INPUT/OUTPUT DEVICES AND INTERACTION TECHNIQUES

**Interaction Tasks, Techniques, and Devices**

A designer looks at the interaction tasks necessary for a particular application (Foley, Wallace & Chan, 1984). Interaction tasks are low-level primitive inputs required from the user, such as entering a text string or choosing a command. For each such task, the designer chooses an appropriate interaction technique. In selecting an interaction device and technique for each task in a human-computer interface, simply making an optimal choice for each task individually may lead to a poor overall design, with too many different or inconsistent types of devices or dialogues. Therefore, it is often desirable to compromise on the individual choices to reach a better overall design.

There may be several different ways of accomplishing the same task. For example, one could use a mouse to select a command by using a pop-up menu, a fixed menu (a palette or command bar), multiple clicking, circling the desired command, or even writing the name of the command with the mouse. Software might even detect patterns of mouse use in the background, such as repeated “surfing” through menus, to automatically suggest commands or help topics (Horvitz, Breese, Heckerman, Hovel & Rommelse, 1998). The latter suggests a shift from the classical view of interaction as direct manipulation where the user is responsible for all actions and decisions, to one which uses background sensing techniques to allow technology to support the user with semi-automatic or implicit actions and services (Buxton, 1995a).

**Properties of Input Devices**

The breadth of input devices and displays on the market today can be completely bewildering. Fortunately, there are a number of organizing properties and principles which can help to make sense of the design space and performance issues. First, we consider continuous, manually operated pointing devices (as opposed to discrete input mechanisms such as buttons or keyboards, or other devices not operated with the hand, which we will discuss briefly later). For further insight readers may also wish to consult complete taxonomies of devices ((Buxton, 1983; Card, Mackinlay & Robertson, 1991)). As we shall see, however, it is nearly impossible to describe properties of input devices without reference to output—especially the resulting feedback on the screen—since after all input devices are only useful insofar as they support interaction techniques that allow the user to accomplish something.

**Physical property sensed**

Traditional pointing devices typically sense position, motion, or force. A tablet senses position, a mouse measures motion (i.e. change in position), and an isometric joystick senses force. An isometric joystick is a self-centering force sensing joystick such as the IBM TrackPoint (“eraser-head”) found on many laptops. For a rotary device, the corresponding properties are angle, change in angle, and torque. Position sensing devices are also known as absolute input devices, whereas motion sensing devices are relative input devices. An absolute device can fully support relative motion, since it can calculate changes to position, but a relative device cannot fully support absolute positioning, and in fact can only emulate “position” at all by introducing a cursor on the screen. Note that it is difficult to move the mouse cursor to a particular area of the screen (other than the edges) without looking at the screen, but with a tablet one can easily point to a region with the stylus using the kinesthetic sense (Balakrishnan & Hinckley, 1999), informally known as “muscle memory.”

**Transfer function**

A device, in combination with the host operating system, typically modifies its signals using a mathematical transformation that scales the data to provide smooth, efficient, and intuitive operation. An appropriate mapping is a transfer function that matches the physical properties sensed by the input device. Appropriate mappings include force-to-velocity, position-to-position, and velocity-to-velocity functions. For example, an isometric joystick senses force; a nonlinear rate mapping transforms this into a velocity of cursor movement (Rutledge & Selker, 1990; Zhai & Milgram, 1993; Zhai, Smith & Selker, 1997). Ideally, the device should also be self-centering when using a rate mapping, with a spring return to the zero input value, so that the user can stop quickly by releasing the device. A common inappropriate mapping is calculating a speed of scrolling based on the position of the mouse cursor, such as extending a selected region by dragging the mouse close to the edge of the screen. The user has no feedback of when or to what extent scrolling will accelerate, and the resulting interaction can be hard to learn how to use and difficult to control.

----------------------------------------Перевод**----------------------------------------**

Может быть несколько разных способов решения одной и той же задачи. Например, можно использовать мышь для выбора команды с помощью всплывающего меню, фиксированного меню (палитры или панели команд), многократного щелчка, обводки нужной команды или даже написания имени команды с помощью мыши. . Программное обеспечение может даже обнаруживать закономерности использования мыши в фоновом режиме, такие как повторяющийся «серфинг» по меню, чтобы автоматически предлагать команды или темы справки.

Последнее предполагает переход от классического взгляда на взаимодействие как прямое манипулирование, при котором пользователь несет ответственность за все действия и решения, к такому, в котором используются методы фонового распознавания, позволяющие технологии поддерживать пользователя с помощью полуавтоматических или неявных действий и услуг. Разнообразие устройств ввода и дисплеев, представленных сегодня на рынке, может вызывать полное недоумение. К счастью, существует ряд организационных свойств и принципов, которые могут помочь разобраться в проблемах пространства дизайна и производительности. Во-первых, мы рассматриваем непрерывные указывающие устройства с ручным управлением (в отличие от дискретных механизмов ввода, таких как кнопки или клавиатуры, или других устройств, не управляемых рукой.

Традиционные указывающие устройства обычно определяют положение, движение или силу. Планшет определяет положение, мышь измеряет движение (то есть изменение положения), а изометрический джойстик определяет силу.

Для поворотного устройства соответствующими свойствами являются угол, изменение угла и крутящий момент. Устройства определения положения также известны как устройства абсолютного ввода, тогда как устройства обнаружения движения являются устройствами относительного ввода.

**----------------------------------------**Краткое содержание----------------------------------------

The text described the various input-output devices and what key functions each of them has.