# Automatic degrader changer

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The purpose of this project is to design, build and install a remote controlled degrader changer for the tape transport system. The changer will allow a more efficient use of beam time by reducing the time it takes for a person to finely adjust the degrader thickness at the beginning of an experimental run. This changer consists of two thin wheels (0.0625 in) with radius 2.50 and 3.85 in. and with 3 and 8 slots, respectively, for different degrader thicknesses. These wheels will be rotated to different positions by two independent stepper motors using Arduino UNO microcontrollers interfaced with Processing software.

Arduino controllers are an open-source-based electronics with their own programming language based on Java, C and C++ [1]. These microcontrollers provide an efficient way to move the stepping motor to the required position with the precision of a fraction of degree, depending on the number of steps in the motor. Similarly, *Processing*, which is an open-source programming language for visual
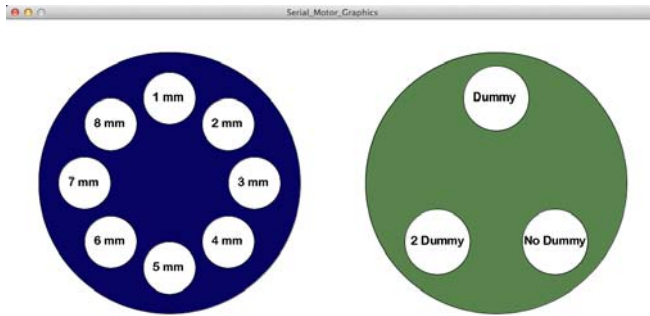
FIG. 1 Graphical user interface written with Processing.
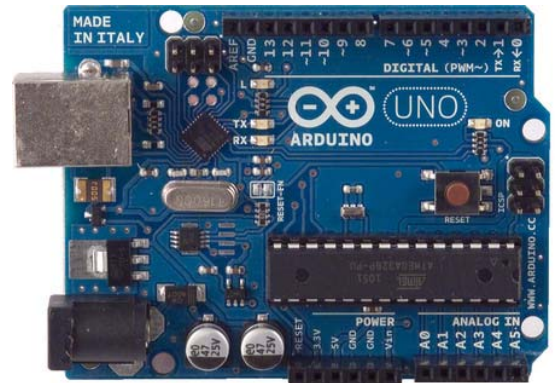

FIG. 2. Arduino UNO microcontroller.

design, also based on Java and C, and developed at MIT Media Lab [2], provides the tools to create the interface for the controllers. So far, code for both the controllers and the interface (see Fig. 1) has been written and tested as well as the serial port communication between them. The Arduino microcontroller is shown in Fig. 2.

The experimental set up was not to be modified, which created some spatial restrictions that complicated the physical design. After several designs had been created and rejected, it was decided that the wheels would be separately supported and driven. Some supports and stands will have to be built to hold the stepper motors in place in order for the degrader slots to be in the correct position. All components will be made out of aluminum for strength and lightness. Currently, the design has been approved, all supports and wheels are being built, and the installation is expected to be completed by the end of May 2013.

The figures below show the different parts needed for this project. Everything in grey represents unmodified components of the experimental set-up; red shows the supports for the stepper motors, which

are themselves shown in black; green is for a minimally modified degrader stand and blue is the color of the wheels.
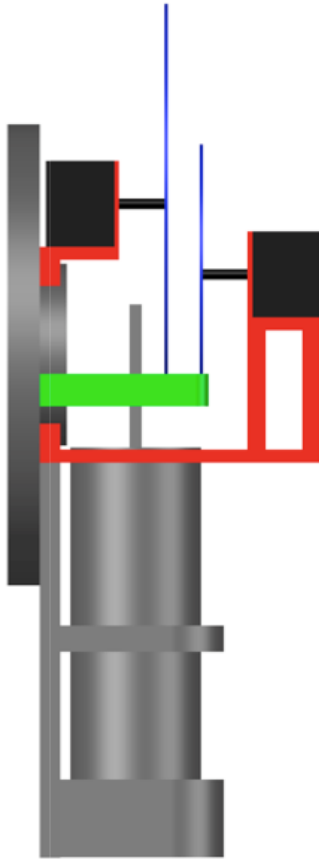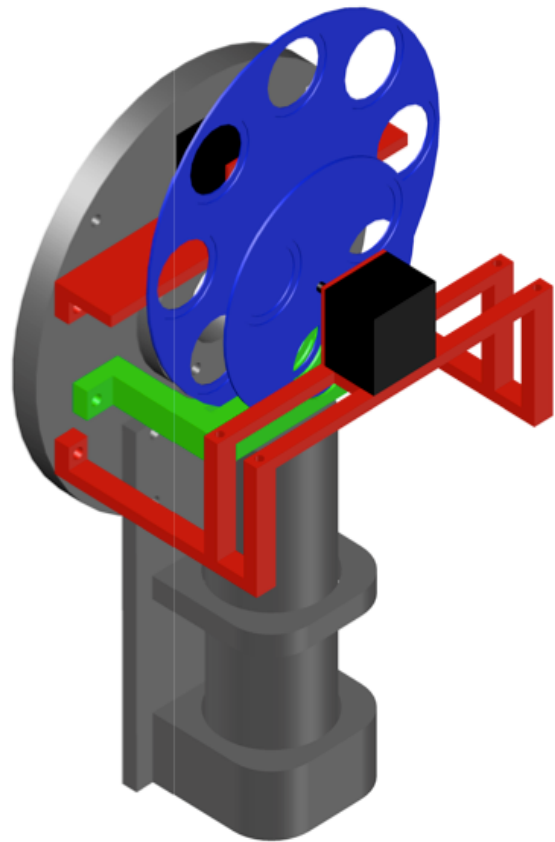

FIG. 3. Side view of degrader changer.

FIG. 4. Isometric view of degrader changer.

[1] http://arduino.cc
[2] http://processing.org