POINTING DEVICES
Understanding the Needs of All Age Groups and Most Physical Limitations Within Those Groups

Pointing device options have now expanded to provide a multitude of configurations, a variety of sizes, easier access, styles to meet user input preferences, variations that deal with height and space constraints — as well as costs to fit within most budgets. In doing so, the usefulness of the device has expanded to meet the needs of all age groups and most physical limitations. In this bulletin, Advanced Input Systems reviews these options and examines their implications on the design and development of user interfaces.
Pointing Devices: Bring It Out Right The First Time

Keeping Customer Limitations to a Minimum
Most everybody has seen the famous original cinema version of the Wizard of Oz. Central to the theme of the movie was the sadness of the characters – the stupid Scarecrow, the heartless Tin Man and the cowardly Lion – in living with their seemingly unbearable deficiencies. Their journey to Oz was to see the great Wizard who could give them those qualities that they lacked.

If you had to make a choice, what limitations would you be willing to live with? Would you most desire to keep your sight – your hearing – your sense of touch? Would you miss listening to great music or the sound of your family if you lost your hearing? Would your life turn upside down if your legs couldn’t take you where you wanted to go or your hands were not at your disposal any more? The closest most of us probably have ever come to disability is that feeling of inability that lasts momentarily when we cause an arm or leg to “go to sleep”. That feeling of inability is uneasy at best. But losing any one of our faculties permanently is not a pleasant option.

In much the same way as our bodies, keyboards are a mechanical interface between a human being and a machine. They are like the robotic arm – trying to duplicate as many natural human functionalities and responses as possible. In today's marketplace the leaders of innovation and sales are companies who recognize that people need the maximum amount of versatility and range of motion out of their input devices.

Purpose Behind Having a Pointing Device
You likely do not work with just a keyboard – at the least you have a keyboard with some kind of pointing device. The most common pointing device is the standard mouse. Your limitations in accessing the system that you use with just a keyboard – whether your operating system is Windows 98 or some other system – would be too great, too slow, or too cumbersome for memory (your memory!).

For instance, use only your keyboard to select another program...or to highlight a sentence for removal from a presentation...or to select a function from the menu bar of a Word document. The people that made your operating system designed most of these functions to be accessed with a mouse or some other type of pointing device. This is a good exercise to evaluate the limitations of your keyboard. By restricting yourself to using just the keys to manage the operating system, you will either experience a drastic reduction in speed or a reduction in access to various functions – or both.

You may remember that there was a day at the beginning of computer development where only text could be inserted into a document. The innovation behind using icons and point / click command structures with a mouse came about with the development of the GUI (Graphic User Interface) structure into PC’s and CAD databases.
Purpose Behind Having a Pointing Device (cont’d)

Since we use these de facto operating systems (OS) and modes of selecting text and imagery with our computers daily, they have become the standard of how we expect to access our systems. No system would be fully functional without them. They enable us to achieve more from our system and move with a greater speed of accomplishment. In addition they can be modified or adjusted to help with space constraints, height limitations, lack of a stable surface, drafting or CAD systems, robotic arms or systems in motion and physical handicaps.

OS software generally falls into two types of functions – discrete or continuous / dynamic. Discrete functions are related to the individual keys that make up your keyboard. The stroke of a key produces a set command or signal – much like one of the letters of the alphabet – that is made to correspond to the particular key that you pressed. You can press that key a thousand times and it will always produce the same effect. Imagine if you had to have a discrete key for every command that is required by your system – how large would that keyboard be! In contrast, continuous or dynamic commands take you beyond the limitations of the legend information called out on the keyboard. These actions allow you access to the GUI and greatly reduce the size requirements of a keyboard. This means more movement or flexibility in your choices and less space required for those choices. Keyboard utilization requires both discrete and dynamic functions to access the full capability of your operating system.

How a Pointing Device Works

To understand how pointing devices work it will help to understand two basic electronic principles – namely that of the transducer and the encoder. It is interesting to note how similar some electronic functions are to the way your body works.

A) Transducer

From the Latin (trans = over or across, as in going over a bridge / ducere = to lead) it means to lead across or transfer. In electronics it is the concept of taking a physical attribute or property from the world around us (like pressure, heat, movement, etc.) and converting it into an electronic signal. Your eyes, nose and fingers sense motion, color, smell, texture and heat and convert these sensations into electronic signals that are neuro-chemically transmitted to your brain. Your brain takes the neuro-chemical data that comes via the nerve pathways and reconverts it into the original sensations of the outside world. Much like this response in your body, a transducer converts physical attributes to electronic signals that a computer can use.

