Advanced Visualizations and Accessability
Part of a GEM – Workshop

Tampereen yliopisto
Tampere University

Advanced Data Visualization & Accessibility

Information Analytics and Visualisation (HTI.550) 2024

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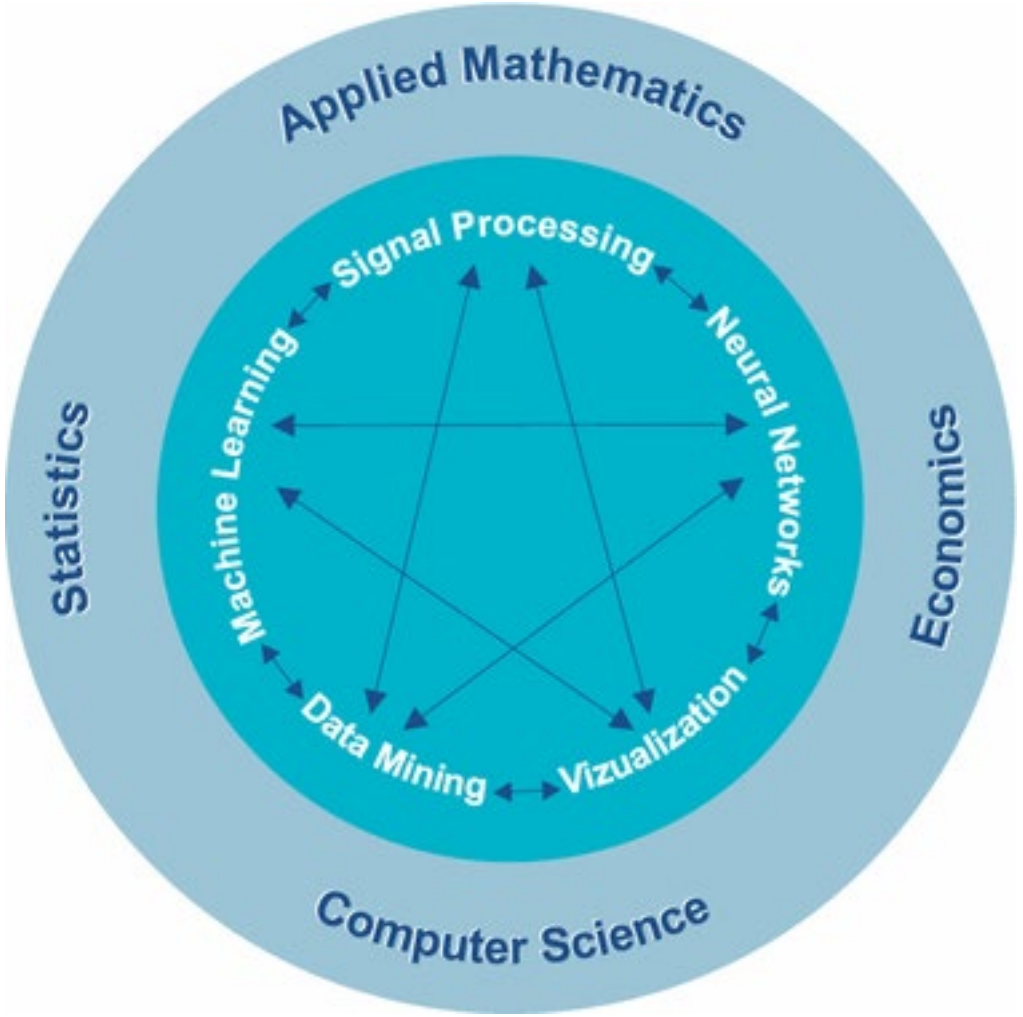
Advanced Data Visualization

Definition

- Integration with Extended Reality;
- Requires synergy of Data Mining , Neural Networks, Machine Learning, Signal Processing, Visual Analytics.
- Real-Time Interaction;
- New tools and equipment for multimodal interaction



Trends 1/3. *Application Development Integration*

New Interactive Systems necessitate support of:

- scaling and navigating in visualized 3D space;
- selecting sub-spaces, objects, groups of visual elements (flow/path elements) and views;
- manipulating and placing;
- planning routes of view;
- generating, extracting and collecting data (based on the reviewed visualized data);
- multimodal control to make it more intuitive.

Trends 2/3. *Equipment and virtual interface*

Optical and video see-through head-mounted displays (HMD);

Appropriate haptic feedback in an XR requires a framework that would allow an interaction with intuitive gestures;

Glove-based systems and hand-tracking;

Dash

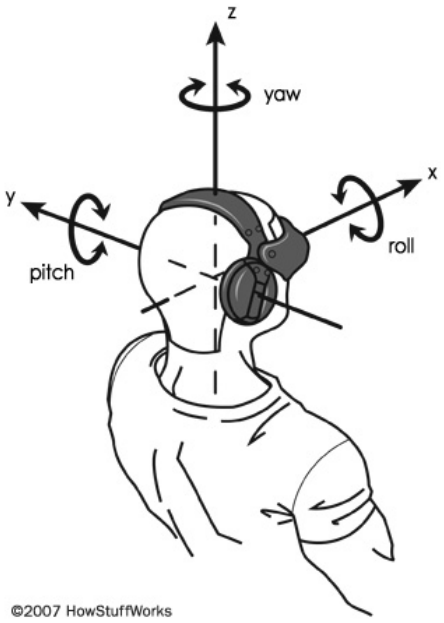
Shift

Hands

Trends 3/3. *Tracking and recognition system*

To avoid mismatch of the physical, augmented and virtual realities:

- Track dynamic position and orientation values of virtual items;
- Head, gesture, motion, gaze tracking;



Challenges

- Spatial Input
- Lack of constraints
- Lack of standards
- Lack of tools
- Lack of precision
- Layout is more complex
- Fatigue

Vision

- Natural interface
- Gesture, speech
- Wide field of view
- Full body input

Reality

- Limited input
- Wireless, limited range tracking
- Reduced field of view
- 2D GUI

Decision-Making

Definition

Includes the acquisition of related information, the construction of a mental representation of the problem and solutions, and the identification of an optimal solution

Visual representation of information may enhance a decision maker's capability of processing information due to extending the working memory and cognition

Collaborative Visualization

Goal: an increased understanding or insight into a dataset, a consensus, or the ability to make informed decisions

Involves unique cognitive activities, such as information foraging and sensemaking

Application scenarios for decision support:

Scientific Research; Environmental Planning; Mission Planning; Business and Financial Domains; Criminal Analysis;

