Engineering Psychology

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Week-03

Lecture-05

Visual and tactile displays - 1

Namaskar friends, this is the fifth lecture in the series on Engineering Psychology. In the last two lectures, we discussed the research methods in Engineering Psychology, and prior to that, we covered the introduction to the field. In this lecture, and the next one, we will be focusing on displays. Displays are crucial for presenting information to operators, and this information is highly critical because it informs the operator's next course of action. Displays come in various shapes, sizes, and forms.

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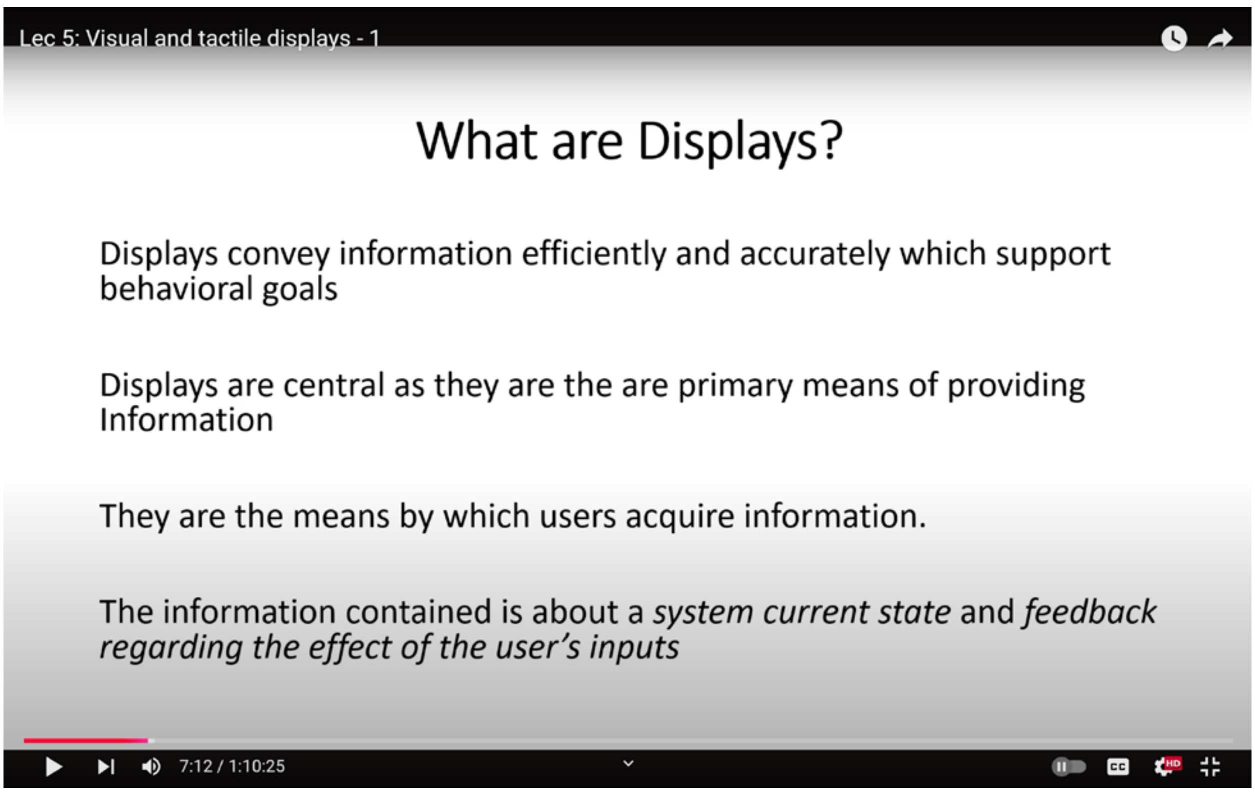

In this lecture and the one that follows, we will discuss visual displays as well as some olfactory displays. But first, what is a display? Take, for example, a digital watch. The interface of a digital or analogue watch shows you the time, and in the case of a smartwatch, it provides additional information such as workout data or health metrics like heart rate. This interface is what we refer to as a display. In today's world of machines, it is almost impossible to imagine one without a display, and displays are vital components.

If you look around, you'll notice multiple displays, for instance, the small display on a printer that indicates whether it is out of paper or what task it is currently performing. Or consider a computer screen that provides you with numerous details, helping you input further information into the system. Displays can range from simple ones, like those on baking machines, to highly complex ones, such as those found in power stations. In all cases, a display is a crucial aid to the operator, providing vital information. In this lecture, we will explore what a display is, the nature of displays, their different types, methods for improving display efficiency, and various display examples. So, let's begin.

Now, you may have encountered individuals who are color blind. Color blindness is a specific deficiency in the retina that prevents people from seeing certain colors. For instance, the Ishihara test is commonly used to detect green color blindness or other forms of color blindness, such as yellow. Color blindness poses significant challenges. Individuals who are color blind cannot distinguish between green and red colors, which may prevent them from reading information accurately from color-coded displays.

Consider a color-blind individual at a traffic intersection. Traffic lights use green, red, and yellow signals. For someone who is color blind, distinguishing between a red light turning off and a green light turning on can be challenging. As a result, they rely on other subtle cues, like observing other cars or hearing honks from vehicles behind them, to figure out when the lights have changed. So, is this a human problem? As mentioned earlier, Engineering Psychology focuses on understanding both human limitations and capabilities, and modifying systems to better accommodate these characteristics to improve human-machine interaction and performance.

The focus of this section is on improving displays to assist not only individuals without visual impairments but also those who have deficiencies in processing visual displays. The goal is to help these individuals interpret displays more efficiently and accurately. Let's start by understanding what a display is. A display is a tool that conveys information efficiently and accurately to support behavioral goals. Take the example of a microwave oven. The display on a microwave informs you of various details, such as how long a process is running, what process is currently active, whether the microwave function or the convection function is in use. The microwave function is used for heating food, while the convection function is for baking. You can't place metal objects in the microwave function, but they can be used in the convection function.

Other information displayed on the microwave includes when the process starts, how much time remains, and when the process has ended. All this information is shown on the small display at the top of the microwave. But why is this information necessary? It helps set further behavioral goals. For example, by checking how much time is left to cook, you can decide whether you have time to read something, watch a TV series, or complete another task. Therefore, displays complement your behavioral goals by providing relevant information.

Most displays are central, serving as the primary means of conveying information. Any information we receive, either from another person or from the environment, is often presented through a display. It could be an analog display or a digital one. Displays can range from being very complex, featuring multiple interfaces and dials, to being as simple as raising fingers to indicate the number of objects in the environment. Hence, displays play an essential role in conveying information.

While displays provide information, the meaning of this information must be interpreted by the user. If the display presents incorrect or unclear information, the user may misinterpret it, potentially leading to errors. Often, accidents occur because individuals misread displays and take incorrect actions as a result. Therefore, designing displays is not only about providing better ways to present information but also ensuring that the information is presented in a clear and accurate manner. This section will cover various methods to achieve these goals.

The information presented on a display can generally be categorized into two types. First, the information can reflect the current state of a system. Examples include the "end" signal on a microwave, the "stop" sign encountered while driving or walking, or the cross symbol on a printer interface indicating a paper jam. All of this information pertains to the system's status and is conveyed effectively through displays. The second type of information a display can manage relates to the effect of user input.

For instance, when I press a button on an interface, this action initiates a process, and the display provides feedback regarding this action, guiding the user towards subsequent actions. A common example of this is seen when setting up a new cell phone. After specifying the preferred language, the operating system prompts you to enter account information, passwords, and select a network connection. At each step, the system provides feedback about whether the previous input was correct and guides the user on how to proceed.

This feedback mechanism encourages further correct actions on the user's part. In summary, displays serve to present information accurately, whether it is system-related or user feedback. As discussed earlier, we will explore different types of displays, including visual, tactile, and olfactory displays in this lecture and the next, while auditory displays will be covered in future lectures. Let us now begin by discussing visual displays.

Information can be presented through different sensory modalities. For example, auditory displays like the jingle or warning sound in a car when the seatbelt is not fastened alert the user to take action. This kind of auditory alert is a warning system, and further details on such auditory displays will be discussed in subsequent lessons. Another type of display is the tactile display, such as phone vibrations indicating an incoming call or message. Additionally, there are olfactory displays, which convey system-related information through smells. For instance, the pungent smell of cooking gas is an olfactory display indicating a gas leak. Now that we have covered auditory, tactile, and olfactory displays, let us elaborate on visual displays.

Visual displays can be classified into two categories: static displays and dynamic displays. Static displays, as the name suggests, remain unchanged and provide limited information. Because of their fixed nature, they offer minimal data. Examples of static displays include road signs that indicate when an elevation is approaching, when to stop, or where the zebra crossing is. Caution labels and warning signs, such as "Do Not Enter" or "Do Not Touch," are also static displays. For instance, a microwave oven often has a warning label stating that the oven is hot and should not be touched with bare hands while operational. Static displays can also include building names, such as those indicating where an administrative building or town hall is located.

