1. Introduction
We describe here two installations of direct manipulation systems in the art and education domain. In these installations, we use a pressure-sensitive computer-projected canvas for user manipulation. As the user presses the canvas, an art piece is created, or image layers are revealed.

2. Characteristics of the Interaction

1) Manual Direct Manipulation
Interaction with the pieces is achieved using direct manipulation. Users touch and press the canvas on which the system projects, and the immediate effects occur on the same surface. Using bare hands is much more intuitive to users than manipulating a mouse. This is especially true when developing systems for children.

2) Group Experience
Computer interactions are usually singular, that is, are designed for a single user. Replacing the mouse and keyboard with a sensor array enables group interaction. Group interaction is useful not only in art exhibitions - but also in education.

3. Technology
We use a sensor array from Tekscan 2002, which measures pressure over its surface. The sensors are usually used for medical and dental applications, as well as for other research tasks [Slivovsky and Tan 2000; Kapoor et. al. 2001]. We hide two sensors under a bright tablecloth (the canvas) and project on it from the ceiling. The projector is fitted and calibrated so that the projection matches the sensors’ surface. Another projector is used to support lurkers. A typical installation is presented in Figure 1.

4. Interactive ExPRESSion Installation
In this installation (see Figure 1), users paint with their hands. As users press the canvas, they activate different pen colors according to the amount of pressure applied on the canvas. Several color maps as well as different interactions are supported. Examples of color maps are a blue-to-red one - that gives a feeling of warmth, and a grayscale one. Different interactions include a temporal image, an accumulating image (like a real canvas) and a depreciated image in which the old details disappear over time.

5. Interactive Exploration Installation
In this installation, an image is first displayed on the canvas. This image appears flat; however, it is a multi-layered image, hiding other images under it. Users interacting with the canvas touch it and/or press on it. This action reveals the underlying images according to the amount of force, duration, and repetitiveness of the action. Some of the implemented scenarios are:

- **Expecting**: allows the users to view a fetus in the womb. A shadow of an expecting woman appears on the canvas. When the users press interesting areas such as the abdomen, they see the fetus hidden inside.
- **Dig Earth**: enables the users to dig into the earth and learn its layers. The dig starts from the surface, and as the diggers progress, they get deeper and deeper to view the different layers such as water, minerals, fossils, etc.
- **Go Sea**: reveals the mysteries of the sea. Starting from the blue surface, the user deepens to see the creatures underneath, until arriving at the busy seabed.

Figure 2 presents two screen shots of Expecting. The left one was captured at an early stage of the user interaction, while the right one comes later, as the fetus is slowly revealed.

References

