SIT4401 - Human Computer Interaction Lab

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1. Human Computer Interaction lab study experiments

Aim: To study the following experiments a) Weber's Law b) Fitts Law c) Hick Hyman's Law

Theory:

a)Weber's law

Understanding human ability of noticing minute differences in shapes, colors, heights etc can help graphic designers in designing better interfaces and interactions. Perceptual ability to make out differences in objects, colors, shapes, texts etc influences the cognition and the interaction efficiency.

Can we perceive the difference between a line of 10cm length against a line of 10.05 cm ? Can we perceive the difference in holding a weight of 10.0 kg against a weight of 10.05 kg ? This incremental threshold for detecting the difference in any observed value is an important human factor useful in designing GUIs.

For an initial stimulus value I (say 10 cm) let the increment threshold for detecting a difference be ΔI (say 0.05 cm).

Weber's Law (E. H. Weber, in 1834) states that the ratio of ΔI/I is constant for a specific measure.

$$\frac{\Delta I}{I} = K$$

The Weber Fraction

where ΔI = Differential threshold   I = Initial stimulus intensity   K= Weber fraction

Weber's Law states that the size of the just noticeable difference (jnd) is a constant proportion(K times) of the original stimulus value. It is the minimum amount by which stimulus intensity must be changed in order to produce a noticeable variation in sensory experience.

Thus there is a linear relationship between differential threshold and the initial stimulus value as depicted in the figure below
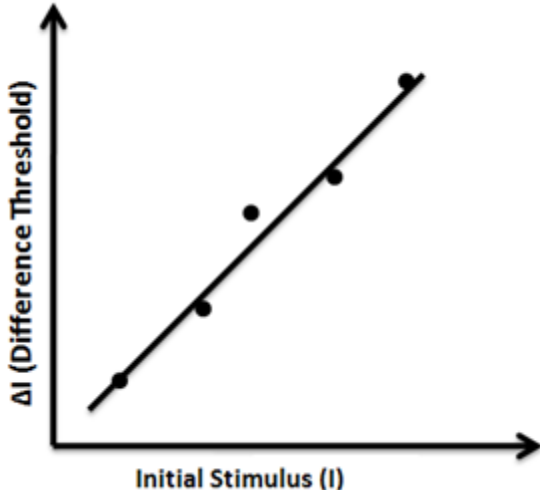
b) Fitts law

Fitts's Law - Modeling Target Movement Time in HCI

Fitts's law is a model of speed-accuracy tradeoffs used in human–computer interaction and ergonomics. It predicts time required to acquire a target on screen as a function of the distance to the target and the size of the target. Fitts's law is used to model the act of pointing, either by physically touching an object with a hand,finger or virtually or by pointing to an object on a computer monitor using a pointing device. It was proposed by Paul Fitts in 1954. (Reference: http://en.wikipedia.org/wiki/Fitts%27s_law)

Mathematically it can be written as

$MT = a + b \log_2 (2A / W)$

MT : Movement time (average) taken to complete the movement or point the target.

a : Start / Stop time of the device (y intercept)

b : Inherent speed of the device (slope of line)

W : Width of the target measured along the axis of motion, which corresponds to accuracy

A : Distance from the starting point to the center of the target

The term $\log_2 (2A / W)$ is called the index of difficulty (ID). It describes the difficulty of the motor tasks. 1/b is also called the index of performance (IP) and measures the information capacity of the human motor system.