B) Encoder

Webster’s defines this as, “to convert (as information) from one system of communication to another; especially to convert (a message) into code.” This principle of encoding is much like the decoder rings that used to come in your cereal box as a kid. You and your friend had the “special code” whereby you could send an encrypted message from one to another. This would be sent in code and deciphered using the same code on the other end. Similar to this analogy of the kids toy, photo sensors and LED’s within a pointing device take the motion of an encoder wheel as a digital signal (on the inside of your mouse) and convert it into an analog electronic signal, much like binary or Morse code. This analog signal, transferred through the cord of the mouse tail, is re-converted through software on the inside of the computer back into motion – which becomes the motion of a cursor across the screen or an external system device. For reference see the parts of the trackball image, in this document and the encoder wheel pictured below.
Various Types of Pointing Devices (cont’d)

The Mouse

The mouse is the beginning standard for most pointing devices. The traditional mouse requires that the user perform three tasks at once – grasp the mouse, move the mouse and click the mouse button at the same time. Available in infinite styles and colors – the basic elements will be an internal encoder wheel moving past photo diodes and LEDs, a ball on the bottom of the case to move against the mouse pad, and several buttons (right, left and sometimes center) for selecting options or drop-down menus. New ideas into the marketplace feature scroll wheels, more ergonomic and attractive designs, optical interface with the surface for higher reliability (instead of the ball touching the mouse pad and periodically getting gummed up) and wireless communication (IR or RF) with the host.

Trackballs

Since there are limitations to providing the motions required to activate the traditional mouse, trackballs were invented. Some limitations, for example, resulted from reduced desktop space, possible lack of access to a flat surface for commuters, or real physical handicaps of some people that made them incapable of motion with their arms. Sometimes called “Roller balls” – trackballs are best described if you first turn the traditional mouse over to expose the ball. Instead of having the ball rest below with the motion activated by your hand, the ball rests on top with the motion activated by your fingers.

All of the internal components and outside custom peripheral options remain the same as those available on the mouse. Often the choice between a mouse and a trackball is just an operator preference.

Pictured: A trackball exposed
The various parts in place on the inside of a trackball housing are exposed for a better idea of how this device works. Referencing the earlier caption showing the encoder wheel – you can now view the shaft and encoder wheel being actuated by the trackball. Phototransistors and LEDs are not visible; they are hidden in the wheel cavity. The second encoder wheel is behind the trackball and cannot be seen in this photo.

Joysticks

When space becomes even more of a constraint or range of motion is further limited, joysticks are used. In this case, continuous or dynamic motion is provided through moving a lever or “stick” in the direction of motion desired for the system or cursor. The button selection functions can be provided alongside the joystick, similar to those on the mouse.

Pictured: Joystick size and shape influenced by space, height, and cost.
Joysticks come in a variety of sizes and shapes for the user, but they provide the same movement and selection variables found in the Mouse and Trackball. This picture emphasizes how space and height made the selection of this style of joystick a necessity for the keyboard shown.
Various Types of Pointing Devices (cont’d)

Micro Joysticks
When space is at a premium, several suppliers in the marketplace provide miniature joysticks that are accessed with the motion of your finger. Sensitive to touch and easily located between two keytops, these miniature joysticks have become quite popular on laptop keyboards and are easily located beneath a protective surface if environmental conditions warrant.

Pictured: Dime-sized Joystick miniaturization

There seems to be no end to the miniaturization of components when the space constraint dictates the need. Obviously the user would be too limited in their program applications if the pointing device was not provided, so micro solutions can be developed, as pictured.

Technology and related integration into the product is too complex without help from a market leader with experience in these applications.

FSR Devices
When space and height are both limiting parameters, a FSR (Force Sensing Resistors) device fits easily under a button or elastomer keypad – where it can be protected from the environment or from side angle breakage (see image). The device that records movement is a resistive layer, much like a touch screen in actuation and thickness, that is thinner than the mechanical encoders found on your trackball or mouse.

Pictured: Force Sensing Resistors (FSR) device suitable in space-restricted environments.

This particular application required a pointing device that was environmentally rugged, protected and able to meet severe limitations in size and height. Shown on the right within the circuit board is the actual circular FSR device with the 3 pick button contacts in pairs below. To the left in black is the elastomeric keypad with the corresponding FSR device button and 3 pick pad keys. The elastomeric covering seals the unit and is designed to limit water, as well as any ripping or tearing of the keys by means of the low button profile.

Advanced Input Systems – Providing More Controls for Keeping Your Customers

We trust that this overview of sample pointing devices has been instructional. Bear in mind that it was not meant to be comprehensive, but a sampler of some available options for your next project.

As the leader in custom input integration, Advanced Input Systems would like to help meet your design needs for all areas of pointing devices – and implement their custom integration into various keyboard or systems applications. We’ve developed over 2000 custom input systems for more than 1000 companies during the past 25 years. Our engineers are proficient with the most current technologies in the field and understand how to integrate those technologies. Advanced Input Systems will effectively meet the requirements of your customer.

Please visit our web site at www.advanced-input.com or call directly at 1-800-444-KYBD (5923) to get more information. Create or enhance your unique product requirements with an experienced team leader.