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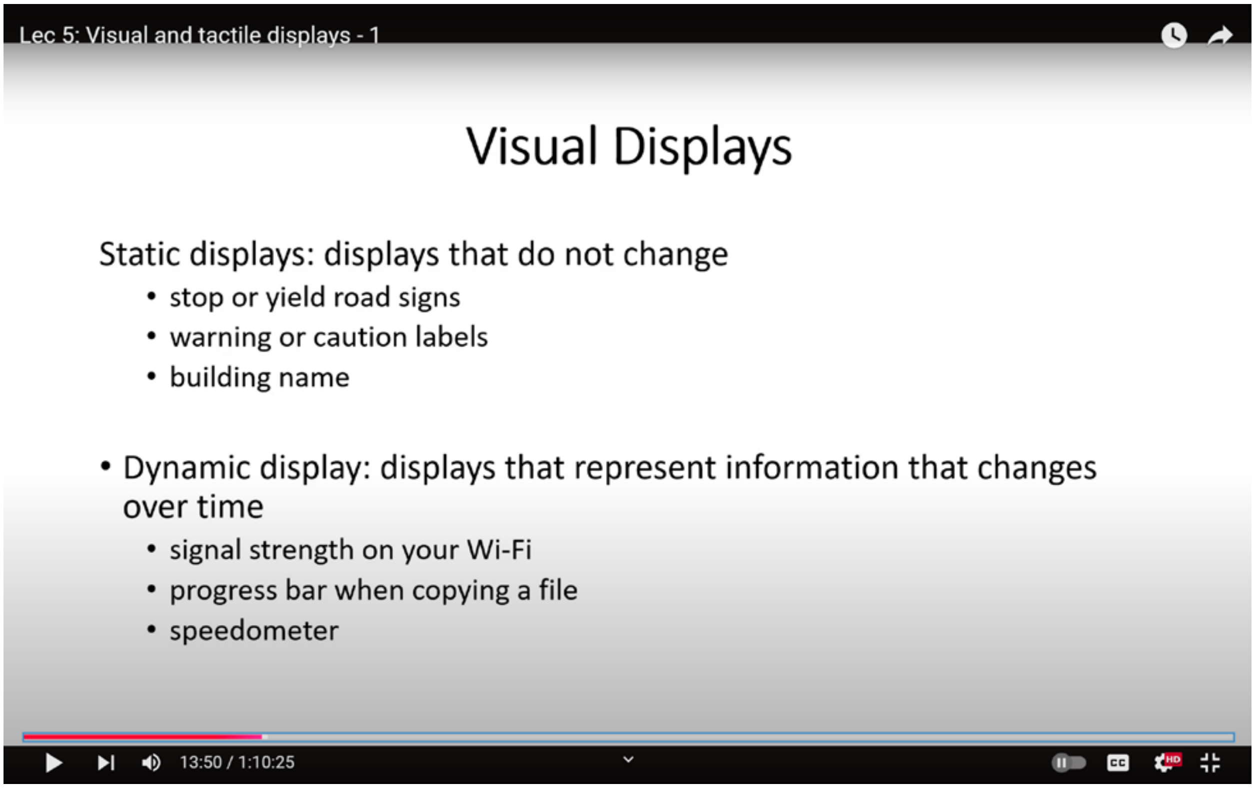

On the other hand, dynamic displays present information that changes over time. While stop signs and labels are static displays, devices like digital clocks or temperature meters serve as dynamic displays. Dynamic displays reflect the system's state over time, often providing real-time feedback based on user inputs. A good example is the Wi-Fi signal strength indicator on your laptop or cell phone. As you move around, the number of bars increases or decreases, showing changes in signal strength, this is a dynamic display.

Another common dynamic display is the progress bar, which appears when copying files between devices. It shows how much of the task is complete and how much time remains, updating as the transfer progresses. Similarly, the speedometer on a car or two-wheeler is another example of a dynamic display, indicating the current speed and helping the driver adjust their actions accordingly. For instance, if the vehicle is moving at a low speed, the driver knows to use a low gear.

When driving at high speeds, higher gears are typically used. This kind of information, representing changes in system states, is conveyed by dynamic displays. There are certain principles to enhance the effectiveness of static displays, and I will outline three or four key rules.

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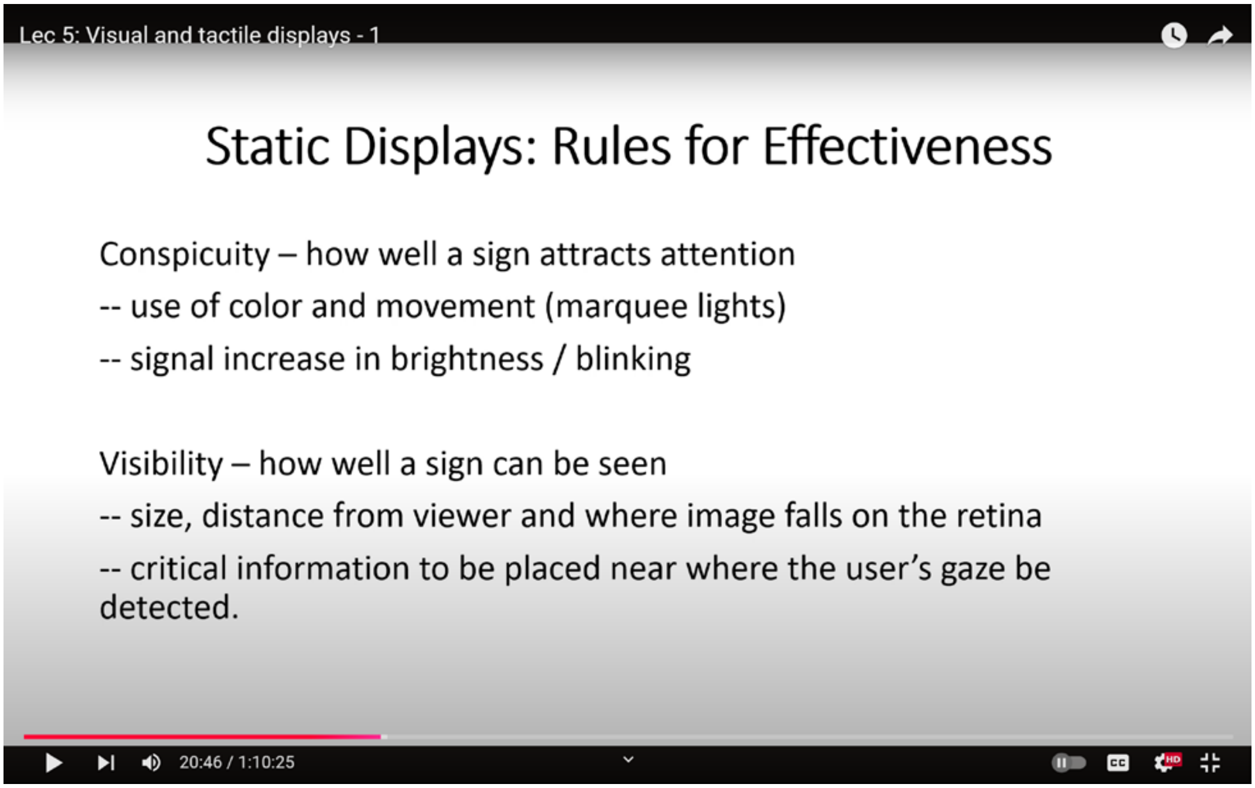

The first rule to improve static displays is "conspicuity." What does conspicuity mean? It refers to how well a display captures attention. Static displays, by their nature, are fixed, and anything static tends to lose its ability to attract attention. While moving objects naturally draw attention, fixed objects often blend into the environment. Therefore, static displays must be designed in a way that ensures they capture attention.

The purpose of any display is to provide information, whether it's a warning, alert, or other important messages. But imagine a situation where people fail to notice the display simply because it blends into the surroundings. Important information might be missed. For instance, there have likely been times when you failed to notice signs indicating men's or women's restrooms, accidentally entering the wrong one. This happens when a display is either not designed to capture attention or is poorly placed.

One way to enhance the effectiveness of a static display is by improving its conspicuity, which refers to how well it attracts attention. How can this be achieved? Using colors is one approach. Colors have a natural tendency to draw attention, making people more likely to look at them. Additionally, lights, specifically macro lights or timed lights, can simulate movement, which also draws attention. You've probably seen lights during festivals that create patterns or words, even though the lights themselves aren't moving. This illusion of motion is another method of attracting attention.

Another feature that can enhance static displays is brightness. Brighter signals convey higher levels of warning, while lower brightness indicates a less urgent warning. Similarly, blinking lights can signal different levels of urgency, the faster or stronger the blinking, the more serious the warning.