Thus MT= a+b   ID = a + ID / IP

$$MT = a + b\ ID$$

Regression line equation
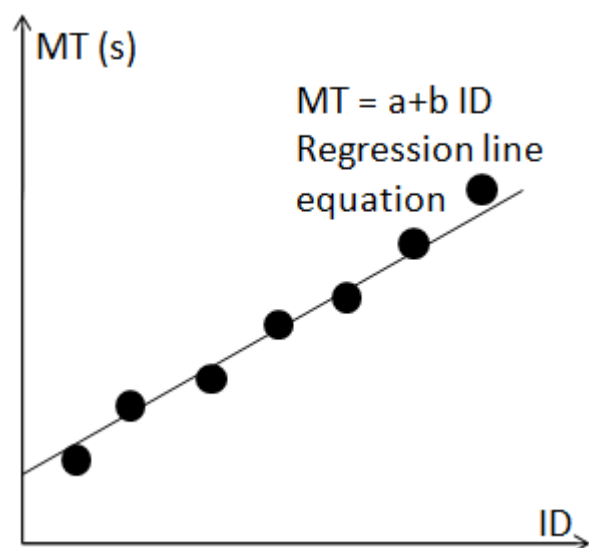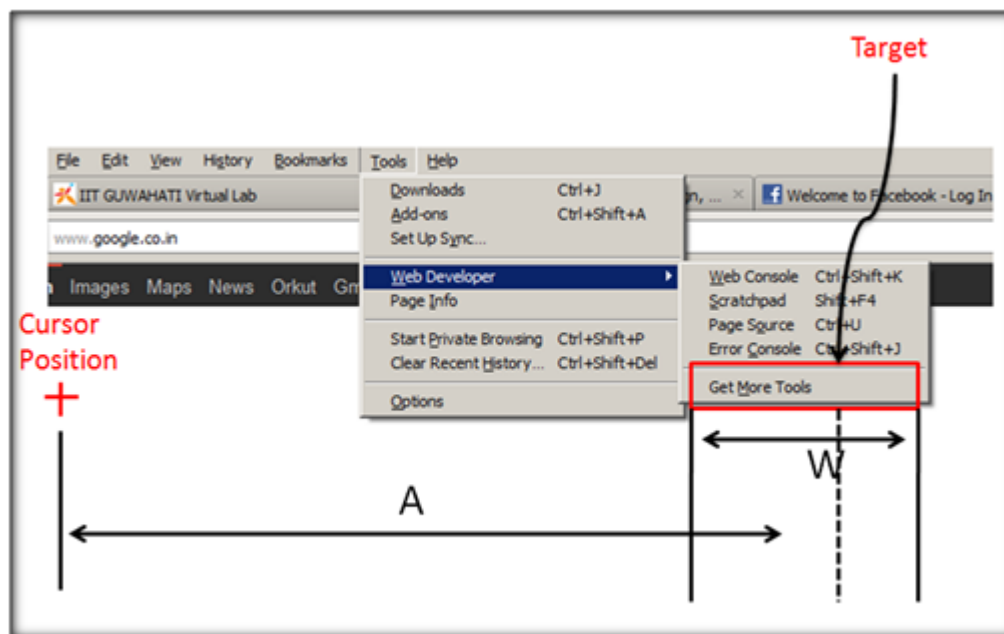
c) Hick Hyman's Law

Hick's Law (for William Edmund Hick) or the Hick–Hyman Law (for Ray Hyman), predicts the time it takes to make a decision in selecting among possible choices. The Hick-Hyman Law measures cognitive information capacity. Given n equally probable choices, the average reaction time T required to choose among them is approximately.

$$T = b.\log2(n+1)$$

The reaction time curve is logarithmic because for quick search we divide choices into categories, skipping half of choices at each step instead of considering each choice one-by-one. To find a given command in a randomly ordered menu, scanning each command is essential, requiring linear time, so Hick's law does not apply here. But if list is ordered we can search and select by subdividing strategy that works in logarithmic time.

Hick's Law is applicable to menu design. It helps in designing menu hierarchy and depth. When we have too many choices (long hierarchy as shown in the screenshot below) we need to cognitively categorize items to reduce the time taken to select an item at any stage. The logarithmic function of Hick's Law decides the depth of hierarchy of the menu tree.

Application of Hicks Law

Figure 1. below shows an example of a bad web-page design which ignores Hick's Law. The web-page has too many choices and scrollbars without proper blocking of contents due to which user's reaction time is extremely compromised.

Figure 2. below shows Google website as an example of a good web-page design. It presents few and clearly distinguished choices that obeys the Hick's Law. Layout is simple, color choices and graphics are limited thereby reducing the reaction time to a large extent.

Useful tips based on Hicks Law for web-page design

1. Distinguish links using colors.

2. Use consistent and familiar layouts to reduce the reaction time.

3. Use techniques (viz. lines, colors) to distinguish related blocks of information(that helps in selecting alternatives quickly) to reduce overall reaction time.

