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Common Input Devices

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In this video from ITFreeTraining, I will look at common input devices that are used by a computer. These devices allow the computer to take input from the user. This is the fundamental way that we are able to control what a computer does.

Input Devices

- Also called Human Interface Devices (HID)

0:13 To start with, let's have a look at what input devices are available. These devices take many different forms, but generally fit the categories of keyboard, mouse or controllers. These devices are also called Human Interface Devices or HID.

Human interface devices provide the computer with input to allow the computer to operate. That is, they allow the user to interact with the computer, in order to get the computer to do something. There are also other devices, like security and credentials devices, which fit the category of human input devices. However, I will have a look at those in a different video. To start with, I will have a look at the keyboard.

Keyboards

- Model M Keyboard


Each key is a switch with a spring

0:54 The keyboard is the oldest, but remains the primary way to provide input to your computer. Back in the 1980s, IBM introduced a keyboard called the Model M keyboard. This keyboard was quite popular and many of us who used the IBM back in those days will remember it. One reason is that it was very distinctive in design and shape. The design was made of very tough plastic and inside there were metal components, thus making it very strong and heavy for a keyboard. But, one of the big reasons that people remember it was for the sound that it made. Pressing the keys on the keyboard made a very distinctive sound as you can hear.

The reason for this is that each key on the keyboard is essentially a switch. Each switch has its own spring. You can see here the spring under the key. This is what gives each key that distinctive sound. Given the material the keyboard is made of and that each key has its own spring, these keyboards were expensive to make. So, as time passed, these keyboards started to disappear and were replaced by keyboards that were cheaper to make.

Let's have a look at how keyboards have changed to make them cheaper and easier to make.

Membrane Keyboard
- Essentially a pressure pad that makes a circuit

Top Membrane layer
'Holes' layer
Bottom Membrane Layer
Conductive Traces
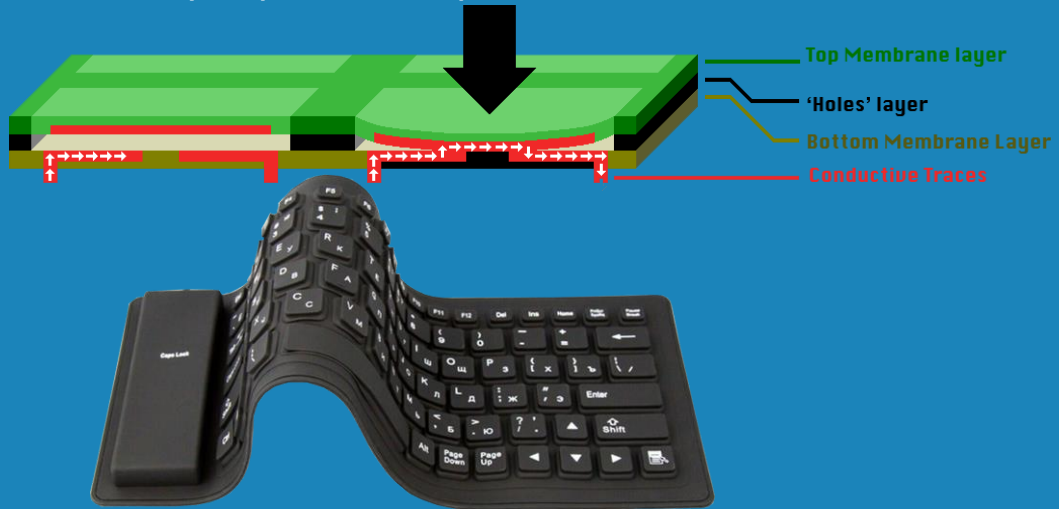
2:05 The first keyboard I will look at is the membrane keyboard. This keyboard is essentially a pressure pad that, when pressed, makes a circuit. Membrane keyboards are often used in devices like electronic devices, for example the control panel on devices like a Microwave oven.

To get a better understanding of these keyboards, consider this flexible keyboard. Essentially this is a membrane keyboard with a flexible cover. If you have ever used a keyboard like this, you will know they are not the best for doing a lot of typing on. This is because the keys are difficult to press. Sometimes you may press a key and it does not make contact. The key also does not spring back into place.

When you type, what you are feeling when you press the keys is referred to as tactile feedback. The better the tactile feedback, the easier it is for you to know that you have pressed a key. Membrane keyboards don't have a lot of tactile feedback, which makes them difficult to type on; however, they are very cheap to make. Let's have a look at how they used this technology to improve tactile feedback, while still making the keyboard cheap to make.