Requires: multiple inputs and outputs; support for social interactions

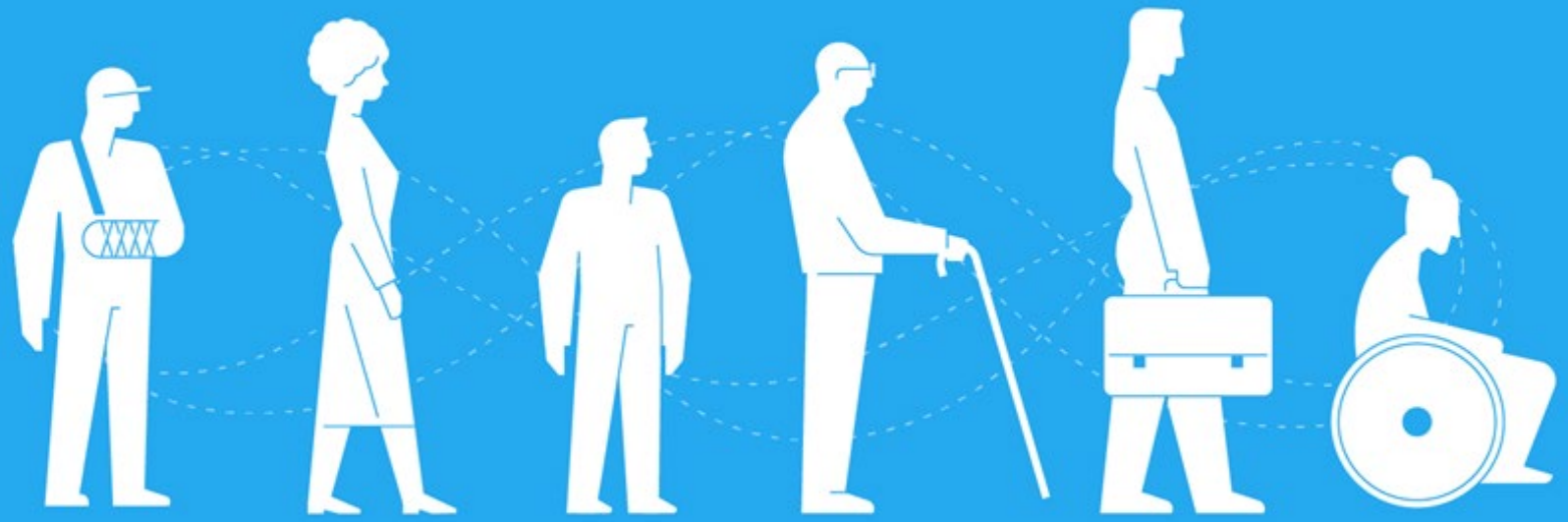
Accessibility

What is Accessibility?

Many terms, but goals, approaches, and guidelines overlap significantly...

- Barrier Free Design
- Universal Usability
- Universal Design
- Universal Access
- Design for All
- Accessibility
- Accessible Design
- Inclusive Design

What is Accessibility?