Example:

2. Design a drop-down list or a menu in a GUI keeping in view the serial position effect

Aim: To be able to design a dropdown menu demonstrating the serial position effect

Theory:

Serial Position Effect

Have you ever thought about the maximum number of items a drop-down list or a menu in a GUI can have? Can it be as large as 20? What about the sequence of items in such lists or menus? Is there any logic for sequencing menu-items within a list? Does it affect the interaction time? The design of menus or lists in a GUI is governed by principle of serial position effect.
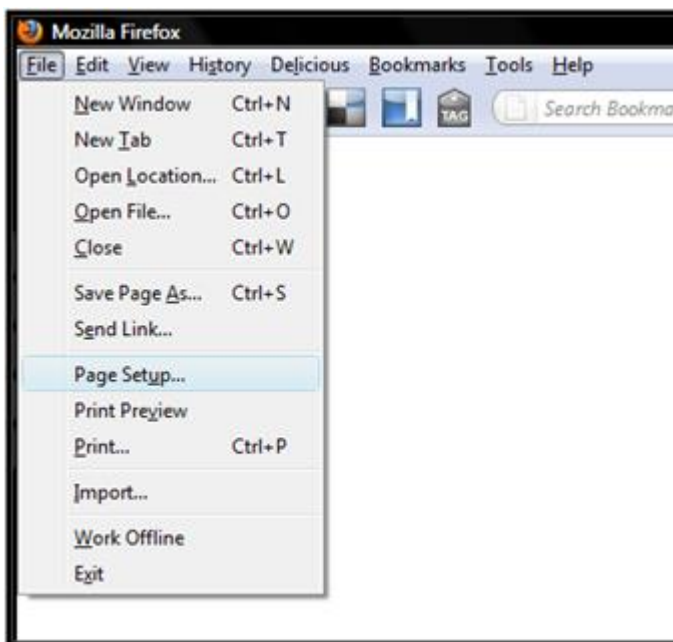
The term serial position effect was coined by Hermann Ebbinghaus which refers to the finding that recall accuracy of an item from a list varies as a function of its position within the list. People tend to recall items at the end of list more reliably (the recency effect). Also the first few items are recalled more frequently than the middle items (the primacy effect).

Applications

We can make use of the recency and primacy effect in sequencing items in a menu of a GUI or a control panel of a product's interface. The more important or more frequently used items or controls should be placed in the beginning or end of the list. Items less frequently used should be placed in the middle of the list. A list of written words may be more easy to recall than a set of colors or symbols.

In case of a list using colors the serial position effect may not be immediately seen. Here recall depends on various properties of color such as brightness, hue and saturation too. Thus a brighter color regardless of its position in the list is more likely to be recalled. This can be used to over-rule the serial position effect whenever the context demands. Thus color can be used as a design element to aid recall.

Procedure

1. Design a drop down menu with list of items say being displayed
2. You will get only 8 seconds time to observe these items in list
3. After that we need to recall which items are present in the list
4. The time taken to recall will be displayed at the end.
5. From the results you will be able to verify whether our recall pattern shows the serial position effect or not.

Code:

```
<!DOCTYPE html>
<html>
<head>
<meta name="viewport" content="width=device-width, initial-scale=1">
<style>
.dropbtn {
   background-color: #4CAF50;
   color: white;
   padding: 16px;
   font-size: 16px;
   border: none;
   cursor: pointer;
}

.dropbtn:hover, .dropbtn:focus {
   background-color: #3e8e41;
}

.dropdown {
   float: 0;
   position: relative;
   display: inline-block;
}

.dropdown-content {
   display: none;
   position: 0;
   background-color: #f1f1f1;
   min-width: 160px;
   overflow: auto;
```

```css
    box-shadow: 0px 8px 16px 0px rgba(0,0,0,0.2);
    right: 0;
    z-index: 1;
}

.dropdown-content a {
    color: black;
    padding: 12px 16px;
    text-decoration: none;
    display: block;
}

.dropdown a:hover {background-color: #ddd;}

.show {display: block;}
</style>
</head>
<body>

<h1> <u>HOME</u></h1>
<div class="dropdown">
<button onclick="myFunction()" class="dropbtn">Menu</button>
  <div id="myDropdown" class="dropdown-content">
    <a href="GUI.html">Home</a>
    <a href="About.html">About</a>
    <a href="contact.html">Contact</a>
  </div>
</div>

<script>
/* When the user clicks on the button,
toggle between hiding and showing the dropdown content */
function myFunction() {
```

```
      document.getElementById("myDropdown").classList.toggle("show");
}

// Close the dropdown if the user clicks outside of it
window.onclick = function(event) {
  if (!event.target.matches('.dropbtn')) {

    var dropdowns = document.getElementsByClassName("dropdown-content");
    var i;
    for (i = 0; i < dropdowns.length; i++) {
      var openDropdown = dropdowns[i];
      if (openDropdown.classList.contains('show')) {
        openDropdown.classList.remove('show');
      }
    }
  }
}
</script>

</body>
</html>
```
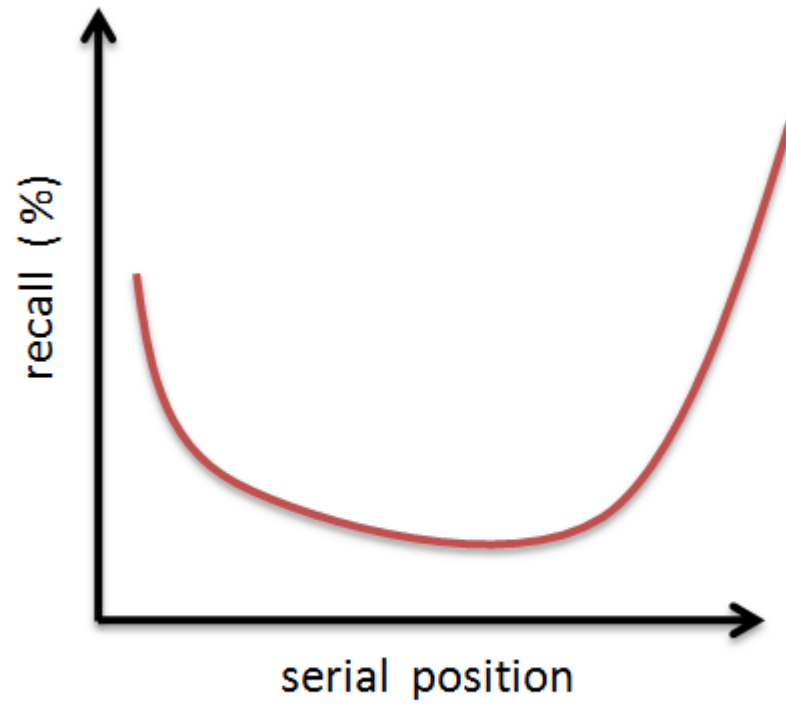
Contact.html
```
<html>
<head>
<title>Contact us</title>
</head>
<body>
<h1 align="center">Contact Us</h1>
<h3><center>Hello : 9856321425</center></h3>
<a href="GUI.html"><center>back</center></a>
</body>
```

