grasp the biological structure and harvest it