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## Touching a 3D Object on a New Type of 2D Touch Screen

When I read the Disney press release that described a new technology that the company's Pittsburgh research division had just created,

have discovered a way to fool our sense of touch so your fingers can feel the surface texture, ridges, bumps, and crevices of an object as your eyes view it on a screen that is perfectly flat. It sounds crazy, so let me take some time to explain how they made possible something that seems completely impossible.

When you run your fingers along a flat, smooth surface, you sense its surface texture and the fact that it is perfectly smooth and flat. If this surface happens to have a sticky substance on it from a

spill, your fingers will sense a change in the surface texture in the area where the sticky stuff lies. If the spill contained a thick, gooey substance,

its other attributes, your fingers might be able to easily feel its physical characteristics even though your eyes might not see it without very careful inspection.

To fool your sense of touch so that you feel surface features from an image on a flat screen, the Disney research group created an electrical vibration display that creates a variety of surface tensions at all the appropriate locations on the screen. (See Photo 1.) In the same way that a sticky spill on a flat surface can cause you to sense surface features that actually exist, the varying resistance to the movement of your fingers on their special screen is interpreted as surface features of the object in the picture. Their electrical vibration display causes your sense of touch to perceive that your fingers are moving up and down across a surface with ridges, crevices, bumps, and textures. Users feel like they are touching the physical characteristics of the object they see in the picture.

To make this false sense of touch work, the Disney researchers had to develop a way to match the change in surface tension between your fingers and the screen in a way that it presents the actual sensory data that your eyes see as you gaze at the image. If what you touch matches what your eyes see, your brain will

**Photo 1—If you were touching this special computer screen, you would be able to feel the texture and crevices of the actual fossil that you are touching.**



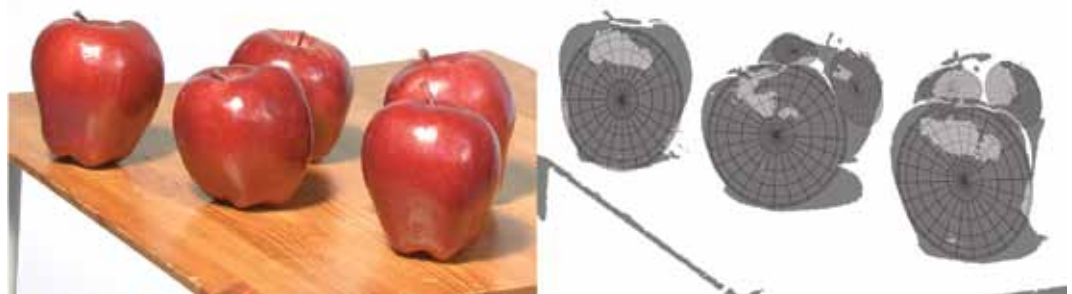
Photos: Disney Research Pittsburgh

my initial impression was that the technology the release described was impossible. We see our three-dimensional (3D) world with our eyes and feel the depth of the objects in this world when our fingers and skin come in contact with the physical things around us. The press release described a technological breakthrough that would let you feel the shape of 3D objects with your fingers even though you are actually touching a flat 2D computer touch screen.

For centuries, artists have known how to fool the human eye into seeing depth even though a work of art existed on a flat surface. The Disney research scientists and engineers

spill, your fingers will sense a change in the surface texture in the area where the sticky stuff lies. If the spill contained a thick, gooey substance,

you would feel both stickiness and ridges, textures, bumps, and crevices that are created by the dry gunk. There is no magic trick here; you are feeling what is actually on the surface. The possibility exists that because of the color of the spill and



**Photo 2—To let you feel the apples in this color photo (A), the system automatically analyzes the black-and-white pixels of the image. The pattern you see in (B) on the apples is the surface disturbances that you will feel if you could touch the image on the screen**

combine the visual image with your sense of touch, letting you feel depth

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**Photo 3**—This photo of a set of DVDs shows the image you see (left side) and a rendering of the tactile disturbances that you would feel (right side) if you were running your fingers across the screen.

the screen to match the features of the object on the display. The color photo of the apples in Photo 2 (picture A) shows what you will view on the touch screen. The black-and-white image of the apples (picture B) shows how their tactile rendering

this image shows the DVDs stripped away. You now see a rendering of the disturbance on the screen that gives your fingers the sensory feeling that they are moving up and down as they touch the different DVDs in the picture. You can watch a Disney video that describes how the system works at [www.disneyresearch.com/project/3d-touch-surfaces](http://www.disneyresearch.com/project/3d-touch-surfaces).

The Disney system is a major advance to a technology called *haptics* (tactile feedback). At the consumer end, you might be experiencing haptics through a video game controller that you own or an arcade game that you like to play. These controllers all provide physical feedback to your hands to increase your total immersion in the game you are playing.

### Recalling the Facts

1. How does the Disney system know where to apply a specific tactile feeling?
2. Haptics already plays a significant role in robotics and medicine. Research its many current uses in different fields of technology. ©

where only the illusion of depth actually exists.

To convert the image on the screen to touch sensory data, the researchers developed an automatic interpretation system they call a *tactile rendering algorithm*. The system automatically determines how much surface disturbance to place under your fingers at each point on

algorithm selected specific surfaces that would receive varying tactile feedback.

Let's look specifically at an image on the screen and what is taking place below the image to give you a 3D tactile representation of what you are seeing. On the left side of Photo 3, you see the screen image of a set of DVDs. The right side of

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