</html>
Results:

Conclusion

Hence Drop down Menu based on Serial Position Effect has been studied.

3. Design of different icons in Graphical user Interface (a minimum of four different icons) using Inkscape

Aim:

To design of different icons in Graphical user Interface (a minimum of four different icons) using Inkscape

Theory:

Icons are graphical representation of objects or actions. They are part of the visual language and communicate large information in a single glance which otherwise may need number of words.

There are two essential aspects of icon design
Aesthetics (communication efficiency)
Construction (realization & reproduction using digital medium)

Aesthetics is not only about looks and attractiveness; it is about how efficiently the icon functions vis-a-vis the human user. An icon can be very creative and good looking but can miserably fail in communicating the right meaning. A poor icon design may lead to human errors or accidents. Imagine a save icon in the shape of a basket being confused with a storage icon because visually a 'basket' represents it. The semantics of an icon - (what meaning a graphic symbol communicates) can therefore be creatively destructive. Some other factors that also contribute to aesthetics are shape, color, simplicity, order and proportions.

Construction aspect of an icon design is equally important. Vector based image construction is far more easy for computation, scaling, refreshing and display compared to pixilated construction. Pixilated icons require heavy sizes and have limited animation capabilities. On the other hand

vector based icons may not be suitable for all situations and screen environments.

We should create separate icon sets for high, medium and low pixel density screens.

Pixel density of a mobile phone screen is calculated as follows:

   Specifications: display size=3.7 "(diagonal) / resolution= 480 x 800 pixels

   Pixel density (PPI) = pixels per inch

   Width: height ratio is same as 1: 800/480

   Thus width= 1.9" and height=3.175" (By Pythagorean theorem and diagonal)

   PPI= 480 divided by width of 1.9 or 800 divided by 3.175 to give 252ppi.

Human eye cannot distinguish the difference in PPI when the figure reaches a saturation point of about 250ppi or 300ppi at the most.

In this experiment, as an introduction to conceptualizing icons for a computer Graphical User Interface (GUI)- you will learn how to imagine, visualize and construct a pixel based icon to represent an object or action. It needs to be noted that there is no one single correct answer to the quest of creating an icon. Three different students can come up with three different icon designs that are equally creative, equally valid and equally rated as good.

Icons can be in the form of 2-dimensional flat symbolic image or 3-dimensional. They can be static or animated. Icons can be accompanied by text or labels. The shape, size and style of the letters that form such labels form part of typography design. Typography is a vast area in design. Here only recommendations for typography are made. Widgets are also designed using the same methodology as the icon.