In addition to conspicuity, the visibility of a display is crucial. If a display is present but not visible, it serves no purpose. For instance, if it is positioned where people's eyes naturally do not fall or if its design blends into the environment, it becomes ineffective. Sometimes, displays are designed in colors that blend with their surroundings, making them difficult to notice. One way to improve the effectiveness of static displays is by enhancing their visibility.

Certain factors can influence the visibility of a display, including its size. What should the size of the display be? It should be large enough to be seen clearly, and it should be positioned at a distance where the angle it subtends on the retina of the eye falls between 0.8 degrees of arc. We will discuss this concept of visual angle in detail later, but the key point is that the display should be large enough that the image it forms on the retina falls on the fovea, the area of the retina responsible for sharp vision.

The retina has different regions, with the periphery being slower in detecting visual information, while the fovea, at the center, provides clear and quick perception. Therefore, displays should be designed and placed so that they subtend an angle that projects onto the fovea, allowing for easy visibility.

Another consideration is the location of critical information in relation to the user's gaze. Designers must think about where the user's gaze is likely to fall. By understanding gaze patterns and identifying the area where most people's gaze naturally lands, the display can be positioned in a way that maximizes its chances of being noticed. Eye-tracking studies, which analyze where people's gaze falls on different stimuli, can help determine this "hot zone." Placing the display in this zone increases its visibility significantly.

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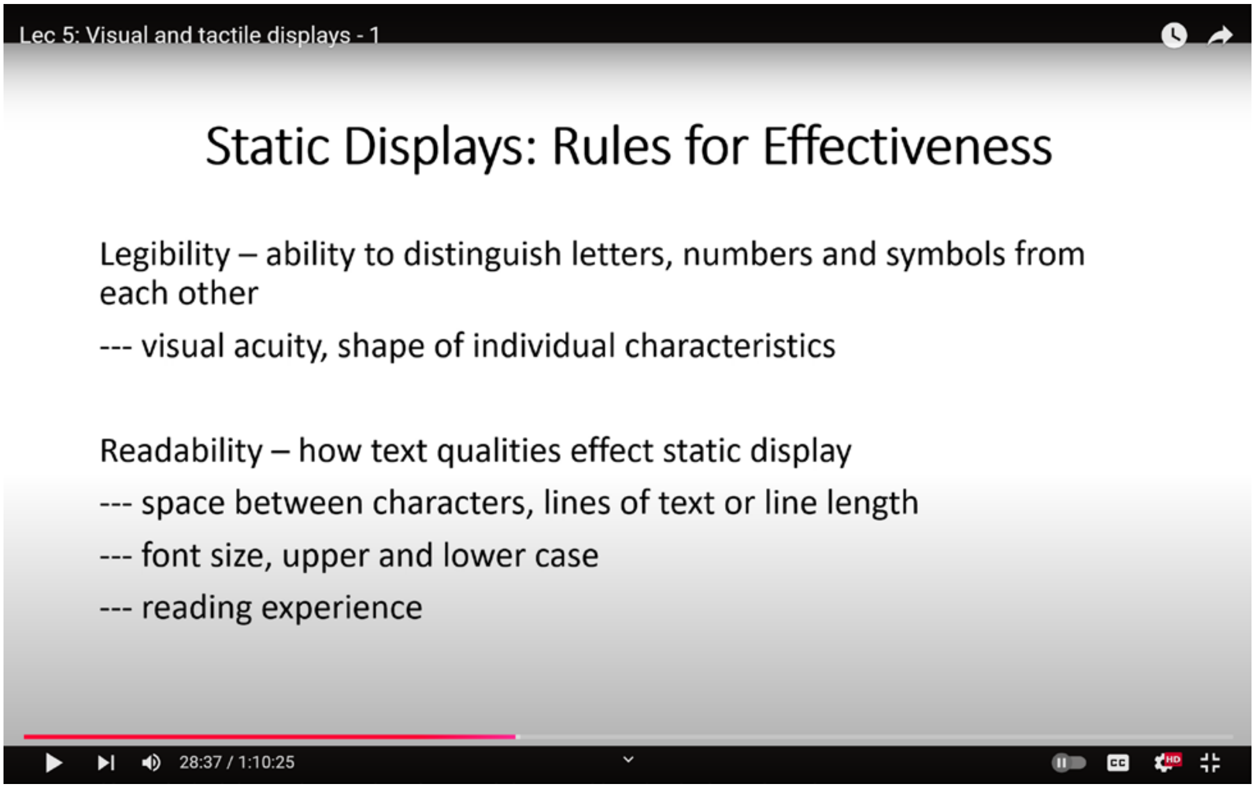

Legibility is another important factor in enhancing the effectiveness of displays. Legibility refers to the ease with which letters, numbers, and symbols can be distinguished from one another. Think of the times when you've struggled to type a password because the letter "O" looked like the number "0," or the number "1" appeared similar to the letter "L." Despite our best efforts, it can be difficult to read or input the correct information when the characters are unclear.

When designing static displays, it's important to consider legibility, ensuring that letters and numbers are easily distinguishable. Additionally, characters should not be grouped too closely together, as this can make the display harder to read. If letters and numbers are bunched together without enough spacing, it can cause misinterpretation, leading to incorrect information being conveyed.

Proper spacing and appropriate font selection are crucial for displaying text effectively. One factor that affects legibility is visual acuity, which refers to how clearly we can distinguish two separate objects or forms. Visual acuity is important in determining how accurately one can differentiate between objects or symbols. In the context of static displays, this feature plays a key role in designing legible symbols.

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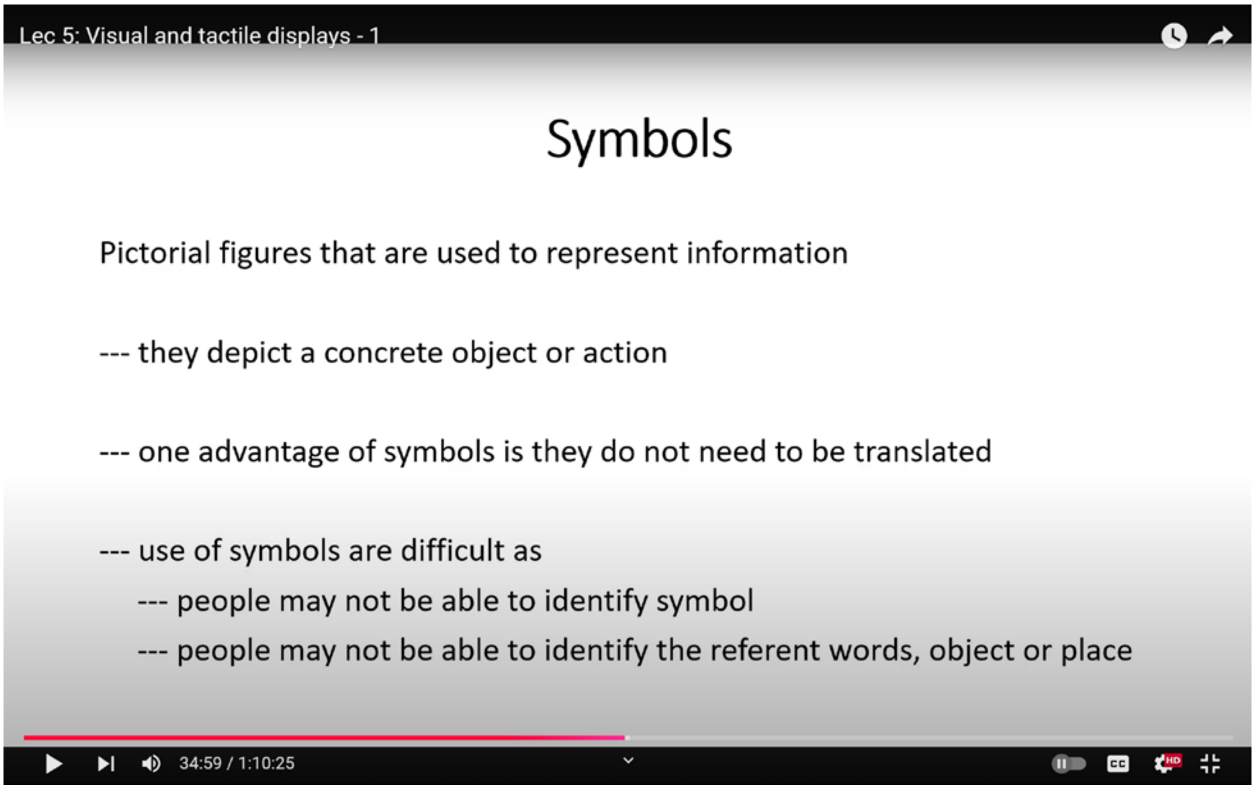

Each character should be shaped in a way that allows it to be easily distinguished from others, which enhances both readability and legibility. A display might be visible and legible in terms of being able to identify the individual characters, but it can still be unreadable. This happens when characters are arranged in a way that makes the text meaningless. Thus, the display should not only be visible and legible, but also readable, ensuring that the information conveyed is understandable.

