

Mathematical Puzzles with Smart Objects Interfaces: Final Report  
by Shalva S. Landy

The Smart Objects project aims to enhance collaborative learning experiences by providing feedback to students working in a physical space. To do this, the system must "watch" as students manipulate physical objects, "decide" how close the students are to meeting their goals, and then "respond" appropriately. The specific application we were focusing on was a Tangram puzzle to be installed at the Goudreau Museum of Mathematics in Art and Science. The work would be general so it could be used for a wide range of other applications.

We are using a QuickCam as an "eye" to track the puzzle pieces. Image processing techniques applied to the camera's input determines which sides and/or corners of which pieces are adjacent to each other. Based on this information, we can determine the state of the puzzle. If the user has completed it, s/he receives a congratulatory animation; otherwise, we try to help the user if s/he seems to be having trouble. We give help by suggesting the user think about how two or more shapes may be used to construct one larger shape. For example, "how can you make a triangle out of two triangles and a square?" or "how can you make a larger triangle out of two smaller triangles?" Then, we play an animation showing how to do so. This is supposed to start the user thinking about how different shapes can fit together to ultimately form the complete solution.

Three people worked on the project this semester: Lori Scarlatos (mentor) and Shalva Landy and Yuliya Dushkina (students). We co-authored a paper titled, "TICLE: a Tangible Interface for Collaborative Learning Environments." This paper was accepted as a Late-Breaking Results paper for the ACM SIGCHI Conference on Human Factors in Computing Systems.

Although the project has not yet been completed, Dr. Scarlatos and I will continue working on it through the summer, so that it may be installed at the museum for the next school year.

I have learned from this project many interesting things regarding research that will hopefully help me when I do research in graduate school. First, there may be many different approaches to solve a problem, and the one that is taken may not necessarily be the best one. This calls for many unplanned changes during the course of the project. Also, research involves more than simply programming. Just because something sounds like a good idea does not mean that it will work. Another important thing is working with reliable people, but don't count on others; if you want the work to get done, do it yourself.