Illustration of some icons

Procedure

1. Sketch an outline of a typical icons in 2 dimensional form as familiar to you.
2. Refine the outline by removing all unnecessary lines, features and clutter.
3. Ask yourself : Does this figure look like how icons look like in real life.
4. Isolate or consolidate significant features of all icons you have noticed till now.
5. Use Inkscape to design your icon from sketch.
6. Assign colours, shadows, highlights as you deem fit.

Introduction to Inkscape

Inkscape is an open-source vector drawing program and is equivalent to commercial packages such as Adobe Illustrator or Deneba Canvas. The current version is 0.48 and it is constantly being developed and upgraded. The project website includes tutorials, guides and forums and can be found here: www.inkscape.org.

Vector graphics are images are made up of a set of objects, usually a set of joined lines or curves which are defined by a series of points (nodes) or a path. This is in contrast to conventional bitmap images which are defined by a set of pixels. Vector drawing facilitates the creation of extremely high quality images, with little pixelation and very small file sizes. It also allows you to easily manipulate and adjust all aspects of an illustration quickly i.e. It 's a fast, flexible and very high quality drawing environment. As most word processing software isn't yet setup to accept vector images, we usually export them as a bitmap at a high resolution so that we can use them in other programs.

Result:
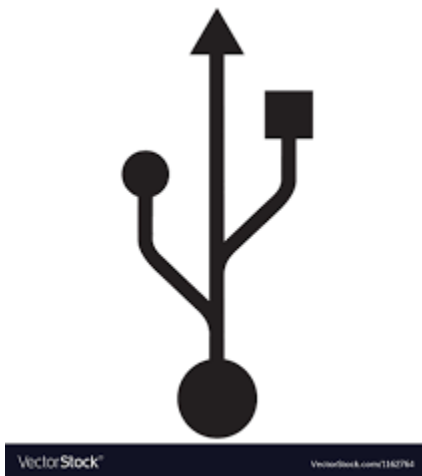
Conclusion:

Thus the above icons have been designed using Inkscape.

4. Design of a Mobile Keypad focusing on size and layout

Mobile Keypad Design - Size, Layout and Bevilling

The layout of a mobile keypad is very important when performing tasks like sending SMS or using a PDA phone. Basic numeric keypad in conjunction with T9 is efficient for typing SMS text messages but for sending emails you may need to look for a cell-phone with a QWERTY keypad with keys properly spaced and large enough to operate with both thumbs.

Some keypads may look good but are very difficult to use. Tiny keys look cool but may be an ergonomic nightmare. The best keypads have sufficient spacing between keys and pressing the keypad gives a positive haptic feedback. Some keys are very close to each other with a raised portion in the middle which is called bevilling. This allows your finger to feel each key which is required for properly using the keys.

In this experiment we will only study numeric keypad layout designs.
Observe the mobile keypads shown below

Procedure:

Design a mobile keypad using android studio or eclipse

Code:
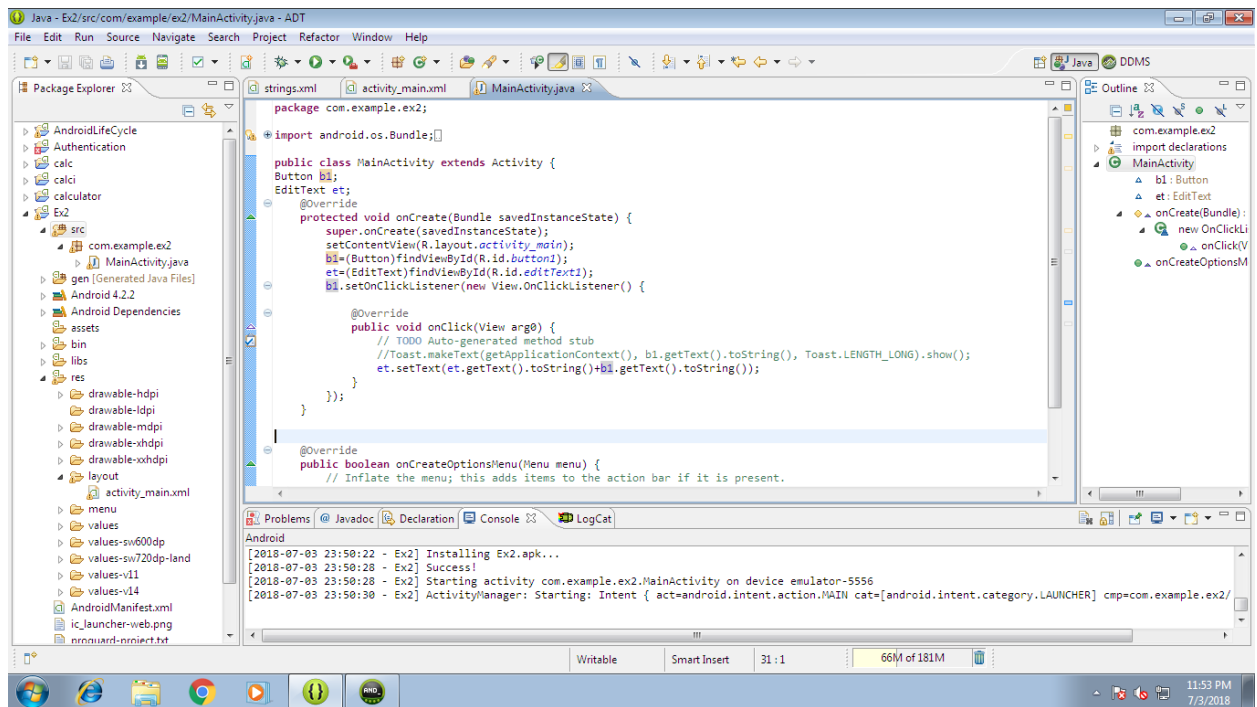
Result:

