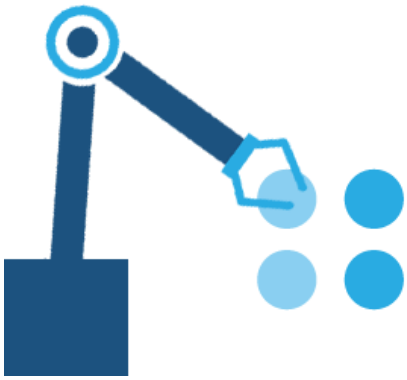
Boston University
EC463 Senior Design Project
Second Prototype Testing Plan



NanoPack
A PACKING MACHINE FOR NANOVIEW BIOSCIENCES

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Required Materials:

Hardware:

NANOPACK MACHINE

- LitePlacer Robotics kit
  - All mechanical parts
    - Framing, sliders, connectors, etc.
  - TinyG motor controller
  - USB cameras, LED ring lights
  - Stepper motors (3 NEMA 17, 1 NEMA 14)
  - Belts and pulleys
  - Limit switches
  - Cable chain
- 3D printed actuator parts
- Tweezers
- 24V power supply
- Wiring & connectors
- E-stop
- Test Computer

Software:

1. Python Control software
2. Machine learning program to process image from wide angle camera
3. Machine learning program to process image from actuator camera
4. .NET GUI for User Interface

Set Up:

The set up consists of both hardware and software components. From the GUI we will run a control program which will move the machine's actuator from rest to hover over a traveler, whose location will be determined using the large angle camera and a machine learning script. The machine will then use the actuator camera to take a photo and locate chips with the image processing. Then, the actuator will jog down the z-axis, close the tweezers, and return back to the clearance height. The machine will not pick up a chip at this time but will return the location of the chips within the traveler. For this prototype testing, our mechanical goals will be to have the machine moving within the workspace as well as a demonstration of the actuator movement. Our software goals are to locate the traveler and clamshells from the wide angle camera, convert that location to units usable by the TinyG motor control board, send the commands to move the board over it, and to identify and locate the chips within the traveler from the actuator camera.

Pre-testing Set Up Procedure:

- Connect the control computer to the TinyG and plug in power supply.
- Ensure that the PWM light is solid red and no other red lights are on/blinking, otherwise reset the board.
- Open the lab computer, and open the file location of the GUI.
- Place clamshells and traveler and chips on the workspace.

Testing Procedure:

- Execute packing procedure in the software.
- An image is taken of the workspace by wide angle camera.
- A machine learning program will process the image; locate the traveler and clamshells within the workspace.
- The control script will home the machine, then proceed to hover the actuator over the traveler.
- A second image will be taken with the actuator camera of the traveler
- A second machine learning program will process this image; identify and locate the positions of the chips within the traveler.
- The machine will jog down to the work space, the actuator will close the tweezers, and then return to the clearance height.

Measurable Criteria and Scoring:

The criteria for successful running and output is as follows:

Criteria	Completed (Y/N)
Image of workspace taken from wide angle camera	
Using image from wide angle camera, returns the locations of traveler/clamshell	
Machine moves to hovers over traveler	
Image of chips taken with actuator camera	
Using image from actuator camera, returns location of chips in traveler	
Machine jogs down	
Actuator closes tweezers	
Machine moves up to clearance height	

Demo:

- From the GUI we run a program that moves from the center over to a point determined from the large angle camera, takes a photo and locates chips with the image processing, down on the z-axis, actuates the grabber (not necessary to pick up chip), moves up and back to where it started.

Things that need to be done to demonstrate:

- Figure out communication between GUI and control loop for the demonstration
- Actuator built
- Actuator motor wired
- Configuration automated with checks
- ML traveler location program working
- ML chip location within traveler program working
- Unit conversion from traveler location program to mm that the TinyG understands
- Home the TinyG units
- Fix the control loop for the demo
- WRITE AND PRINT 4 COPIES OF TESTING REPORT