Equal access and equal opportunity for the people with disabilities

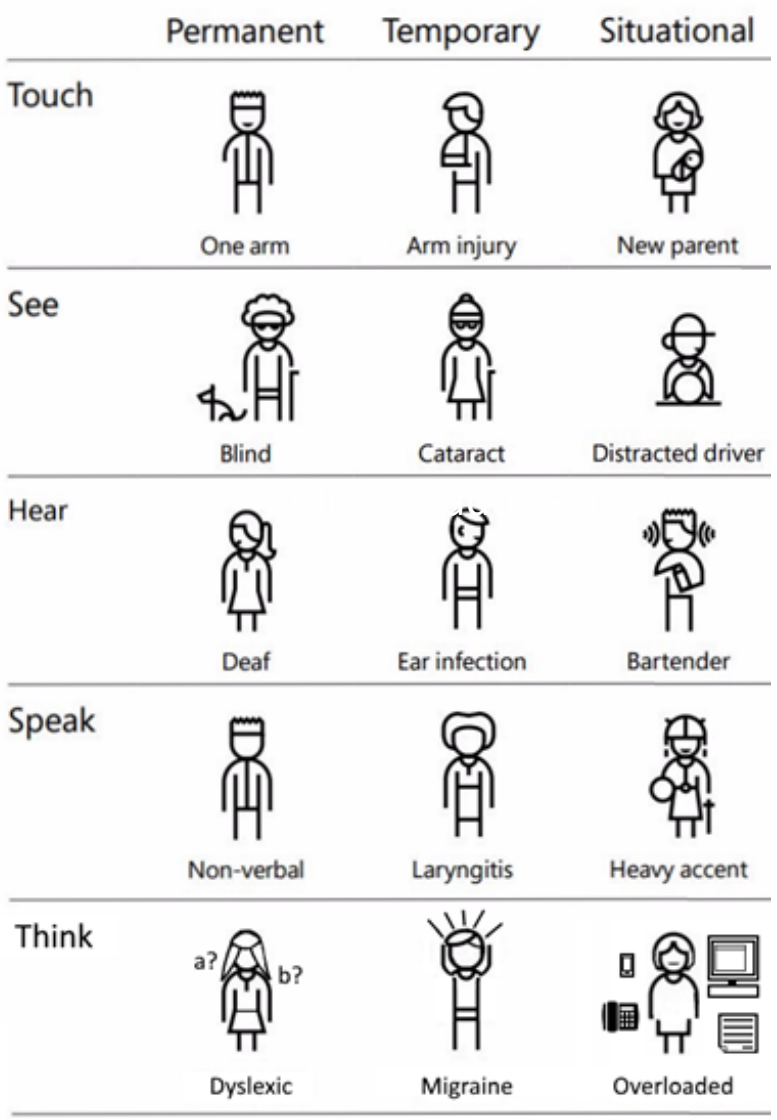
Disabilities

Physical

Sensory

Linguistic

Cognitive

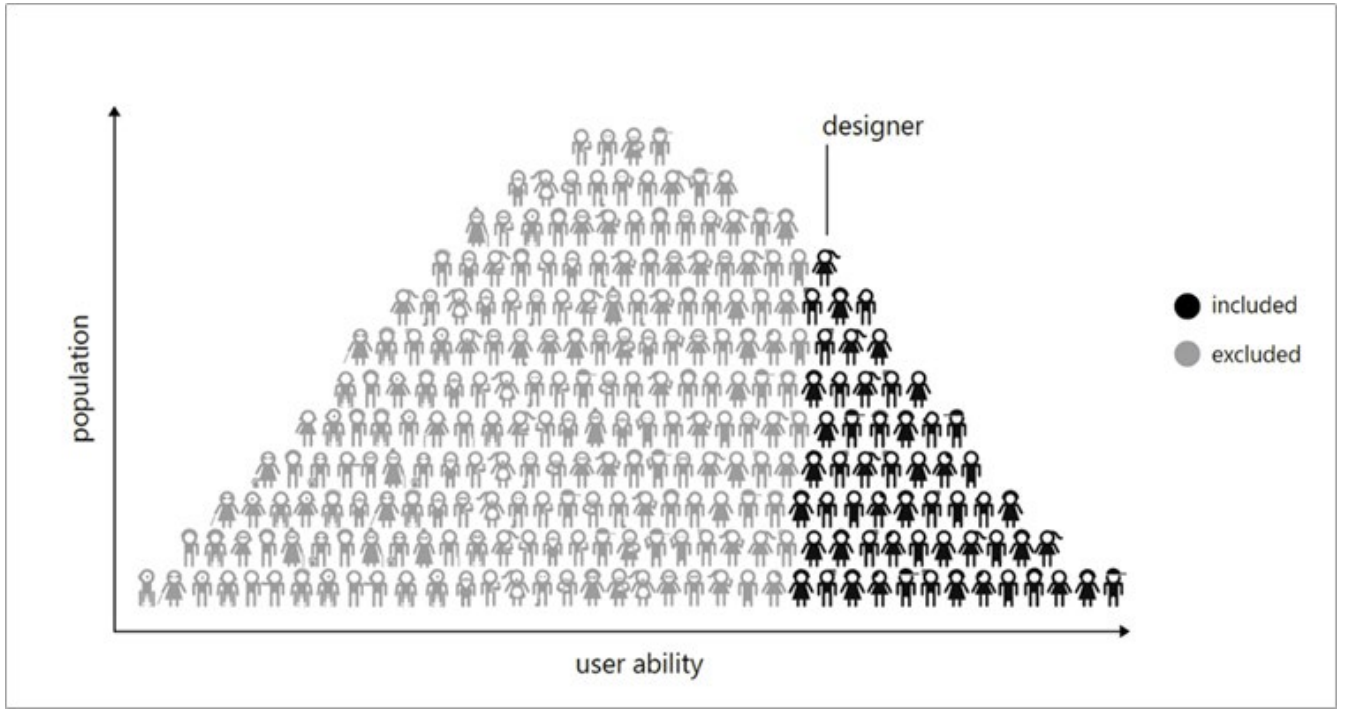


Conditions and Social exclusion

- Old people
- People in rural areas
- People in developing countries
- Illiteracy or low-literacy
- Language barriers

Inclusive Design by Microsoft

So - What is Accessibility?



Inclusive Design by Microsoft

- Accessibility is not Usability
- Accessibility easily becomes a feature of the physical environment, but today it is also a feature of digital content
- Usability is essential to making technology to work for everyone, while **accessibility addresses aspects that concern discrimination and inequality** supporting social inclusion.

Assistive Technologies

Technologies that assist in improving quality of life are classified as assistive technologies.

Very strict and practical point of view: Assistive technology takes the functional needs of people with disabilities as starting point for specific design.

General point of view: Assistive technology includes both devices and services (a service that support assistive technology adoption, meaning assessment, acquisition and device use).

The World Health Organization (WHO)[1] defines assistive technology as any device or system that enables a person to perform a task that would otherwise be too difficult to execute, and which facilitates a task being performed.

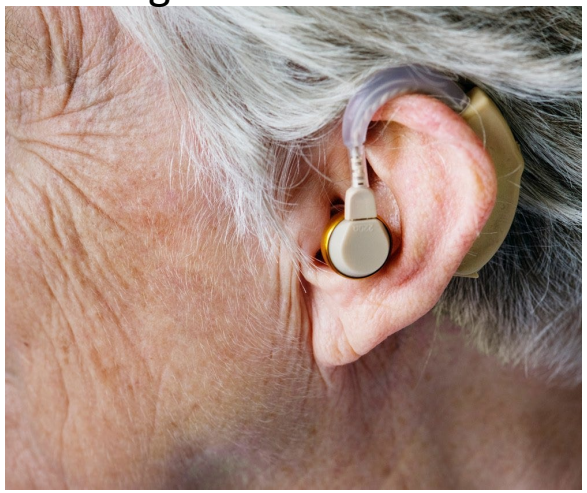
1. https://www.who.int/news-room/fact-sheets/detail/assistive-technology

Assistive Technologies

Screen Readers

https://itaccessibility.uiowa.edu/about

Hearing aids



Hearing aids

Prosthesis

Hand prosthesis

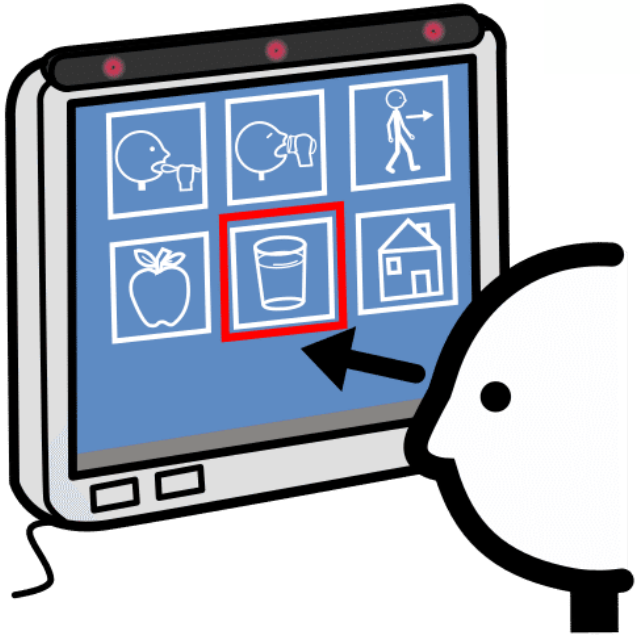
Screen readers in Braille

Speech to text

Stephan Hawkings- brand ambassador of assistive technologies

Adaptive Strategies

- Adaptive strategies are techniques that people with disabilities use to interact with the digital environment.
  - Adjusting browser settings, resizing windows
- **Every person has thier own strategies.**
- Some people may use specialized software and hardware to interact (assistive technology), others may just adjust platform and settings to accommodate their needs.
- **Usability through adaptability and personalization.**



Who benefits accessibility?

- Many assistive technologies originating as a tool for people with disabilities have become mainstream and a part of our daily lives.
  - Keyboard (typewriter)
  - Voice recognition (in mobile devices, cars and home devices)
  - Pinch zoom
- By removing barriers to access, whether physical or digital, **everyone benefits** from accessibility.
- Accessibility also **supports social inclusion** for people with disabilities as well as others.
- Accessibility is also **good for business**:
  - *innovation* (accessibility features solve problems)
  - *enhance brand* (corporate responsibility)
  - *extend markets* (to different user groups)
  - *minimize legal risk*

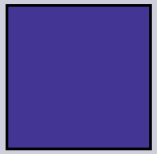
  (by following principles, standards and checklists)

Accessibility- benefits for all

Accessibility and Visualization

We live in visual world! Most of all information is visually perceived.