Conclusion:

Thus Mobile keypad has been designed.

5. Design a prototype of a TV remote Control Panel

Aim:

To design the prototype of a TV remote control panel

Theory:

What Constitutes A Control Panel?

Parts of a product that user interacts with to perform a task constitutes the user interface (UI). A systematic and effective arrangement of user controls and

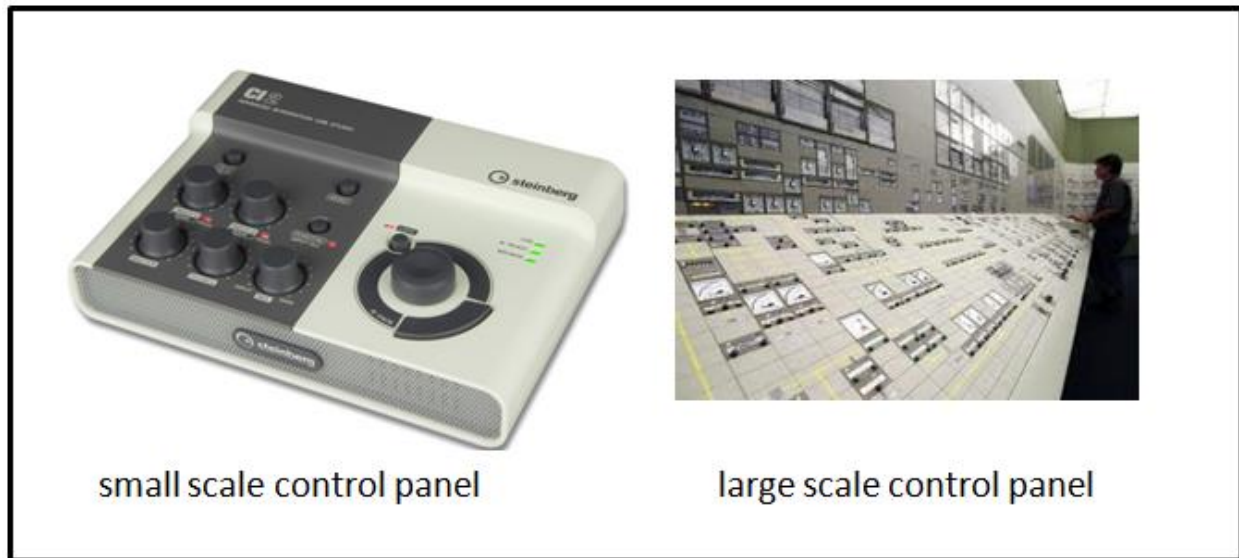displays of a product makes the control panel. Control panel can also be used to configure product's internal features.

small scale control panel   large scale control panel

Control panel of electronic equipment comprises of elements like LEDs, displays, lamps, switches, meters, push buttons, dial knobs, fuses, printed instructions, labels, name plate etc. In software products the graphical user interface (GUI) forms the control panel.

The interaction between user and control panel elements need not always be physical. Panel elements like visual displays and audio signals also form a part of user interaction and communication. This applies in case of airplane where entire cockpit constitutes the control panel environment. Cockpit control panel design (both aircraft and space craft) is most challenging design tasks.

