1. Introduction
Time on a scanning electron microscope is a precious commodity within the University due to their high cost and limited availability. New users often find it hard to schedule time on a scanning electron microscope as they take considerably longer than others to produce a high quality result and this takes resources away from more immediate research. Thus, it would be beneficial to have a system where new users can practice scanning electron microscope operation without having to use the real device; a ‘virtual scanning electron microscope’ (VSEM).

2. Specification
The application must effectively emulate the core functionality of an SEM. This included changes to the image:
- Brightness
- Contrast
- Focus
- Astigmatism
- Magnification
- Shift
Moreover, it was essential for the application to adopt the look-and-feel of a real SEM interface in order to allow users to recognise similarities and support training. Thus, a control console input device was required.

3. Development
The application was developed using Python 2.7. with a wxPython user interface. In order to change the image brightness and contrast the Python Imaging Library was used. Image magnification and shift was achieved using Matrix Plotting Library. Changes in the images’ focus and stigmata’s was accomplished by modelling an ellipse the shape the beam of an SEM would be. A kernel is then produced from the ellipse with values inside being one the rest zero. This kernel was then convolved with the image resulting in a new manipulated image. A MIDI device was used to act as a control console, interfacing with the application through pyGame.

4. Testing
The application was tested by a group of university students who acted as possible SEM trainees. From the inexperienced users it was desired to determine how easy the application was to use and if they were able to produce a high quality SEM image. During each test the trainees actions in the application were logged and a NASA Task Load Index (NASA-TLX) assessment completed. Expert SEM users were also tested to determine how close the VSEM application was to emulating the actual SEM look-and-feel.

5. Conclusion
The project was successful in developing an application that matched the system requirements and emulated the core functionality of an SEM as defined by expert SEM users. Moreover, results from the NASA-TLX indicated a strong positive acceptance for the application by new users. However, insufficient data was collected to determine the applications effectiveness as a training tool.