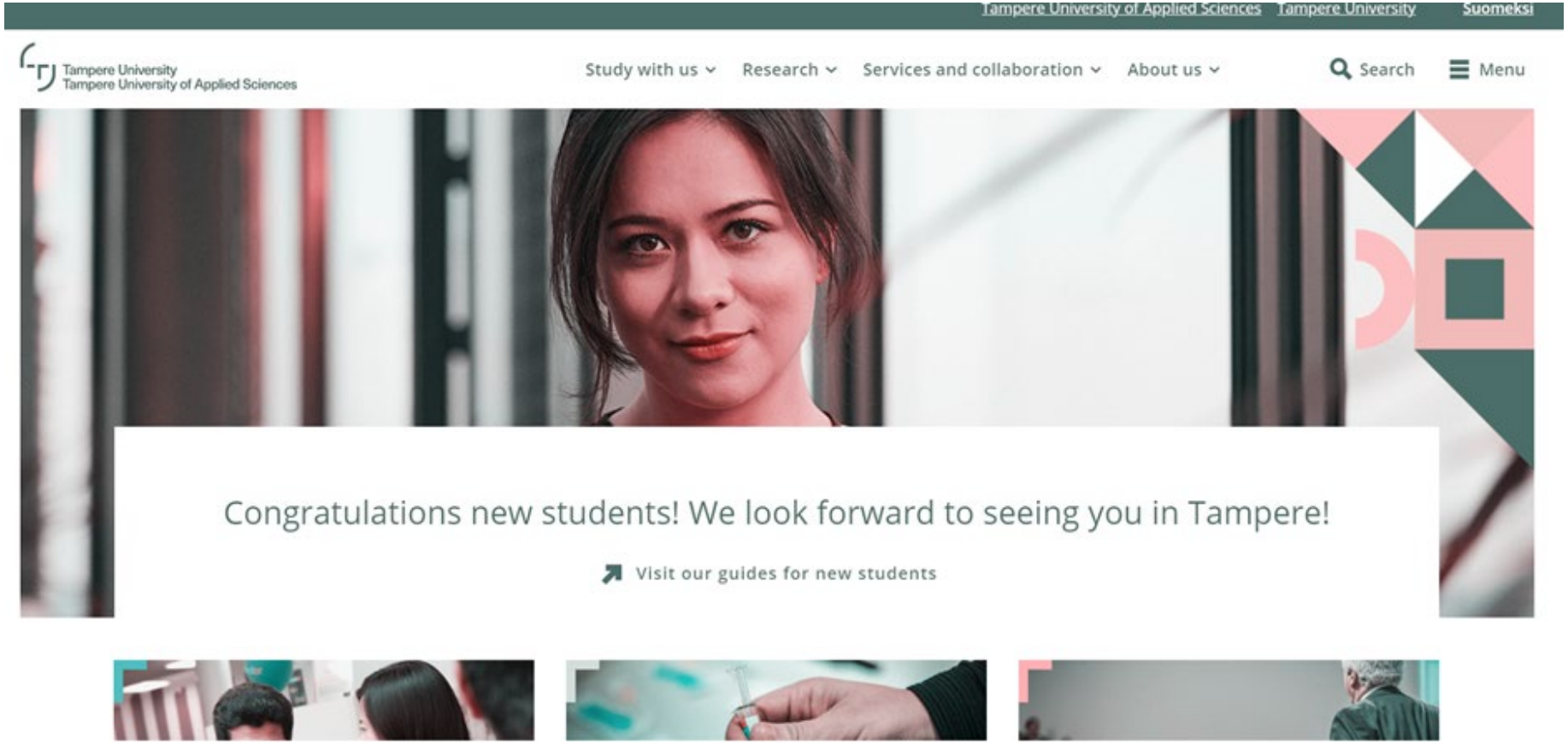
Perception is processing of human sensory information with cognition (awareness, reasoning, learning).



Visualization is the process of transforming information into a visual form, enabling users to observe and use the information.

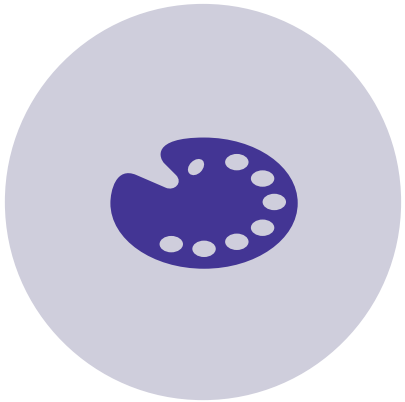
Accessibility tools

- https://chrome.google.com/webstore/detail/nocoffee/jjeeggmbnhckmgdhmgdckeigabjfbddl
- https://wave.webaim.org/extension/