Modern Keyboards

- Membrane-based
- Most widely used
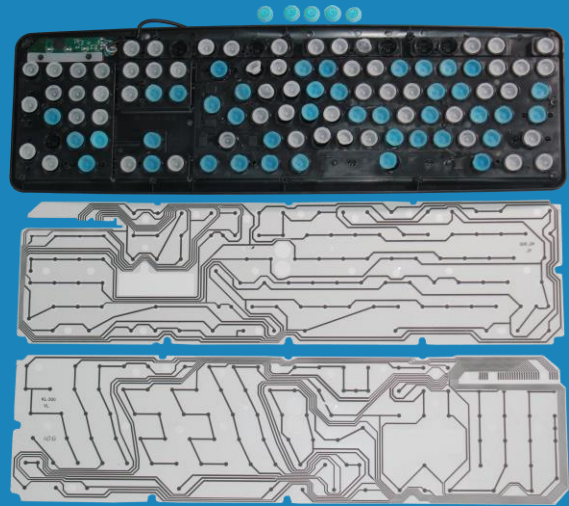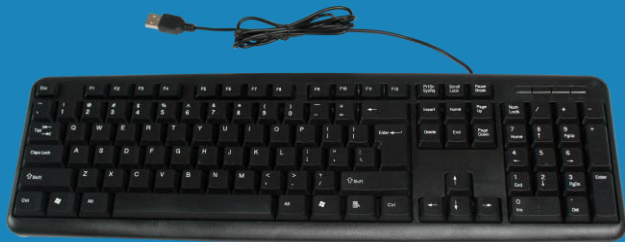
3:12 The most widely used keyboard on the market is a membrane-based keyboard combined with a plastic case. These keyboards are cheap to make. Inside this keyboard you can see that under each key is some rubber. When a key is pressed, the rubber pushes down onto a contact layer. This is what crates a circuit which allows the keyboard to detect a key has been pressed.

These keyboards differ in design. In this example, each key has its own separate piece of rubber. In most cases, you will find that the keyboard will have one rubber sheet that fits under the keyboard. This will look like the flexible keyboard that I just looked at. It is up to the manufacturer to decide on how they will make the keyboard.

These keyboards provide more tactile feedback then just using a membrane keyboard. When you press a key there is a little bit more bounce in the keys, which make them easier to type on. This low cost and ease of use makes them the most commonly used keyboard on the market. However, some of us remember the feel that the old IBM keyboards had and thus there are keyboards on the market that are made of a similar design as those keyboards.

Mechanical Keyboards

- Each key is a switch
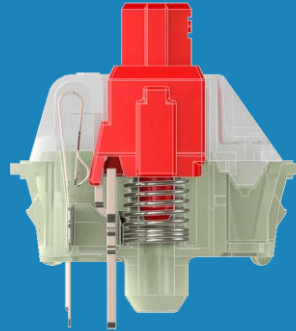
Cherry key sample switches

4:21 The next keyboard that I will look at is the mechanical keyboard. Mechanical keyboards are like the old IBM keyboards in that each key on the keyboard has its own switch. There are many different keyboards on the market. Each keyboard has different features; for example, some keyboards are back lit. This makes it easier to see the keys, particular in low light conditions.

The main switches that you will see used in keyboards are the Cherry switch. An example of a Cherry switch is shown here. Cherry switches have been around since the 80's and nowadays are the most widely used switch on the market. You can see in this example the switch is red in color. Cherry switches are different colors to indicate the way the switch operates – the different switches require a different amount of force to push down, activate at different times and have different levels of noise they make when they are pushed.

Shown here are samples of Cherry switches. When you purchase a mechanical keyboard, some stores may have some sample switches for you to try. Which one you choose is up to personal preference. If you purchase a mechanical keyboard, take note in the specifications which color switch it is using; this will tell you how the keyboard will perform.

Mechanical keyboards cost more than keyboards designed using a membrane. Some users prefer the mechanical keyboards. The choice is up to you. The biggest difference between the two, besides the price, is that mechanical keyboards are louder than other keyboards.

If you have spent a lot to buy a fancy keyboard with lots of features, for example some keyboards have a LCD screen and additional multimedia controls, they may have some compatibility features included on the keyboard.