Unreadable displays occur when too many letters are strung together, or when sentences are poorly structured, causing the information to lose its clarity. Therefore, readability must also be considered when designing static displays. Readability refers to how the text's qualities affect the user's ability to comprehend the message. One important aspect to consider for improving readability is the spacing between characters. If characters are placed too closely together, it creates confusion, making it difficult to distinguish them.

Similarly, lines of text should not be too close to one another, as this can cause overlap, making it hard to read. Another consideration is the length of the lines of text. If a line is too long or contains complex sentences with multiple ideas, it becomes difficult for people to extract the intended meaning. Displays are meant to convey important information quickly and efficiently, so overly long or complicated text defeats this purpose. To maintain effectiveness, the line length should be minimized.

Font size also plays a significant role. Lowercase and uppercase fonts have their respective uses. It has been found experimentally that using all uppercase letters in a sentence makes reading more difficult. While uppercase letters may be useful in specific cases, such as for immediate warnings where attention needs to be drawn quickly, using all uppercase letters throughout a display is not advisable.

Reading experience also influences how people interact with displays. Experienced readers often rely on heuristic methods for reading, meaning they might guess rather than fully engage with the text. Therefore, displays should be designed to encourage users to read the information carefully, rather than guessing its meaning. The goal is to create displays that require active reading, where the user reads and processes the information before extracting meaning. This prevents automatic reading habits from leading to misunderstandings.

Symbols are another important form of static display. Symbols are pictorial figures used to convey information. For instance, a symbol may indicate a restroom for individuals with special needs or direct a person to specific areas like immigration counters at airports. Symbols also convey actions, such as the exclamation mark that alerts users to take action or proceed. For example, when scanning a boarding pass at an airport, the symbol "proceed" instructs the user to move forward, indicating a specific action.

Symbols have both advantages and disadvantages. One significant advantage is that most symbols are universally recognized and do not require translation. For example, symbols for a battery, a cross, or weight are universally understood without the need for further explanation. The universality of symbols makes them easy to interpret across different cultures and languages.

However, symbols also have disadvantages. One issue is that people may not always be able to identify or understand the meaning of a particular symbol. Misinterpretation can occur, leading to confusion, especially if the symbol is unfamiliar to the user.

Consider a symbol that displays an animal, with a circle and a cross over it. If you are driving through a wildlife region, the intended meaning of the symbol might be to indicate animal crossing, warning you to beware and stop before entering certain areas. However, this symbol, with the circle and cross, could easily be misinterpreted as a suggestion to kill the animal. The circle highlights the animal, while the cross typically signifies cancellation or removal, leading to a potential misunderstanding. This example demonstrates how symbols can be misinterpreted if not designed properly, and how such misinterpretation can obscure the intended message.

In addition, symbols can also fail to communicate effectively if people cannot identify the referent, what the symbol is supposed to represent. This miscommunication can occur even if the symbol isn't misread, as people may still be unable to determine what the symbol refers to or where it is relevant. For instance, imagine a warning sign at an airport that advises you not to cross a security checkpoint. Now, if the symbol is designed using yellow with three crosses or a skull and crossbones, it might convey a heightened sense of alert, but it could confuse people regarding what action they should take. The symbol would suggest danger or caution but may not clearly indicate to stop before the security checkpoint.

In such cases, a more straightforward symbol, like a red stop light or a sign indicating "STOP" before the yellow line, would be much clearer. The skull and crossbones symbol typically implies a serious threat, not a simple instruction to stop, which could cause unnecessary confusion. Therefore, symbols need to be designed with care to ensure they accurately convey the intended message. Misinterpretation of symbols can have serious consequences, even if the goal is to improve security or the user’s information processing capabilities.

Another significant shift in modern symbol and text design comes with the advent of digital text displays. Traditionally, text was printed in books or magazines, which made reading easier. However, with the rise of digital platforms, text has transitioned to being displayed on screens, and this change presents new challenges. Many people experience difficulty when reading from a digital screen or PDF compared to reading from a printed book. This can even lead to physiological problems, such as headaches. The shift from printed material to electronic displays has required a new approach to text design, especially since reading on screens poses its own set of challenges.

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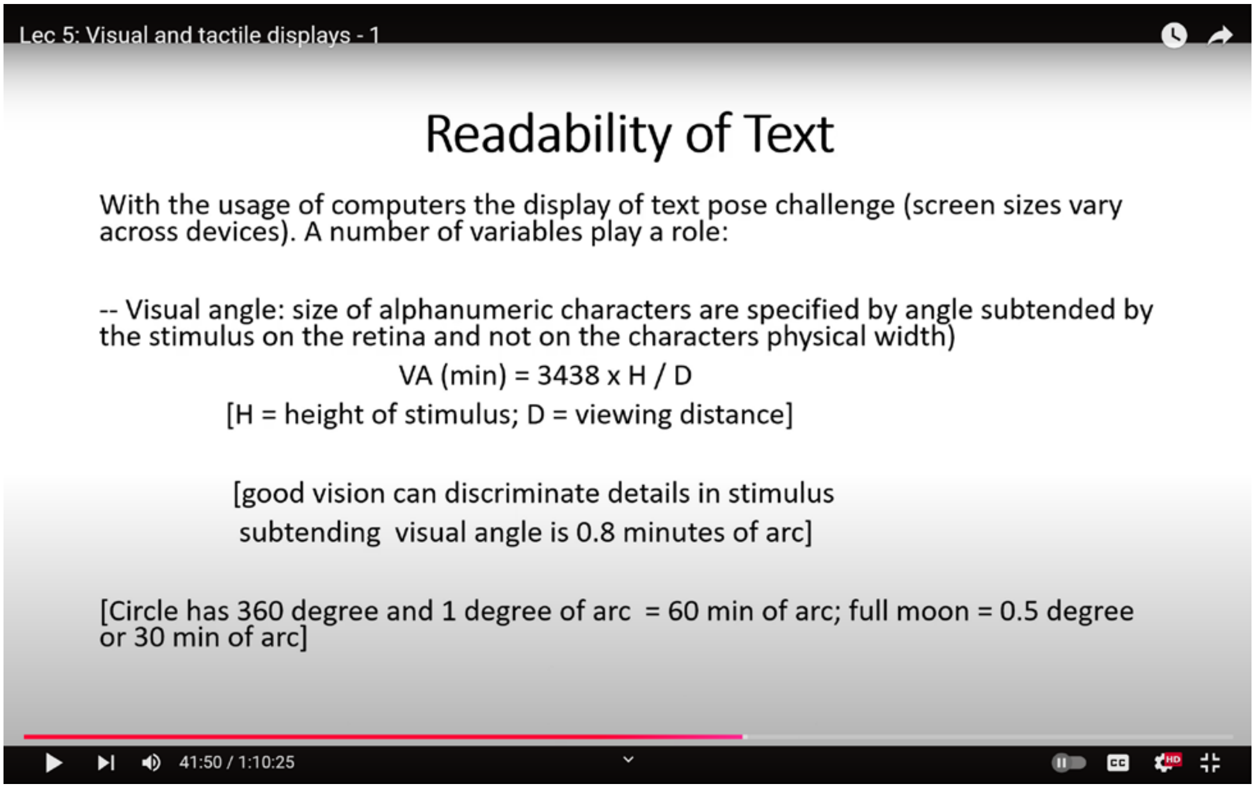

One such challenge arises from screen refresh rates, which differ across devices. Unlike books, which are static and have no refresh rates, screens continuously update themselves, changing their brightness and intensity. Although these changes might seem minimal, they can still create difficulties when reading. Moreover, screen size is another issue. Web pages are now viewed across a wide range of devices, from large television screens to 14-inch computer monitors, down to handheld smartphones and even smartwatches. Making text readable on both large and small screens is a complex task.

There are several variables to consider when designing text for different screen sizes. One such variable is the visual angle, which refers to the size of an alphanumeric character as perceived by the eye, determined by the angle subtended by the stimulus on the retina, not by the character's physical display dimensions. This visual angle is crucial in determining how readable a character is, and it depends on both the size of the text and the distance from which it is viewed.

The visual angle can be calculated using the following equation:

$$\theta = \frac{3438 \cdot H}{D}$$

Where:

- θ is the visual angle in minutes of arc,
- H is the height of the stimulus (in the same units as d),
- D is the distance from the observer to the text.

To give an example, a full moon subtends a visual angle of about 0.5 degrees or 30 minutes of arc. A well-designed text display should subtend a visual angle of approximately 0.8 minutes of arc for optimal readability. By adhering to this standard, designers can reduce the strain on the reader's eyes and improve reading efficiency.