Making Information Visualization Accessible

COLORS

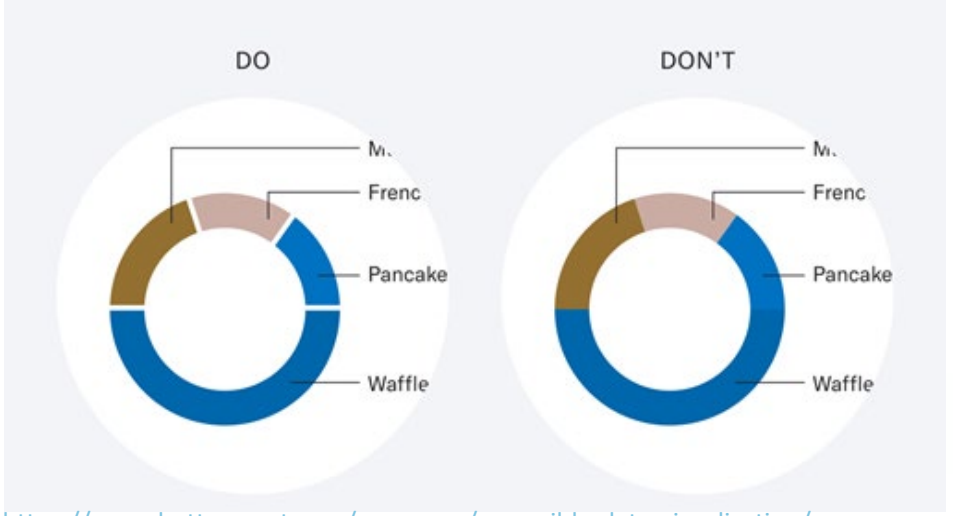


CONTRASTS

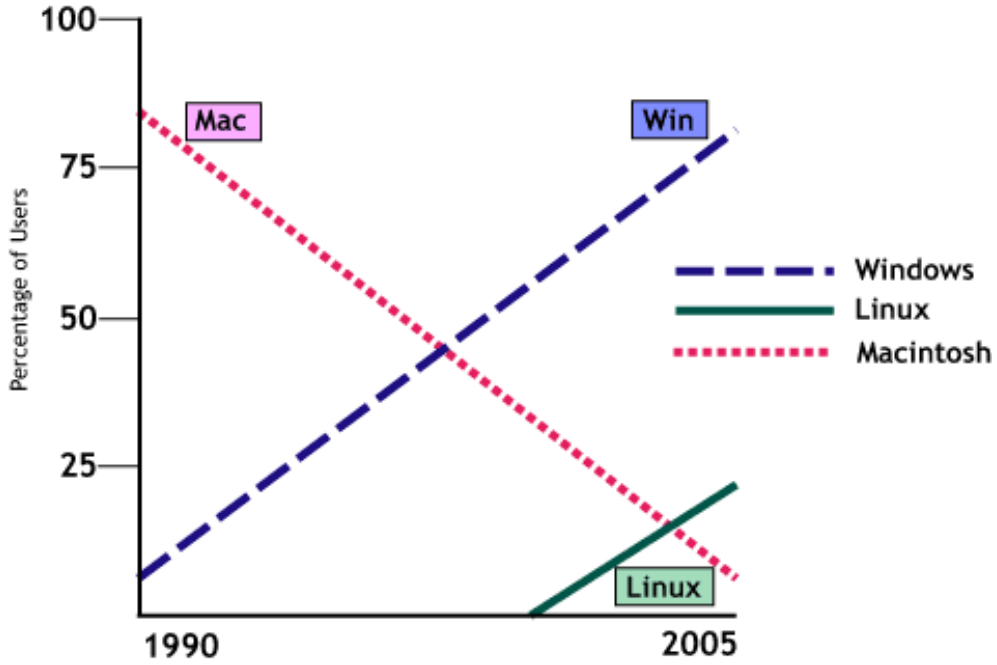
ALTERNATIVE TEXTS

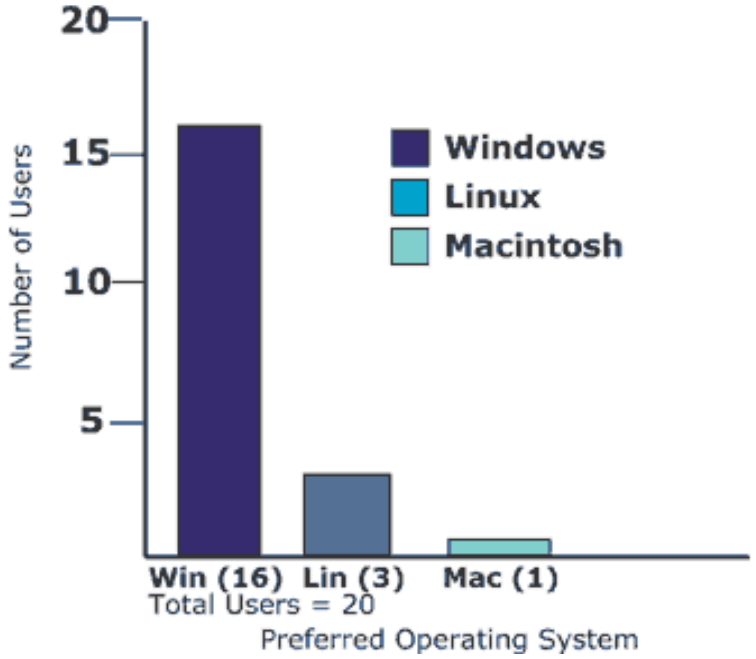
Colors

- Worldwide, there are approximately 300 million people with color blindness
- Don't use only colors to deliver information



https://www.betterment.com/resources/accessible-data-visualization/

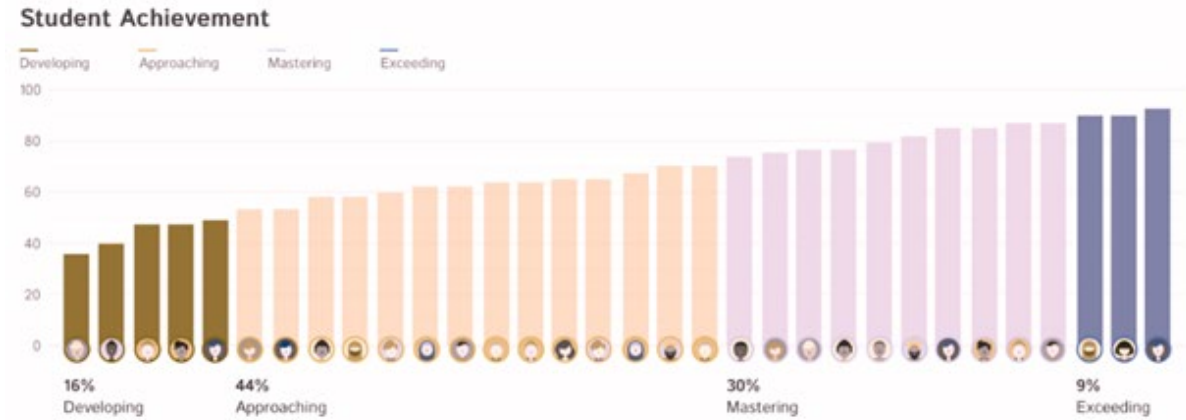




Contrasts

With right contrasts levels users can perceive the contents better

https://webaim.org/articles/contrast/



https://uxdesign.cc/data-visualization-for-color-accessibility-8a30ce25d90b

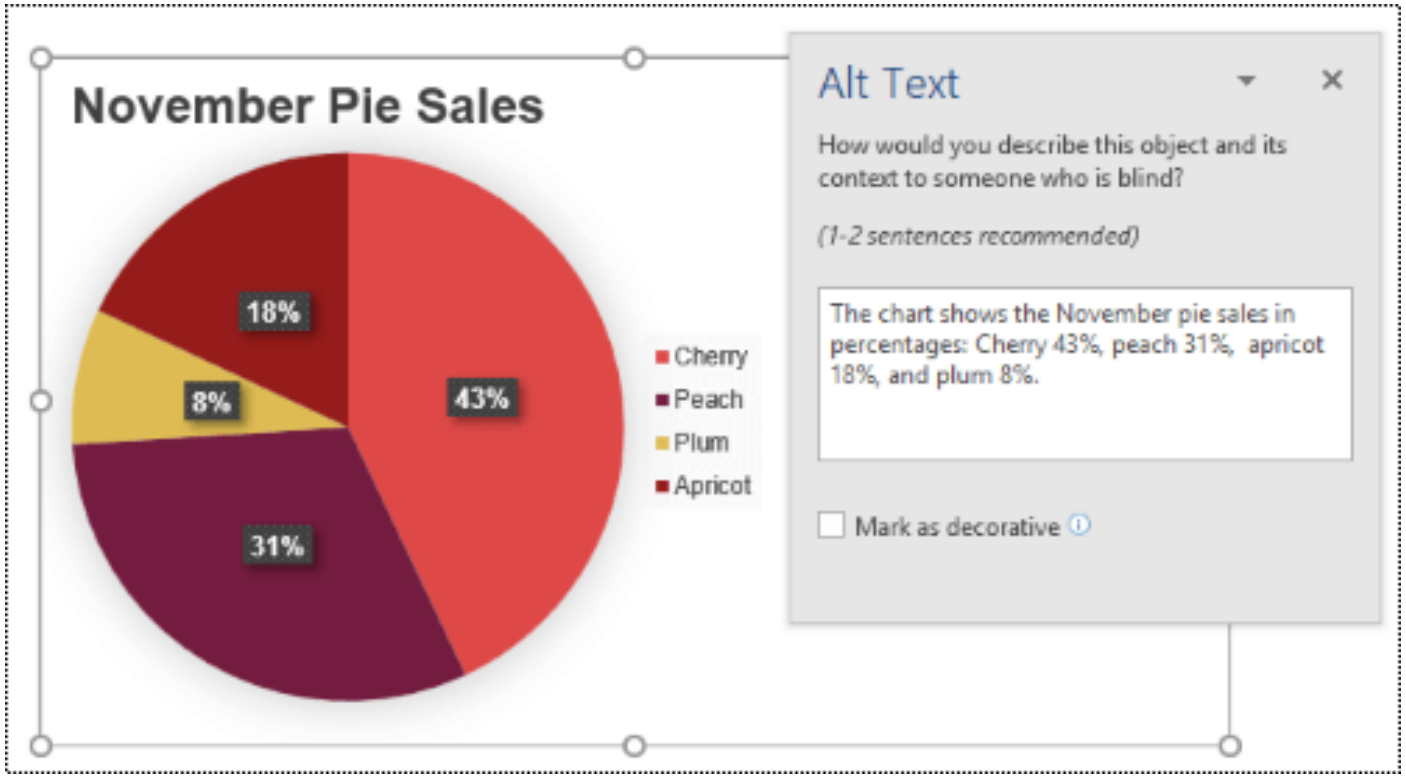
Alternative texts

"Alt-texts"