Keyboard Compatibility

- Keyboards are plug and play
  - Some features may require additional software
- Some keyboards not compatible with some BIOS
  - May depend on what features are configured

6:00 Nowadays, any keyboard that you purchase will be plug and play. This essentially means that the operating system will detect the keyboard and install the required drivers in order for the keyboard to operate. Some keyboards may have additional features and require additional software in order to operate.

Although it has improved over the years, the BIOS may not support newer keyboards with additional features. This essentially means that some keyboards are not compatible with some makes of BIOS. What this essentially means is that, when you boot the computer, you may not be able to access the BIOS using that keyboard. However, when the operating system boots up, the keyboard will start working. This may also change depending upon what features are configured in the BIOS. For example, if the BIOS is configured to use fast booting or have legacy BIOS features switched off, this may prevent the keyboard from operating.

To get around the problem of the keyboard not working with the BIOS, the simplest way is to use a very basic keyboard without any (or with limited) additional features. These keyboards are generally very cheap. I have a very basic keyboard that I keep just for the purpose of accessing the BIOS. If I come across a computer where I can't access the BIOS, that is I start the computer and press the BIOS key and it does not work, I plug in my basic keyboard and use that one. Once I have finished configuring my BIOS I can unplug the basic keyboard and use my existing keyboard, instead.

The problem occurs because, as additional features like extra buttons for multimedia were added to the keyboard, this added to the protocol used by the keyboard. This caused it to be

incompatible with some BIOS's; however, the operating system will still detect and be able to use the keyboard. On some keyboards, although rare, there will be a BIOS compatibility switch on them. This switch will disable some of the additional features to make the keyboard compatible with the BIOS. This switch is generally found at the back of the keyboard. To access the BIOS, flip the switch to the compatible option, and when done, switch it back, otherwise some of the extra features on the keyboard may not work with the operating system.

Nowadays, USB is the standard that is used with keyboards. In some cases, you may come across a computer that still uses PS/2 keyboards. This will be because the computer is very old or in a highly secure environment where the USB ports have been disabled. The keyboard will have a purple plug and the mouse plug will be green. A lot of computers will combine the plugs into one. These plugs will generally be half purple and half green.

If you do not have a PS/2 keyboard, use a USB to PS/2 adapter to connect your keyboard. This adapter works really well and you won't require a PS/2 keyboard. I generally keep one of these adapters with my basic keyboard. You won't use them that often, but when you do require them you will be glad that you have them.

That covers it for keyboards; the next device that I will look at is pointing devices.

Pointing Devices

- Most commonly used device is the mouse
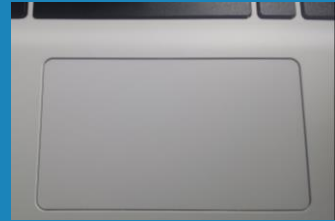
9:01 A pointing device allows the user to provide input to a computer which, generally, is used to move a cursor around the screen. The most commonly used pointing device with a computer is the mouse. Modern mice have changed a lot since they were first developed in the late 70's.
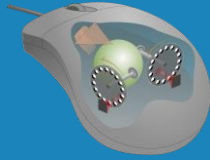
To give you an understanding of how they have changed, consider a trackball. A trackball captures movement by the user moving the ball with their hand. The old computer mice worked the same way as the trackball except they were essentially upside down. The ball was on the bottom of the mouse and, when the user moved the mouse, it captured the motion.

You don't tend to see trackballs used that much nowadays. They were common on laptops but more often you tend to see track pads used on laptops. To use a track pad, you put your finger on the track pad and it senses the pressure. Some trackpads have buttons, while others sense the user tapping the trackpad, which simulates a mouse click.
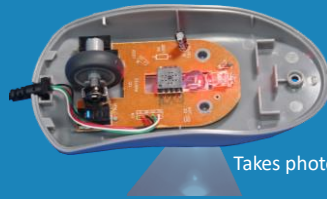
Different devices will have different numbers of buttons. It is pretty much standard nowadays for mice to have two buttons and a scroll wheel. With most mice, if you press down on the scroll wheel it will act as a third button.