Another factor affecting the readability of text is contrast, which refers to the difference in luminance between the foreground (text) and the background. With printed text, this isn't usually a problem since neither the text nor the background is illuminated, and light primarily comes from external sources. However, in digital displays where both the text and background can be illuminated, contrast plays a significant role in determining text legibility. If the contrast is too high or too low, the text can become difficult to read. A balanced contrast is essential for clear text readability.

For example, black text on a white background is highly readable because black absorbs light and reflects less, while white reflects more light. This contrast helps distinguish the text from its background, ensuring that it stands out clearly to the reader. Therefore, the proper use of contrast is key to designing readable text, particularly in digital environments where brightness and illumination levels are constantly shifting.

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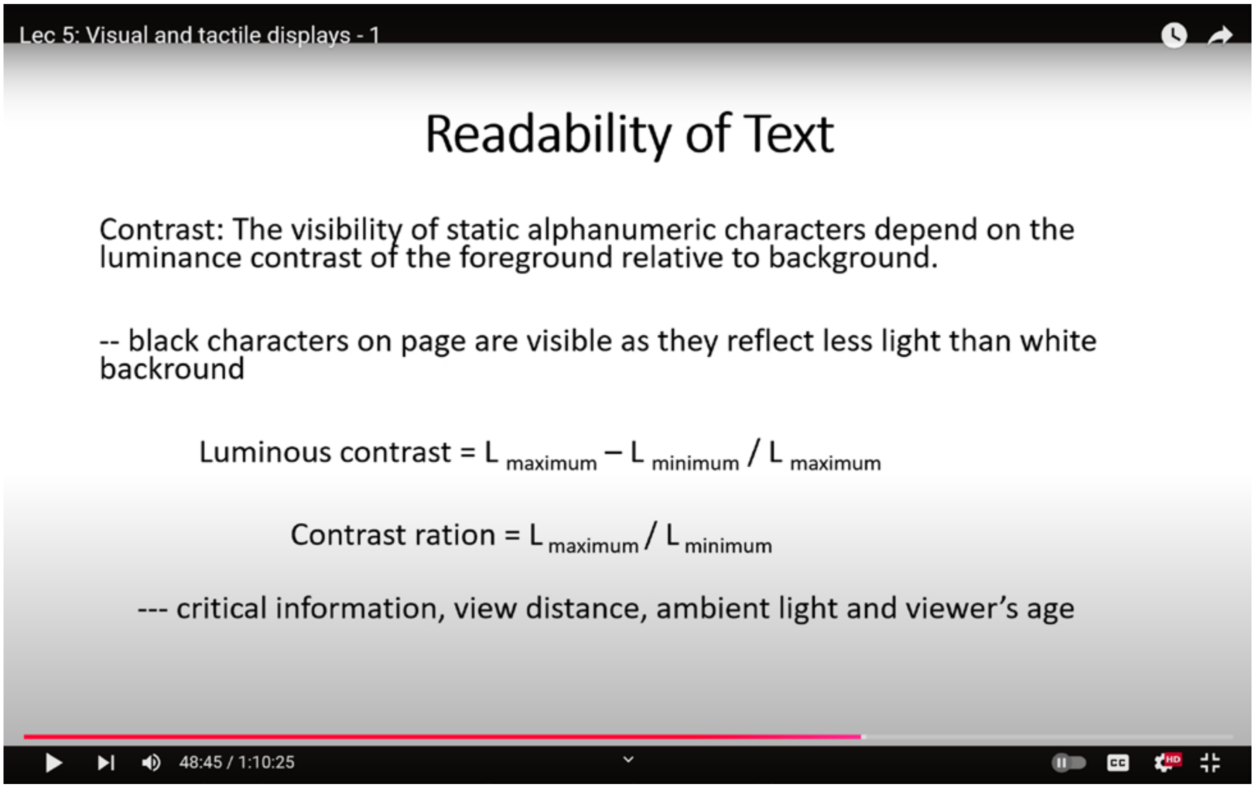

The same considerations apply when designing electronic displays, where contrast must be handled appropriately. Luminous contrast can be measured as the difference between the maximum and minimum luminance, divided by the maximum luminance, giving the luminous contrast ratio. The contrast ratio is the ratio of maximum luminance (foreground) to minimum luminance (background). This information is critical for readability, especially when dealing with vital information. For such cases, the foreground should be significantly brighter than the background, ensuring that critical information is easily recognizable.

Viewing distance also impacts the contrast requirements. For greater viewing distances, the contrast should be adjusted so that the foreground stands out distinctly from the background. Ambient lighting further affects this contrast, requiring careful balance to ensure the text remains legible in varying lighting conditions. Age of the viewer is another factor; older individuals may take longer to read and decipher letters. Therefore, the contrast should be optimized for visibility across all age groups, ensuring legibility for both younger and older individuals.

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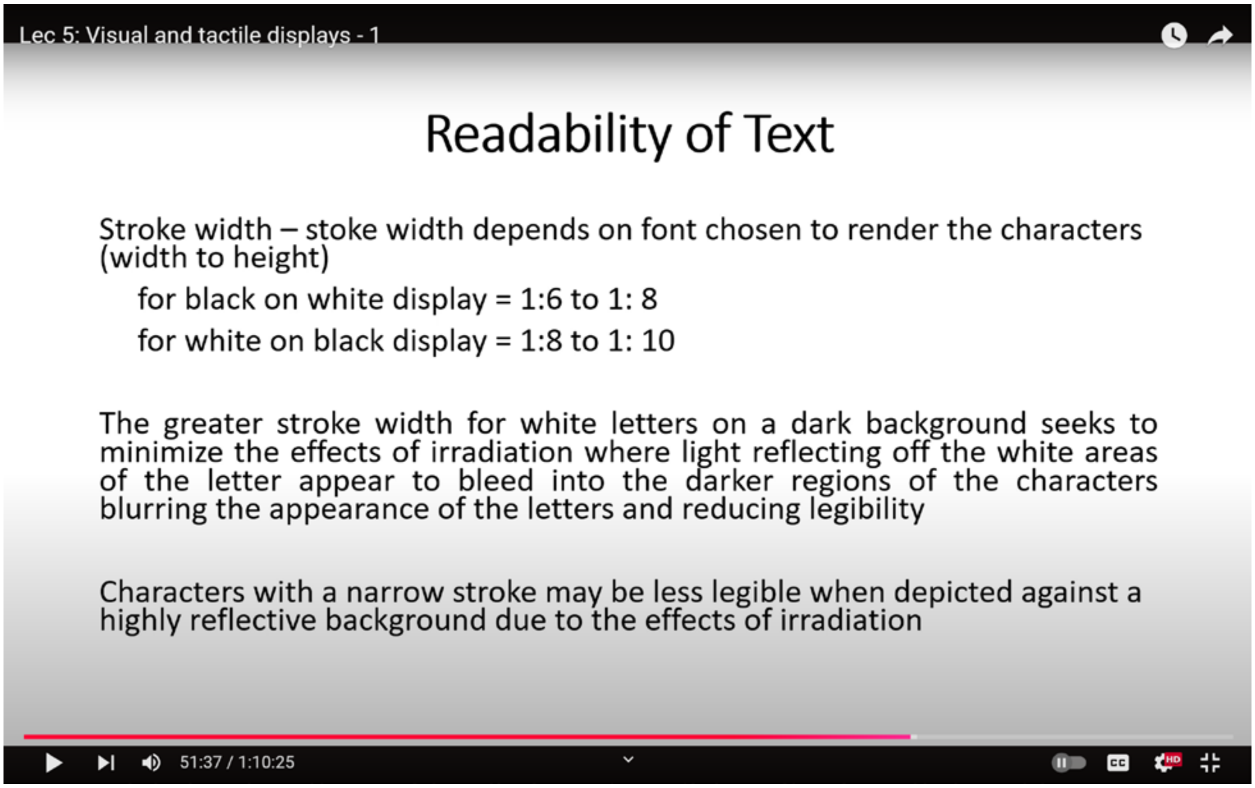

Another critical factor influencing text readability is stroke width, which depends on the font used to render characters. Stroke width refers to the ratio of a character's width to its height. For black text on a white background, a stroke width ratio between 1:6 and 1:8 is optimal, while for white text on a black background, the ratio should be between 1:8 and 1:10. Increasing the stroke width for white letters on a dark background helps minimize the effects of irradiation, where light from the white areas bleeds into the darker regions, making the letters harder to read. Conversely, characters with narrow strokes may become less legible against reflective backgrounds due to this same irradiation effect. Minimizing these effects and selecting the correct stroke width improves text readability.

Font selection also plays a significant role in text legibility. Popular fonts like Sans Serif, Serif, Verdana, Times New Roman, Arial, and Calibri have distinct readability characteristics. Fonts like

Gothic, for example, may reduce legibility, as certain characters might not stand out clearly from the background. For this reason, many websites use Verdana or Arial, which are easier to read on digital displays. Fonts used for alphanumeric characters generally fall into two categories: Serif and Sans Serif. Serif fonts are characterized by decorative strokes at the ends of letters, commonly found in printed materials like books, magazines, or newspapers. Serif fonts help readers identify individual letters more easily, making them ideal for print.

