Adding Tactile Feedback to the Trackpoint: A Demonstration of Tractile

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1. INTRODUCTION

This demonstration supplements our companion paper "What you feel must be what you see: Adding tactile feedback to the Trackpoint" (Campbell, Zhai, Kim, Maglio, 1999). We intend to give conference attendees first hand experience with tactile feedback provided through the IBM Trackpoint, which a small in-keyboard isometric input device. We call our tactilely enhanced Trackpoint, *Tractile*. Though, various force feedback or tactile devices have recently been developed, Tractile is unique in that it is very small yet can provide useful tactile information.

In addition to the tractile device itself, we demonstrate two applications of tactile feedback. One is steering through tunnels, which is similar to menu selection, and the other is "Press-to-Select", which enables users to press the Trackpoint cap as a button.

2. TRACTILE DEVICE

The design goal for the Tractile device is to maintain the very compact size and low power consumption of the IBM Trackpoint while adding tactile vibration. The result is a device that appears as a normal Trackpoint (Figure 1) and is suitable for laptop computers but that contains several internal modifications. One modification is the inclusion of a cylindrical coil at the base of the actuator. When current is passed though the coil, the resulting magnetic field forces a ferromagnetic slug upward toward the actuator tip. The movement of the slug hitting the actuator tip feels like a tap even through the plastic cap that covers the actuator post. As shown in Figure 2, the plastic cap is attached to the post of the pointing device. The coil wrapped around the bottom of the sensor has a resistance of 70 ohms. The ferromagnetic slug is inserted into the cylinder with the correct polarity. A rubber cap is attached to the top of the cylinder to retain the ferromagnetic slug. The

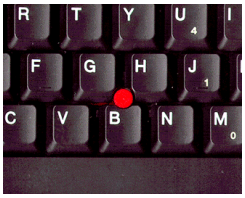

Figure 1: IBM Trackpoint with tactile feedback

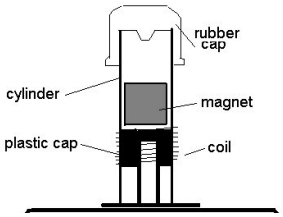

Figure 2: Schematic of the Tractile device.

coil is excited by external electronics to apply a 10ms pulse at 5volts/100ma. Thus, a magnetic field repels the slug from the coil in an upward motion, striking the underside of the top rubber cap, which is what the user feels as tactile feedback. The maximum pulse rate of the device without significant loss of amplitude is 30Hz.

Movements in the actuator post are registered by the force sensor and communicated through the PS/2 port. Tactile events are monitored by a program and communicated to the device through the serial port. Thus, when the pointer hits a "bump" on the screen, the program can send a signal to the Tractile device. In this way a program can control both when to pulse and how often.

3. STEERING DEMONSTRATION

Being able to feel the "texture" of a GUI interface should enrich user experience and improve interaction performance, as an additional source of information about the location of the pointer can be provided. However, determining where and how textures can be effectively applied present a challenge. We have studied just this issue in steering tasks. Participants can steer the mouse cursor through a tunnel (Figure 3), which is similar to navigating through menus.

There are many ways to provide texture in the tunnel to help users. In our demonstration, participants will experience four feedback conditions. First is no tactile feedback, as a control condition. Second, as shown in Figure 3, the participant sees and feels more bumps toward the center of the tunnel. The user can see and feel the cursor deviation from the center of the tunnel by the frequency of bumps. Third, the user can both see and feel the deviation from the tunnel center, but what is felt is different from what is seen. Fourth, a solid line of bumps is placed on each side of the tunnel, similar to Botts dots on California freeways.

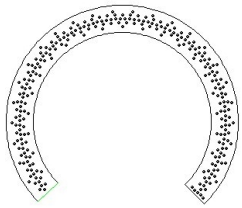

Figure 3: Tunnel Steering Task

The rational and experimental results of these conditions can be found in our companion paper. The central conclusion, however, can be simply summarized as "What you feel must be what you see". The tactile information is most powerful when it is in concert with the visual information.

4. SELECTION DEMONSTRATION

When using the Trackpoint, many novice users attempt to press on the Trackpoint cap itself, rather than the buttons, to select a GUI object. To enable this, the *Press-to-Select* feature has been added to the Trackpoint in recent IBM Thinkpad models, such as the 600 and 770. With Press-to-Select, icons, windows, and files can be selected, picked-up, dragged, dropped, and double clicked by pressing down on the Trackpoint cap. However, the lack of feeling that the button has been pressed – as is provided by a normal mouse button – makes the Press-to-Select feature seem less appealing. This demonstration shows the effect of adding tactile feedback to Press-to-Select. In this case, the Tractile device provides tactile feedback for button-down and button-up events when the user makes selections through Press-to-Select.

Overall, our demonstrations enable participants to examine how tactile feedback can be added to the existing Windows visual interface, for instance, by adding tactile feedback operations for selecting and releasing desktop objects. They also enable users to experience the benefit of consonant visual and tactile information, and to consider how visual interfaces might be designed to better incorporate tactile feedback.

REFERENCES

Campbell, C. S., Zhai, S., May, K. W., & Maglio, P. P. (1999). What you feel must be what you see: Adding tactile feedback to the Trackpoint. In *Proceedings of INTERACT '99*.