Nowadays, the mouse is the primary pointing device that is used with a computer, so let's have a closer look at how it works.
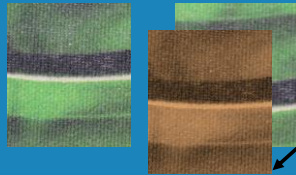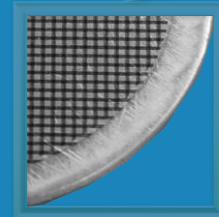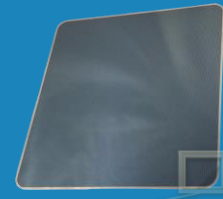
Mouse

Takes photo of surface

Distance moved

Early mice had a ball to sense motion

Optical/Laser mouse Uses small camera to track movement

Older models required special mouse mats

10:19 The first mice used a ball at the bottom of the mouse to measure distance. In order to measure the motion, the mice had two circular disks inside that spun as the ball moved. These discs had holes all around the outside of the disc. This allowed light to be blocked or allowed through. As the disc spun the light was measured and this determined which direction the ball was moving. One disc measured the 'x' direction and one measured the 'y' direction.

Ball mice were the best technology could offer at the time, but were not without their problems. The ball itself would pick up dust and dirt. This dust and dirt would often get transferred onto the rollers inside the mouse that spun the discs that measured movement. The result was, that after a while, the rollers did not work effectively. To fix this, the ball had to be removed and the rollers cleaned.

The next problem with the mice is that they were not the best at measuring motion accurately. Essentially the discs had to move in order to detect motion and thus the ball had to move a certain distance before anything was detected.

Technology has improved and nowadays mice are made with light emitting diodes or lasers. The light emitting diodes otherwise known as LEDs or the laser are used as a light source under the mouse. The idea behind this is, there is a small camera in the mouse which takes photos of the surface the mouse is on. This means the mouse ball could be removed which in turn means these mice do not require cleaning.

The photos are taken continually and compared. To understand how this works, consider that

the first photo is taken. A second photo is then taken. This is compared with the first photo. The distance between the two photos is measured and this tells the mouse how far it has moved. The photos are low resolution, but good enough to detect small movements.

Different mice take photos at different speeds, the more photos taken, the better the accuracy of the mouse. It is not uncommon for mice to take up to 1000 photos per second. This uses power so, you may find to save power, the mouse may have a switch to turn the light source on and off. With this particular mouse, you can see the LED is flashing on and off constantly. Some mice may have a switch that will change the speed the LED flickers at. A slower rate will use less power, and a faster rate will use more power. A slower rate, however, does decrease how quickly the mouse will pick up movement.

You may wonder what the difference between using an LED and a laser is. Since the mouse is constantly taking pictures, the light source is needed for the sensor to see anything. The laser is a cleaner light source and thus the quality of the images is better. This means the mouse can detect smaller movements and does so with more accuracy. For example, there are mice on the market that will detect movement up to 10,000 dots per inch. To give you an idea how accurate this is, a human hair is about ten dots per inch. Accuracy starts becoming more important when you start using very high resolutions. The higher the accuracy, the less you have to move the mouse to move between pixels, and the less distance you have to move from one side of the screen to the other. Now add some extra monitors and you can start to see you where the accuracy comes in handy.

The technology has improved a lot and now mice will work on most surfaces. This was not always the case. Some of the early mice required special 'mouse mats' in order to operate. These mouse mats were designed to be good reflectors of light allowing good photos to be taken by the mouse. Also, the mouse mat had a grid pattern which made it easier for the mouse to pick up motion. These early mice would not work unless they were used on these special mouse mats. As mice improved, they did not require a special optical mouse mat and a mouse mat could be made out of different materials. Some of the early mice still required a mouse mat and would work badly, if at all, without one.

Nowadays, mice work on most surfaces and thus do not require a mouse mat. Sometimes you may find that on very shiny, smooth surfaces, the mouse will not work well. This is because the images taken by the mouse are too similar so the mouse can't detect any movement. When this occurs, you will need to use a mouse mat or use the mouse on a different surface. If you don't have a mouse mat, a piece of paper should work pretty well.

Generally speaking, the cheaper mice on the market will use an LED for the light source and potentially a lower resolution sensor. As the price goes up, the sensors generally improve and the light source is changed to a laser rather than an LED light source.

There are a lot of different opinions as to whether it is worth the extra money for a more expensive mouse. Generally speaking, if you are doing a lot of fine graphic work or playing computer games, the extra accuracy of the mouse helps. If you are using basic application like MS Office then the additional accuracy is not worth the extra money. It does not hurt to have it, but it is not really needed.