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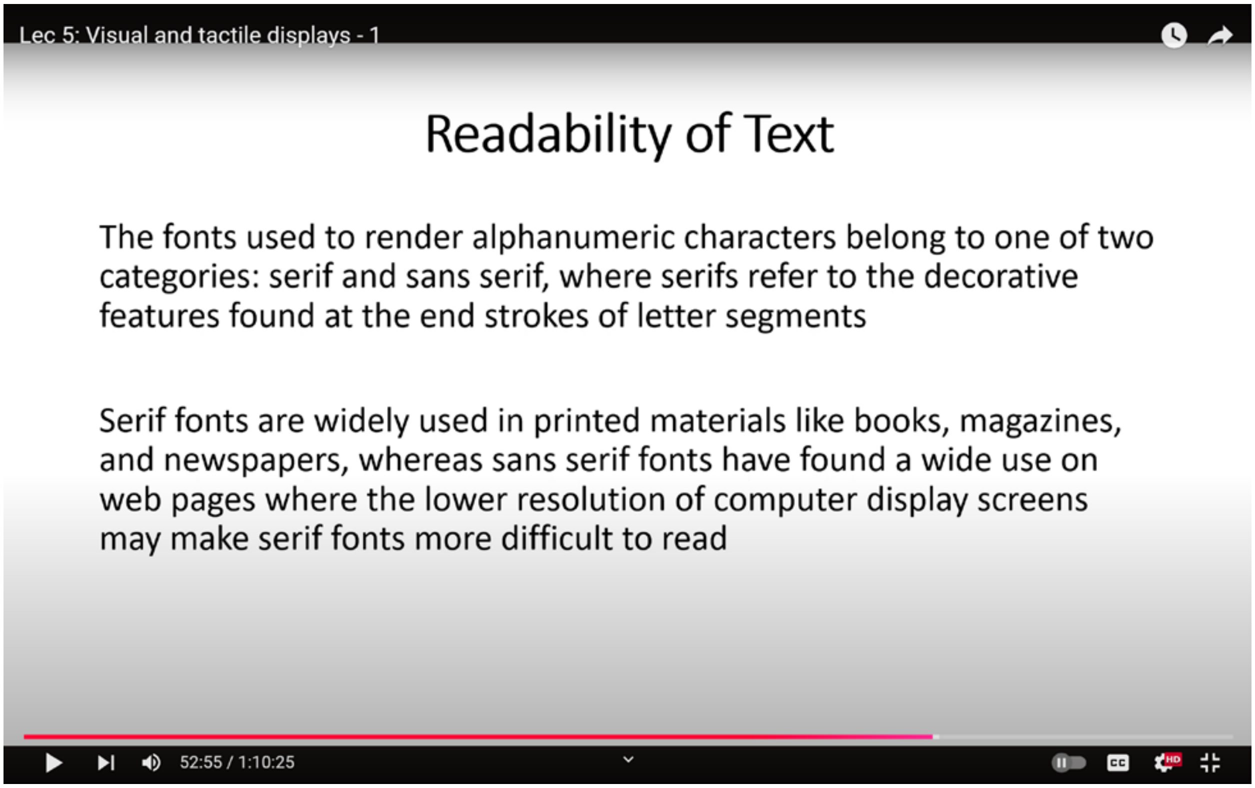

On the other hand, Sans Serif fonts are commonly used on web pages due to the lower resolution of computer displays. Serif fonts can blur on low-resolution screens, making them harder to read, whereas Sans Serif fonts provide better clarity. The use of appropriate fonts enhances the readability of text, especially in digital environments.

Thus far, we've discussed static displays, but let's now turn to dynamic displays. Dynamic displays are used to present qualitative information about variable values, rate of change, and system parameters. Unlike static displays, which provide consistent and unchanging information, dynamic displays constantly update. Examples include progress bars, digital clocks, speedometers, and tachometers in vehicles, which reflect continuous changes in speed or engine RPM.

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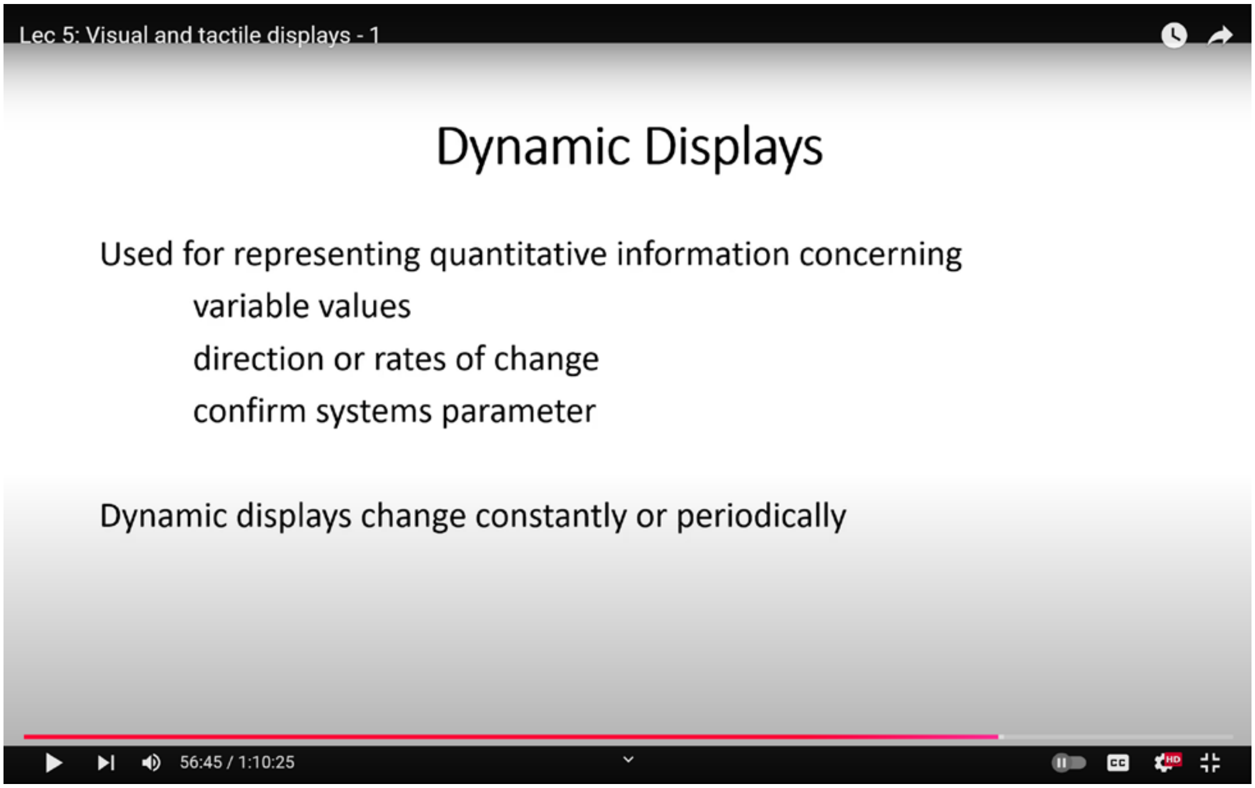

Dynamic displays are especially effective when representing variable values, such as rate of change or directional shifts. For instance, consider a compass: when moved, it reflects the changing direction relative to the Earth's north. This dynamic feedback provides real-time updates on the user’s position. Similarly, dynamic displays can confirm system parameters. For example, in a microwave oven, the change from one cooking mode to another indicates how the oven shifts between different cooking procedures.

Most dynamic displays exhibit continuous or periodic changes. Continuous changes occur when data like speed or time updates in real-time, while periodic changes include signals like Wi-Fi status bars, which fluctuate periodically. These dynamic changes are displayed through both analog and digital displays. Analog displays present information through fixed scales with a moving pointer, such as traditional car speedometers or bathroom scales. The pointer’s position corresponds to the value it represents. In digital displays, however, the information is completely refreshed to show the updated data.

