A melody of staccato piano notes sings out from the speakers of Victor K. Wong’s desktop computer. But it is not a melody made by Bach or Liberace or even Alicia Keys; it is the melody of color.

Wong, a Cornell graduate student from Hong Kong who lost his sight in a road accident at age 7, is helping develop a software that translates images into color. “Color is something that does not exist in the world of a blind person,” explains Wong. “I could see before. But there is no way that I can think of to give an exact idea of color to someone who has never seen before.”

For Wong to develop the software in Cornell’s Department of Electrical and Computer Engineering (ECE) with undergraduate engineer Ankur Moitra and research associate James Ferwerda from the Program of Computer Graphics.

“The inspiration for using image-to-sound software came around 2004 when Wong realized his problems in reading color-coded weather maps of the Earth’s upper atmosphere. His task is that a necessary part of his doctoral work in Professor Mike Kelley’s ECE research group. It is a field dubbed “space weather,” which attempts to predict weather high in the atmosphere for use by Global Positioning System and other satellite communications. A space weather map might show altitude in the vertical direction (along the y-axis), time in the horizontal direction (along the x-axis) and the density and reflectance of different colors.

As a scientist, Wong needs to know more than just the general shape of an image. He needs to explore minute fluctuations and discern the numerical values of the pixels so that he can create mathematical models that match the image. “Color is an extra dimension,” explains Wong.

After the team tried everything from having Kelley verbally describe the maps to Wong to attempting to print the maps in Braille. When none of those methods provided the detail and resolution Wong needed, Wong and Ferwerda began investigating software. Moitra later became their project leader.

“We started with the basic research question of how to represent a detailed color-coded image to someone who is blind,” recalls Ferwerda. “The most natural approach is to read it aloud, but color cannot be directly related and [the human ear’s] sensitivity to changes in pitch is quite good.”

Gladly, one of their students Zvonko Moitra wrote a Java computer code that could translate images into sound, and in August he unveiled a rudimentary software program capable of comparing pixels of various colors into piano notes of various tones. Wong test-drove the software by exploring a color photograph of a parrot. He used a rectangular Wacom tablet and stylus – a computer input device used as an alternative to the mouse. It is a computer input device used as an alternative to the mouse – which gives an absolute reference to the computer screen, with the bottom left-hand corner of the tablet always corresponding to the bottom left-hand corner of the screen.

As Wong guided the stylus about the tablet, piano notes began to sing out. The full range of keys on a piano was employed, allowing color resolution in 88 gradations, ranging from blue for the lowest notes to red for the highest.

The software also has an image-to-speech feature that reads aloud the numerical values of the x- and y-coordinates as well as the value associated with a color at any given point on the image. “In principle I could turn off the music and just have the software read out the value of each point,” Wong says. “I would know what the gradient is in a more absolute sense, but it would get annoying after some time. It keeps reading out ’200.1’, ’200.8’, ’200.5’ and so on.”

One of the biggest challenges of the project is the so-called “land-and-sea” problem. “Sometimes I just want to know where is the land and where is the sea,” says Wong – meaning that he would like to have an idea where the major boundaries in the image lie, such as the boundary between the parrot and the background. The problem hinges on shape-recognition, which for Wong can be difficult.

In the simplest situation, the right half of an image would be completely blue and the left half completely red. To find the boundary, Wong has to move the stylus continuously back and forth from one color to the next along the length of the tablet, which is both time-consuming and error prone.

To solve the land-and-sea problem, Wong, Moitra and Ferwerda tried printing the major boundary lines of an image in Braille and then laying the printed sheet over the Wacom tablet combining both audio and tactile detection. However, they are still working to develop software that can effectively pick out the important boundaries in an image so that they can be printed.

“It is also important that there is no time delay between the image and the tactile feedback. The image will be shifted and distorted in Victor’s mind.”

One of the major issues facing the project is funding. “The initial work was done on a shoestring as a side project to grants Kelley and I have received,” says Ferwerda, who is preparing a proposal to the National Science Foundation to extend this work and explore other ideas for making images and other technical content accessible to blind scientists and engineers.

Wong says, “Tackling complex color images is only one problem out of many that blind scientists are facing. But I think this is a pretty important idea.”

Reported and written by Thomas Oberst, a science writer intern with Cornell News Service.