Consumer products too have control panel or interface. The interface designer of a domestic appliance needs to simplify operations to perform complex tasks. This can make wide spectrum of users use the domestic appliance with ease without

much technical knowhow about the product itself. A microwave oven needs careful design of its controls. Any confusion in its operation can result in serious accidents. The buttons on the keypad of a TV remote control, mobile phone or a portable music player are so small that they are difficult to use or are not used eventually by the users.

Therefore designing of control panel is a creative but technically demanding effort that aims at efficient and aesthetically satisfying human product interaction.

Control panel elements are classified into following categories :

1. Activation : for activating a operation e.g. switches, push buttons

2. Discrete : for setting fixed operational values or inputs e.g. a rotary dial

3. Continuous: for varying continues values e.g. dials , slider switches , volume knob

4. Rapid : for inputing data rapidly e.g. data entry buttons on a keyboard

Procedure:

Design a Tv remote control panel using android studio or eclipse

Code:

Result:

Conclusion:

Thus Tv remote control panel has been designed

6. Design a Web Interface for a University website

Aim:

To design a web interface for university website

Theory:

Web Interface design

E-learning course cannot be effective unless we understand the human factors like the learner's psychology, learning needs and behavior. HCI studies in this area attempt to explore learning interfaces, pedagogy and learning experience design.

Few research topics concerned with HCI and Web Interfaces are-

- Parallelism in learning interfaces.

- Learner communication behaviors

- Cognitive understanding using multimedia

- Effectiveness of static and dynamic visuals

- Interfaces for collaborative learning

- Learning through direct-touch horizontal interfaces

- User interfaces for supporting innovation

- Design rules for effective learning interfaces

The effectiveness and efficiency of an website can be determined by measuring user's interaction patterns while using such a site. Measuring usability has many dimensions. A tool specifically desined for webdesign is often used to collect various performance data. This data is analysed by the tool to reveal patterns.

Generic website usability criteria

1. Accessibility:

   Making users with disabilities perceive, understand, navigate, and interact with the website. In short avoiding anything that might keep a visitor from being able to access the information on a website. Few checklist points are mentioned below …..

   - Site load-time should be reasonable (avoid flash & add-ons)

- Text-to-background contrast should be adequate for readability

- Font size/spacing should be easy to read

- Images should have appropriate ALT tags.

- Site should have a custom not-found/404 page.

2. Identity :

A website should quickly and clearly project its identity , its goals and its trustworthiness to the user. Few checklist points are mentioned below …..

- Company logo should be prominently placed

- Use of tagline is recommended to make company's purpose clear

- Use of tagline is recommended to make company's purpose clear

- User should get the company information quickly

- User should get contact information quickly

3. Navigation :

User should be able to view contents of his relevance and interest with less efforts. Information architecture and navigation guidelines plays a vital role. Few checklist points are mentioned below …..

- Main navigation items should be easily identifiable

- Labels to navigation items should be clear & concise

- Number of buttons/links should be reasonable

- Links should be consistent & easy to identify

- Support user with site search feature for easy access

4. Content :

Content is the most important part. Content needs to be consistent, organized, and easy to navigate through . Few checklist points are mentioned below …..

- Headings should be clear & descriptive

- Styles & colors need to be consistent

- Emphasis (bold, etc.) should be sparingly used

- Content should be concise , to-the-point & self-explaining

- URLs should be meaningful & user-friendly

5. Pedagogic Usability

Pedagogic Usability denotes whether the tools , content , interface and tasks of the e-learning environment support various learners to learn in various learning contexts according to selected pedagogical objectives. [1]