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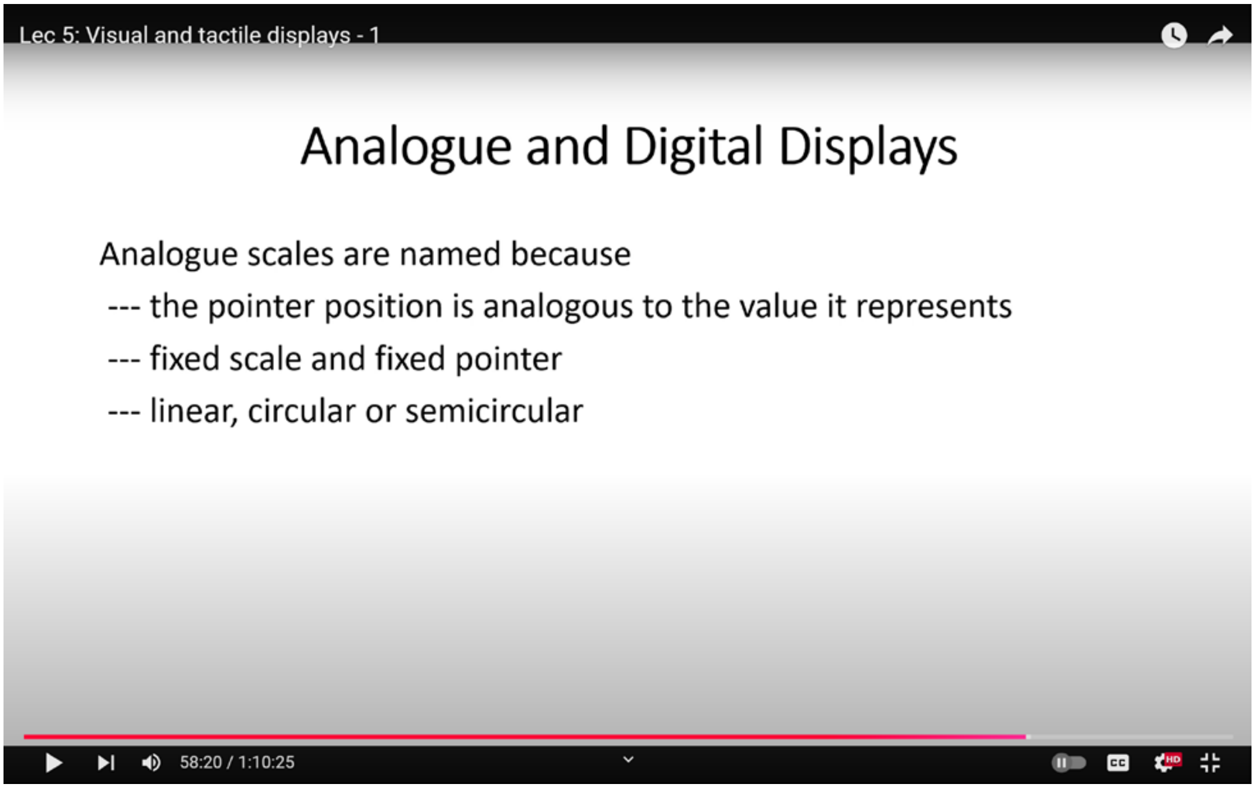

Analog displays can be further categorized based on how they present changes. For example, fixed pointer displays feature a stationary pointer with a rotating scale, as seen in traditional speedometers. Alternatively, in variable pointer displays, the scale remains fixed while the pointer moves. Both types serve different functions depending on the specific application. A good example is a bathroom scale, which can either use a fixed pointer with a rotating scale or a fixed scale with a moving pointer to indicate the weight.

The speeds 0, 20, 40, 60, and 80 are fixed, and there is a pointer that moves as we accelerate or decelerate. On the other hand, a fixed pointer can be seen in a bathroom scale where the pointer remains stationary, and the scale itself moves. The same analogy can be applied to a compass. In a compass, the needle representing the north remains fixed, while the surrounding dial rotates, indicating direction.

Analog scales can be categorized into linear, circular, and semicircular types. A linear scale shows vertical or horizontal movement, such as in weight measurement scales found at railway stations. Circular scales, like a compass, display information in a full circle. Semicircular scales, as seen in a car's speedometer, show speeds in a half-circle format, with the pointer moving to indicate different speed levels.

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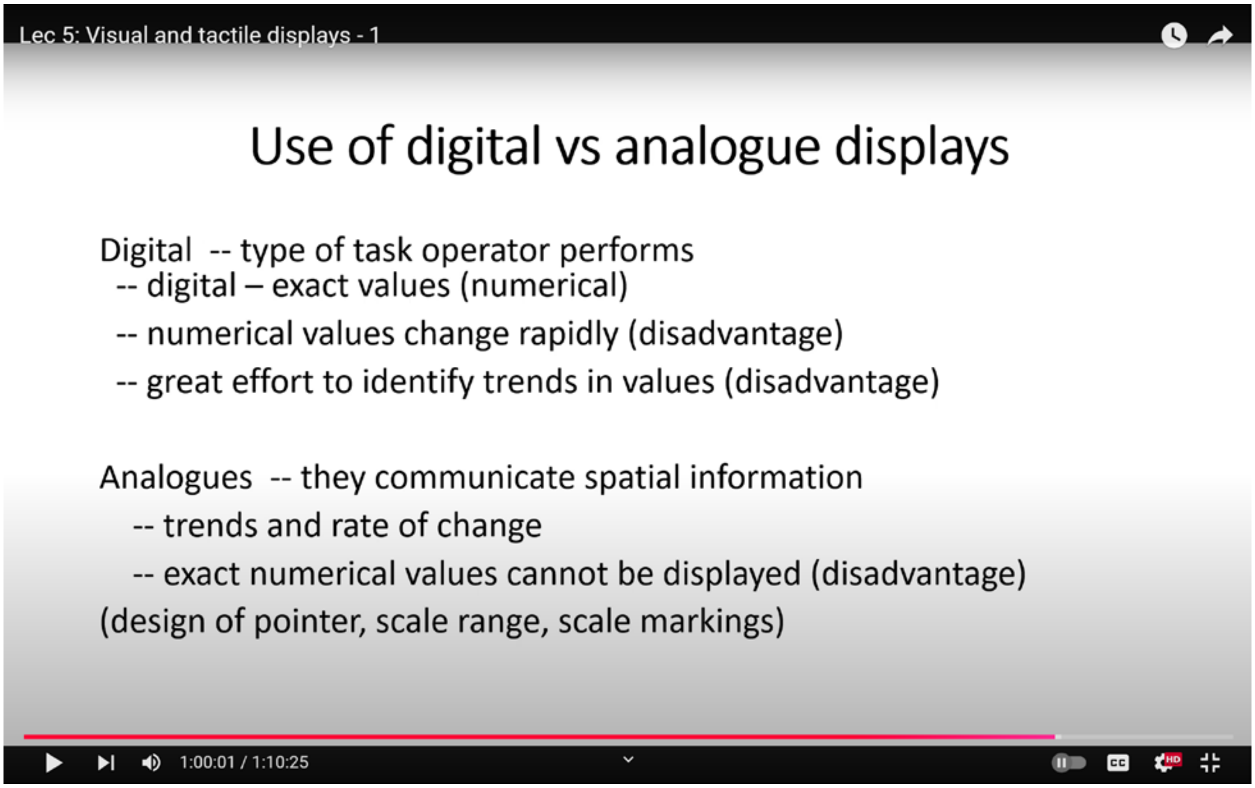

So, when should we use a digital scale versus an analog scale, or a digital display versus an analog display? Digital displays are ideal when the task at hand requires precise numerical values. For instance, in a power station, workers need to know exact values to take specific actions, such as turning off a system when a particular threshold is crossed. These exact values are crucial for making informed decisions. However, a common issue with digital displays is that the numerical values can change rapidly, making it difficult to keep up with and track trends. This rapid update of information can overload working memory, making it harder to monitor changes over time. While digital displays provide precise values, they do not clearly convey trends or changes over a period. To track trends, one would need to manually record each value, making it harder to understand how the system has evolved.

In contrast, analog displays communicate spatial information effectively. They allow operators to easily grasp trends and rates of change, providing a clearer understanding of how a system is performing over time. For example, an analog speedometer indicates the rate of acceleration or deceleration in a car, giving a quick sense of how speed has changed. However, analog displays do not provide precise numerical values. Instead, they offer rounded numbers that approximate the actual value, which can be a limitation when exact data is needed.