Controllers
- Device used to control operation of the computer

15:23 The next devices that I will look at are controllers. Essentially a controller is a device that is used to control the operation of the computer. Given this definition, a keyboard and mouse would also come under this category. In this particular case, I will look at other controllers that are not mice or keyboards.

One of the more common controllers are game controllers. PC computer games generally use the keyboard and mouse; however, there are many different game controllers that can be purchased for the PC. Generally, game controllers are commonly used with gaming consoles.

For business, you may come across other specialized controllers. For example, for 3D applications, it is not uncommon to have a controller commonly referred to as a Spaceball mouse. This controller has a large ball that measures pressure of the user's hand on the ball. The end result is that the user can easily use a Spaceball mouse to rotate an object in 3D. This is particularly useful in 3D design applications.

There are also a lot of other specialized controllers; for example, flight controllers which are designed to work with flight simulators. But you can also get all kinds of different controllers; for example, controllers like car steering wheels are quite common.

The last choice you need to make is whether you will use a fixed or wireless controller.

Wired/Wireless

- Requires cable
- Maybe slightly faster
  - Unlikely to notice difference
- Generally cheaper

- May use a receiver
- Requires batteries
  - Some devices use less power
  - May have low-power option
  - May have sleep/standby mode
- Subject to interference

16:41 Wired and wireless components essentially provide the same functions; however, what changes is the need for a cable to connect the controller. Regardless of which controller you choose, they essentially work much the same, so I will use an example of a wired and wireless mouse. Other devices will work much the same as these two devices; but I will point out some of the differences you may come across in how they operate.

To start with, a wired controller requires a cable. This is the big disadvantage of a wired controller in that its use is limited to where you can run the cable. Also, the cable can be a trip hazard. In some cases, your computer or device will have a receiver for your wireless controller built in, but in other cases you will need to plug in a receiver like the one shown. The receivers are generally quite small.

The big disadvantage with wireless controllers is that they require batteries. These maybe physical batteries that can be removed or internal batteries that need to be recharged. At some stage the batteries will become dead and the controller will stop operating. This can sometimes happen at the most inconvenient times. So, if you don't want this to occur, make sure the batteries are full before you start using the wireless device.

You will notice that with wireless devices like mice, their batteries go flat quickly compared to wireless devices like keyboards. This is because keyboards only use power when a key is pressed; mice in contrast have to continually test to see if the device has moved or not.

In order to make the batteries last longer, some wireless controllers have low power options.

This is quite common in devices like mice. In order for the mouse to operate, it needs to have an LED or laser light the surface below it. This takes power to achieve. Some mice have the option to reduce the number of times a second the light will flash and thus increase how long the batteries will last. The downside is that the mouse will be less responsive to movement.

Some devices may also have a sleep mode or a standby mode. This is particularly common with wireless mice. When the device is asleep or in standby, it will need to wake up before it will operate. In the case of the mouse, if you move the mouse nothing will happen. In order to get it to operate, you will need press one of the mouse buttons.

Wireless controllers have the advantage that they do not require a cable in order to operate, so you can use it anywhere as long it is in signal range of the receiver. The controllers themselves, however, work the same. There is some debate over speed differences, and you may find that a wired controller is slightly faster than the wireless equivalent. There are many factors to consider when comparing speed. The point to remember is that controllers are low-speed devices to start with, simply because they don't require a lot of speed. Different controllers will also transmit at different speeds. Also, a good wireless keyboard may perform better than a cheap wired keyboard. All things considered, you are unlikely to notice any difference. The potential speed difference between controllers will come down to microseconds, so unless you are a pro-gamer, it is nothing really worth worrying about.

The last point to consider with wireless, which may affect the response time, is that they are subject to interference. Generally, this is not too much of a problem, but if you have a lot of wireless devices in the same area this can cause problems. In some cases, two wireless devices may conflict with each other. When this occurs, some wireless devices have a switch to change the signal or the device ID it is using. All you need to do when this occurs is to make sure that both wireless devices are configured differently, so they don't conflict. Other wireless devices will pair the controller with the receiver, so you may just need to re-pair the device. Generally, these devices will have a button on them to start this process.

The last advantage with wired devices is that they are generally cheaper. Even if you take out the extra cost of buying batteries, wired controllers cost less than wireless ones. At the end of the day, it is up to you to decide which one you want to buy.

That concludes this video on some of the common input devices you will come across. I hope this video has been informative, and I hope to see you in other videos from us. Until the next video, I would like to thank you for watching.

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