Alternative text describes the content of the non-text content

Used mainly by screen readers

Every image, table, infographic and visualization should have an alternative text



support.microsoft.com

https://webaim.org/techniques/alttext/

Further Guidelines

Avoid complex tooling

Label data points directly

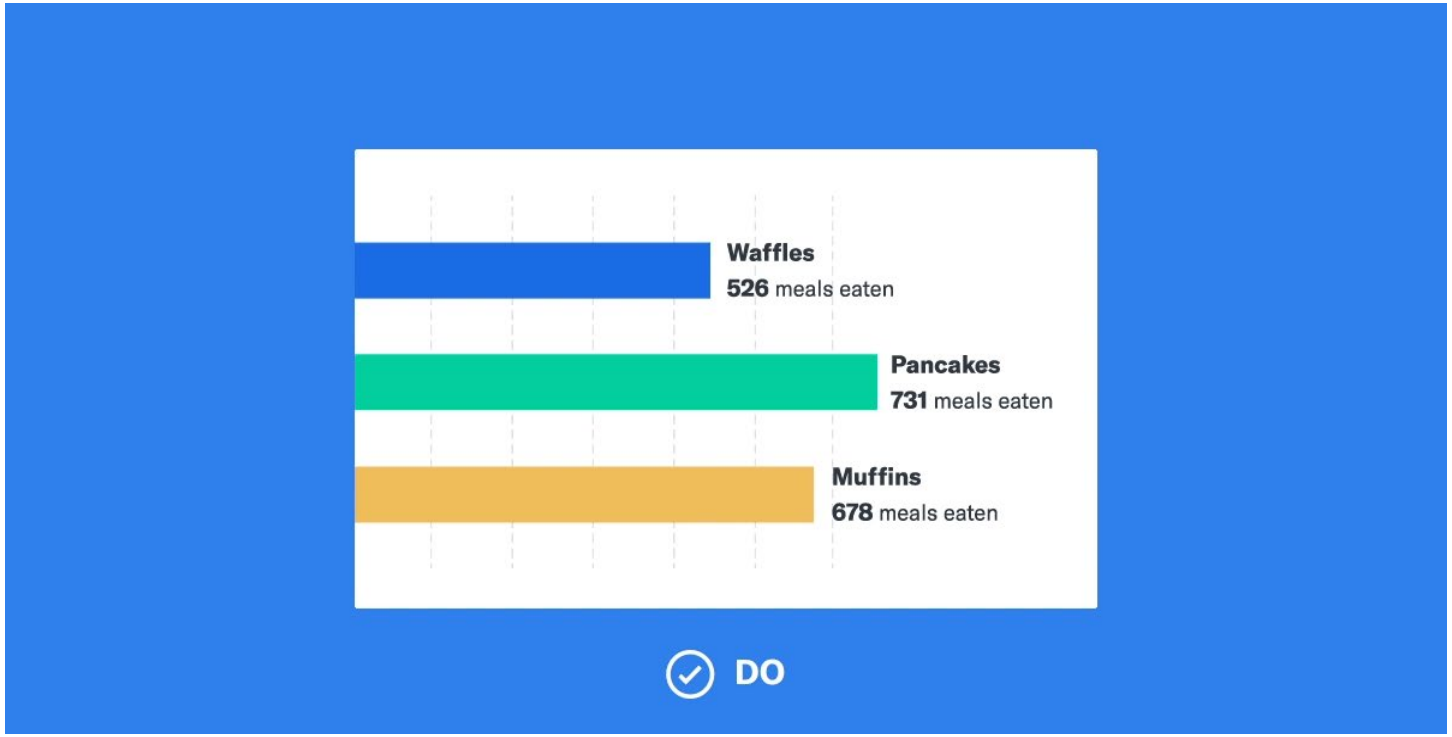
Avoid hover overlays

Support charts with tables

Language selection

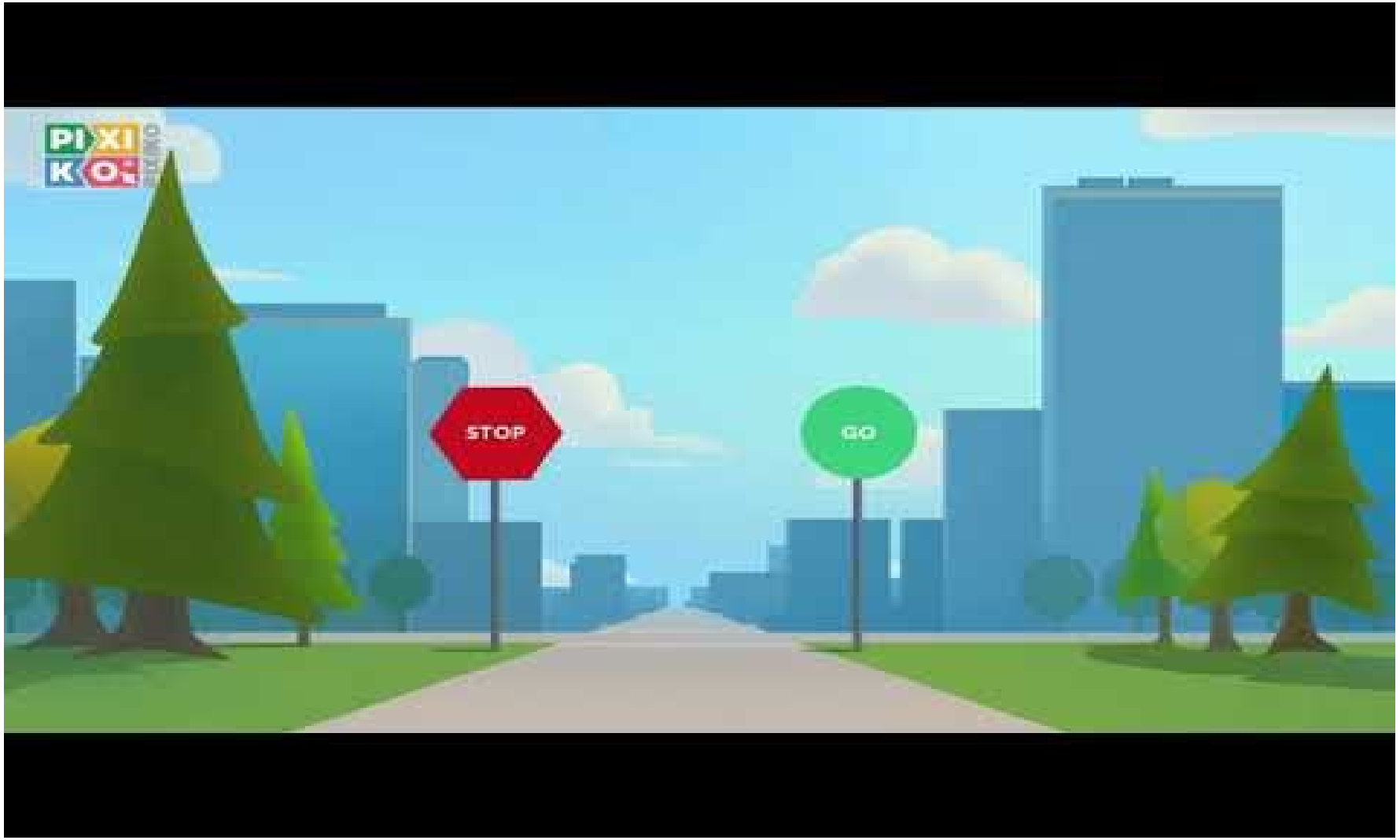
Mobile & Tablet iOS Version Market Share Worldwide	
Category	Share
iOS 11.4	7.32
iOS 11.2	2.35
iOS 12.1	71.48
iOS 11.3	1.95
iOS 12.0	4.54
iOS 10.3	3.86
iOS 9.3	2.8
iOS 11.1	0.72
iOS 11.0	1.33