There are several layers of website usability in context of learning like context-specific, pedagogic, general and technical usability. This is as shown below
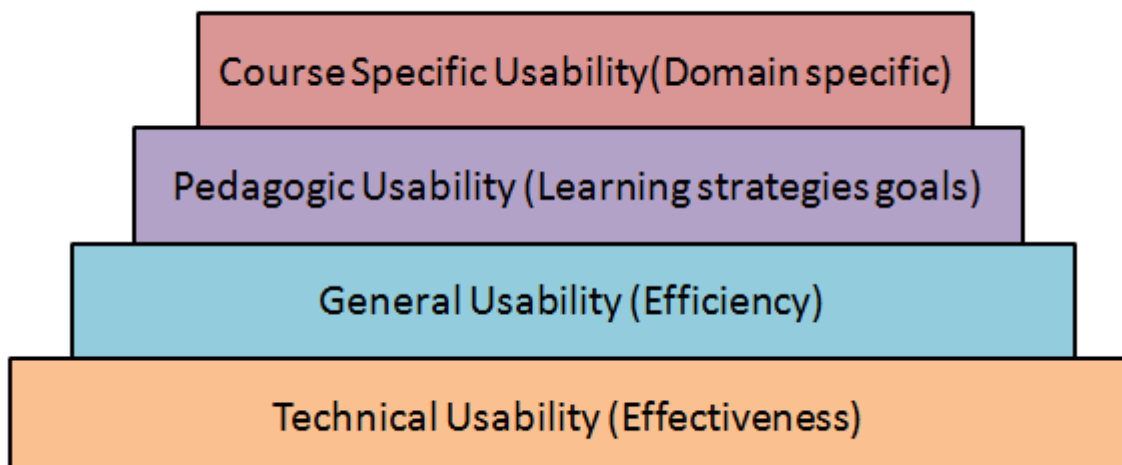
Procedure:

Design a University website using html and css

Code:

index.html

Result:

Conclusion:

Thus University website has been design keeping in view the web Interface design rules.

6. Design a personal webpage with all your details

Aim:

To design a personal webpage with all user details

Procedure:

Design a personal website using html and css

Code:

Link.html

```
1<html>
2 <body style="background-color:red;">
3 <h1>Priya's Blog</h1><br><br><br>
4 <a href="#">HOME</a></li><br><br>
5 <a href="#">FRIENDS</a></li><br><br>
6 <a href="#">FAMILY</a></li><br><br>
7 <a href="#">VIDEO</a></li><br><br>
8 <a href="#">ARTICLE</a></li><br><br>
9 <a href="#">PHOTOS</a></li><br><br><br>
10 <input type="button" value="Search Blog...">
11 </body>
12 </html>
```

Home.html

```
1<html>
2 <frameset cols="20%,80%">
3 <frame src="link.html" name="link" id="link">
4 <frameset rows="20%,80%">
5 <frame src="header.html" name="header" id="header">
6 <frame src="display.html" name="display" id="display">
7 </frameset>
8 </html>
```

Header.html

```
1<html>
2 <body style="background-color:yellow;">
3 <center><h1><b>******SMILE IS THE SECRETE FORMULAE OF
LIFE******</b></h1></center>
4 <marquee><h1>"KEEP SMILING.........!!!"</h1></marquee>
```

```
5 </body>
6 </html>
```

Display.html

```
1 <html>
2 <head>
3 <title>Smile please</title>
4 <style>
5 footer {
6 background-color: #555;
7 color: white;
8 padding: 35px;
9 box-shadow: 0 100vh 0 100vh
10 }
11 </style>
12 </head>
13 <body style="background-color:green;">
14 <h3>RECENT POSTS</h3>
15 <h1>I LOVE SMILE</h1>
16 <h6> Post by Priya, June 21, 2018.</h6>
17 <h2>Don't cry because it's over, smile because it happened. More smiling, less
worrying. More compassion, less judgment. More blessed, less stressed. More
love,
less hate.<h2>
18 <hr>
19 <h3>RECENT POSTS</h3>
20 <h1>I LIKE TO SMILE</h1>
21 <h6> Post by Priya, June 21, 2017.</h6>
22 <h2>Peace begins with a smile.. Sometimes your joy is the source of your
smile, but
sometimes your smile can be the source of your joy. If I can see pain in your eyes
then share with me your tears. If I can see joy in your eyes then share with me
your
smile." </h2>
23 <hr>
24 <h3>Leave a Comment</h3>
```

```
25 <form>
26 <textarea name="message" rows="5" cols="200"></textarea>
27 <br>
28 <input type="submit"><br>
29 <hr>
30 <b>2 Comments:</b>
31 <form>
32 <p><b>Jayasri</b>  June 21, 2017, 9:12 PM</p>
33 <h5>It is super.</h5>
34 <input type="submit" value="Like">    
35 <input type="submit" value="Reply">
36 <p><b>Siva</b>  June 21, 2017, 9:12 PM</p>
37 <h5>I try to smile atleast once an hour.</h5>
38 <input type="submit" value="Like">    
39 <input type="submit" value="Reply"><br><br>
40 <footer>
41 <center>@Copyright All rights reserved.</p>
42 </footer>
43 </body>
44 </html>
```

Result:

Conclusion:

Thus personal webpage has been design keeping in view the web Interface design rules.