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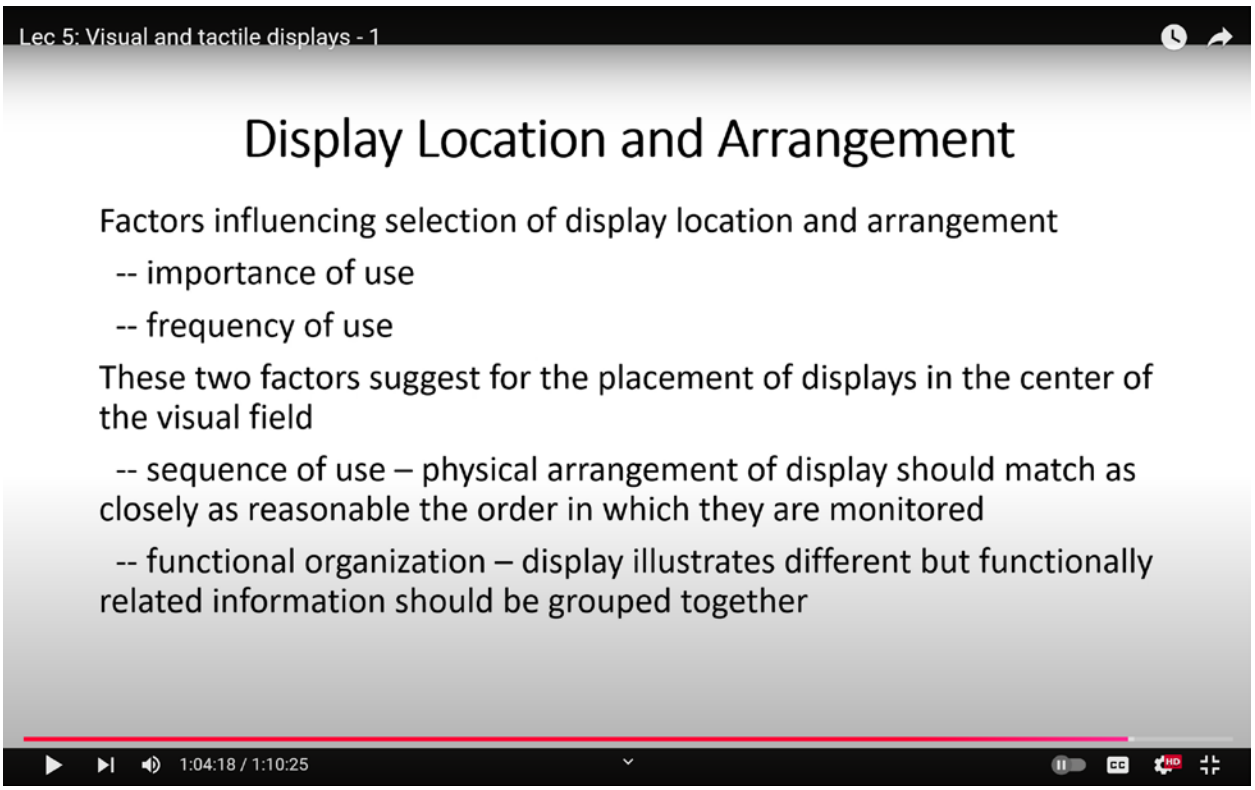

Several features must be considered when designing an analog display. The design of the pointer is critical in ensuring clarity and accuracy. The range of the scale is another important factor. For example, in some cars, speedometers go up to 100 kilometers per hour, while in more advanced models, the range might extend to 300 kilometers per hour. This means the spacing between speed increments, such as 0 to 20 km/h or 40 to 60 km/h, will be narrower in cars with higher ranges, affecting the readability of the scale. Similarly, scale markings are crucial. In some speedometers, the initial increments may have finer markings, while after a certain threshold (say 80 or 100 km/h), the markings become more widely spaced. This variation in scale markings can create challenges in accurately reading the display at higher speeds.

The placement and arrangement of displays are also critical factors to consider. Several elements influence the decision regarding where to position a display. The importance of the display and its frequency of use are key considerations. In a car, for instance, the speedometer is of utmost importance and must be placed directly in front of the driver. Similarly, indicators showing whether the car is on or off, or which gear is engaged, should be positioned centrally within the driver's field of view. In contrast, less critical information, such as engine oil levels or auxiliary indicators, can be placed on the periphery of the display. Features such as braking status or speed, which are frequently referenced during driving, must be positioned in the center of the visual field. These factors, importance and frequency of use, determine the optimal placement of displays for maximum usability and safety.

Two other important properties to consider when locating and arranging a display are the sequence of use and functional organization. The physical arrangement of displays should, as closely as possible, match the order in which they are monitored. The placement of a display depends on the frequency of its use and the transition between different features. For instance, when you enter a car, the button that starts the car is located on the dashboard, and it is often colored for easy identification. It is typically positioned on the right-hand side, assuming most users are right-handed. After starting the car, attention shifts to the center of the display, which shows the engine status and certain parameters related to the vehicle. Once the car is in drive, the gear position is displayed in the center of the dashboard. As you begin driving, the speedometer takes priority in the center of the display. Other less critical information, such as the engine status, which is only relevant at the start of the journey, can be positioned off to the side near the tachometer since it is not frequently referred to during driving. Therefore, the placement of these displays should be entirely dependent on the sequence of use, determining which displays will be used and when.

Additionally, displays should be functionally organized. Functionally related information should be grouped together. For example, driving speed and gear position are related and should be placed within the same semicircle, whereas other related information, such as vehicle torque, speed, or momentum, should be displayed together on a separate screen. Since speed is connected to gear position, and gear position is connected to braking status, these interrelated pieces of information should be grouped on a single display. This type of functional organization enhances usability and efficiency.

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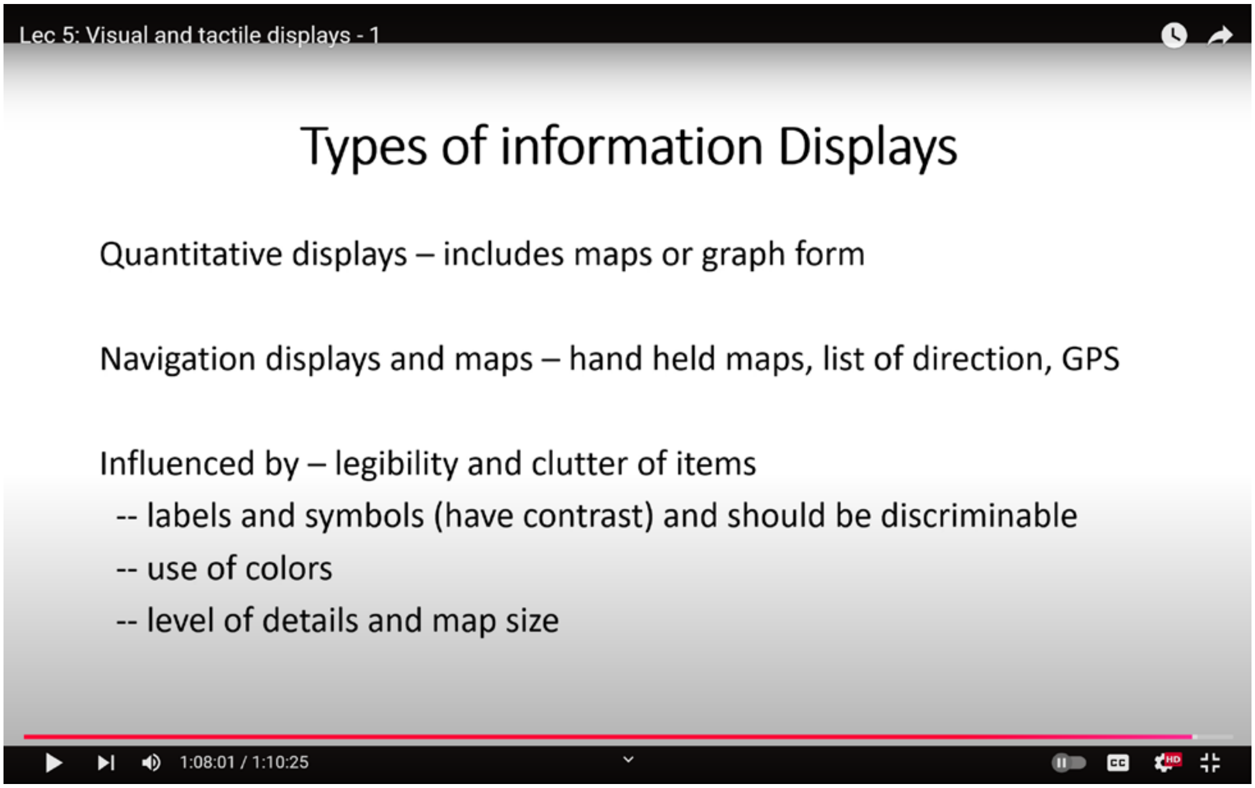

Lastly, let's discuss the types of information displayed. There are quantitative displays, which present data in the form of maps and graphs. These displays provide numerical values, showing increases or decreases over time. For example, a graph depicting the change in a country's price index over time offers valuable quantitative insight. Another type of display is the navigation display, which helps users navigate. These can take the form of handheld maps, lists of directions (as seen in Google Maps), or visual maps that provide step-by-step guidance, such as telling you where to take the next left or right turn. The GPS is another common form of navigation display.

The effectiveness of these displays is influenced by several factors similar to those affecting static displays, such as legibility and clutter. Labels and symbols must have good contrast and be easily distinguishable from one another. Colors can be used to differentiate types of information, and the level of detail, as well as the map size, can also help categorize and present information more clearly.

In today's class, we discussed visual displays, various types of displays, and methods for making them more effective. In our next session, we will explore the human visual system, its capabilities, limitations, and two other types of displays.

Thank you for being with me today. Namaskar and goodbye from the MOOC studio. Amen.