High charts

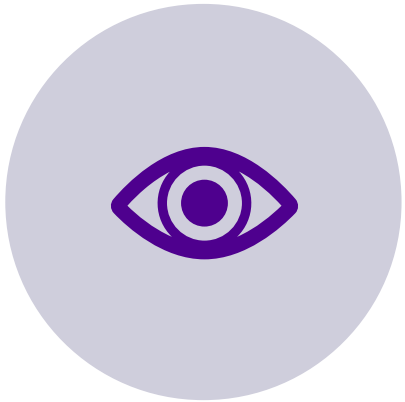


Betterment.com

Accessibility and Advanced Visualization

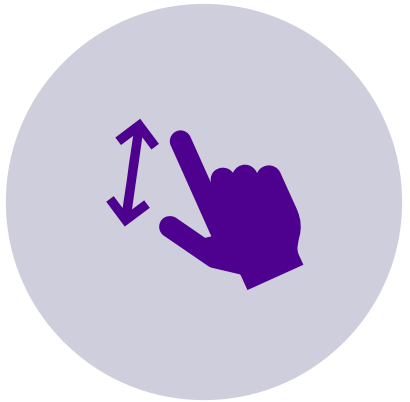


Accessibility and Advanced Visualization



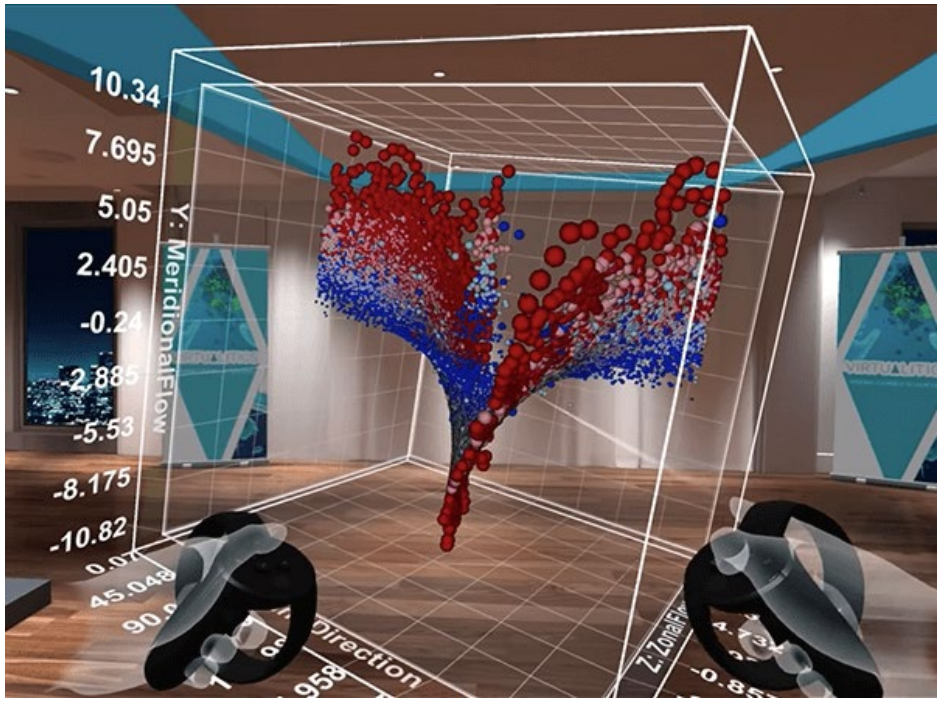
VISUAL INDICATORS

SPATIALIZED AUDIO

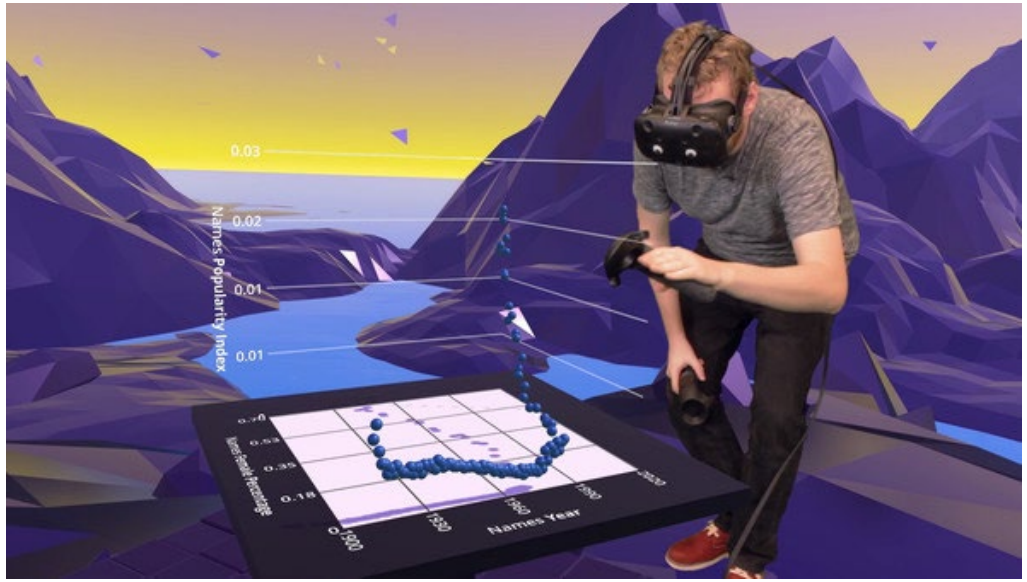


MOTION ALTERNATIVES

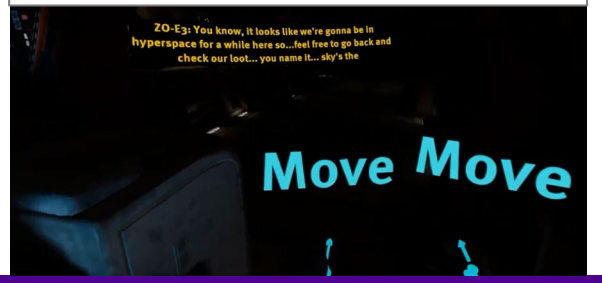
Visual Indicators



http://datavizcatalogue.com/blog/whos-offering-data-visualization-vr/



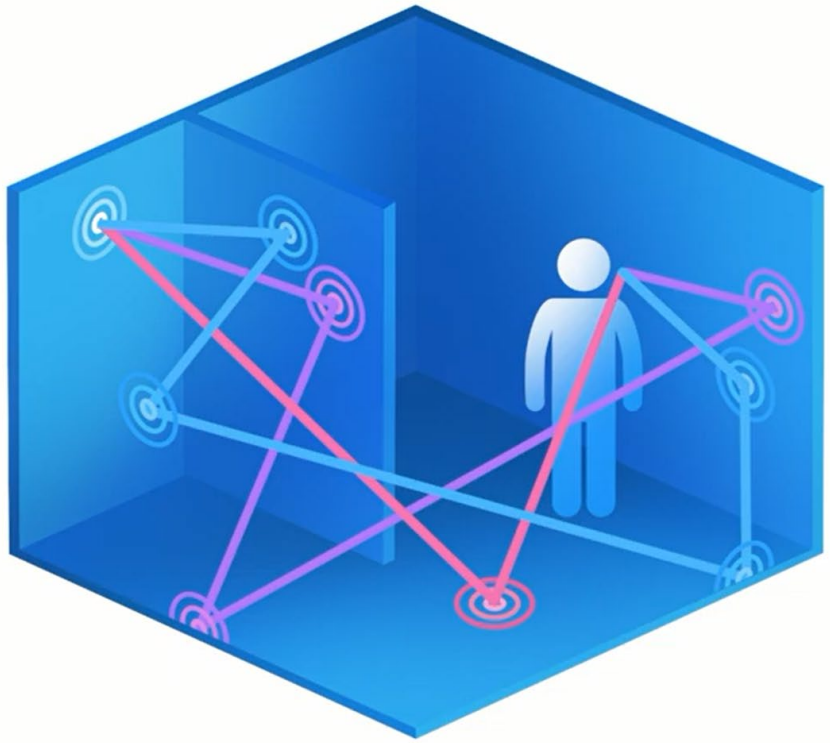
LookVR



Oculus accessibility guidelines

- Subtitles and textual indicators
- Labeling datapoints

Spatialized Audio



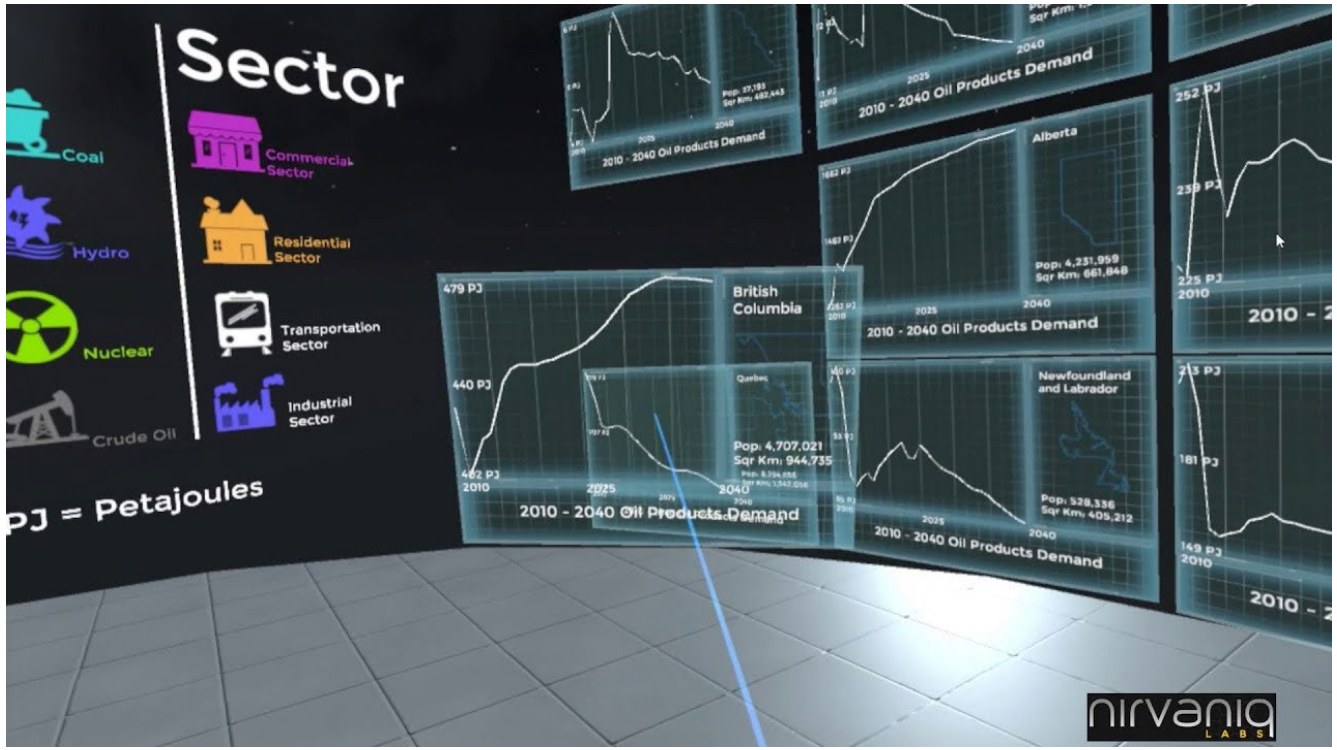
Oculus accessibility guidelines

- Audio for UI interactions
- Association of subtitles and audio

Motion Alternatives

With customization

https://www.futurevisualizations.com/2019/04/17/nirvaniqs-displaying-data-in-vr/



Oculus accessibility guidelines

- Teleportation
- Speed or slow move
- Point and move

Projects

Seeing VR:

https://www.microsoft.com/en-us/research/video/seeingvr-a-set-of-tools-to-make-virtual-reality-more-accessible-to-people-with-low-vision/

WalkinVR:

https://www.youtube.com/watch?v=i3bV6YBILZ8&t=5s

More information

Tampere University accessibility courses:

Accessibility in a Digital Society study module (30 ECTS): https://research.tuni.fi/taccu/accessibility-in-a-digital-society-study-module/

Tampere Summer School: Fundamentals of Accessibility (5 ECTS): https://www.tuni.fi/en/study-with-us/summer-school

TACCU - Tampere Accessibility Unit:

https://research.tuni.fi/taccu/

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- https://electronics.howstuffworks.com/gadgets/other-gadgets/VR-gear6.htm
- https://www.microsoft.com/design/inclusive/
- https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness/types-color-blindness
- https://www.w3.org/WAI/fundamentals/accessibility-intro/
- https://www.highcharts.com/blog/tutorials/best-chart-accessibility-practices/
- https://developer.oculus.com/blog/introducing-the-accessibility-vrcs/
- http://graphics.wsj.com/3d-nasdaq/

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