

Using extended reality technologies in distributed computer systems

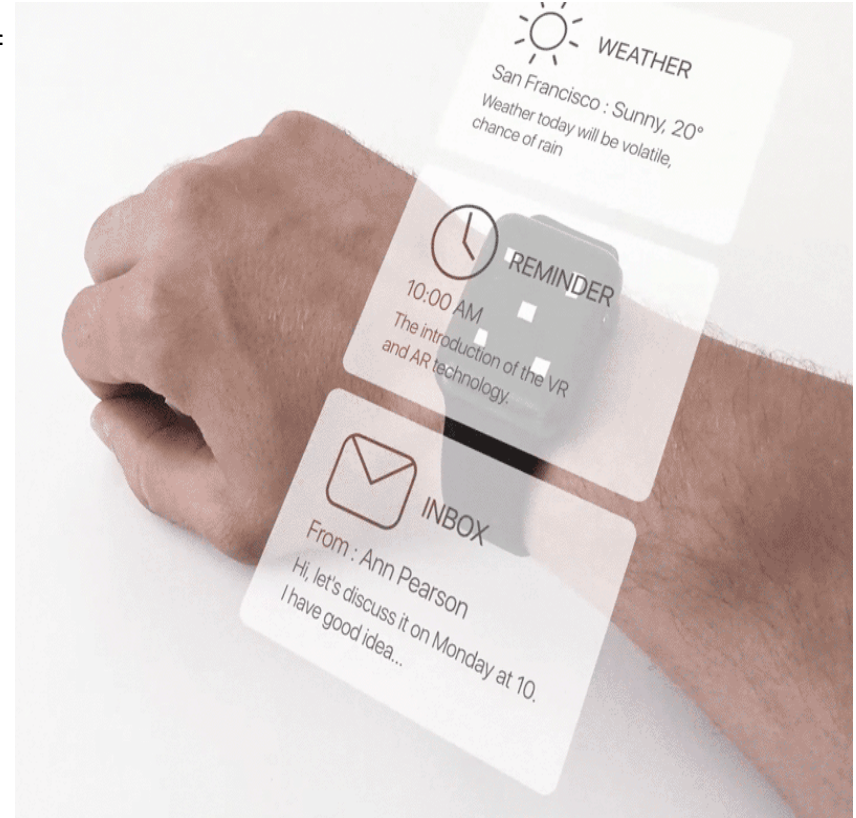


Nadezhda Vozdvizhenskaya
Dubna State University

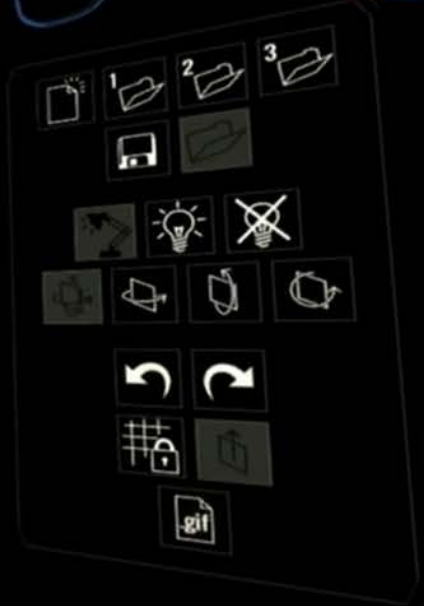
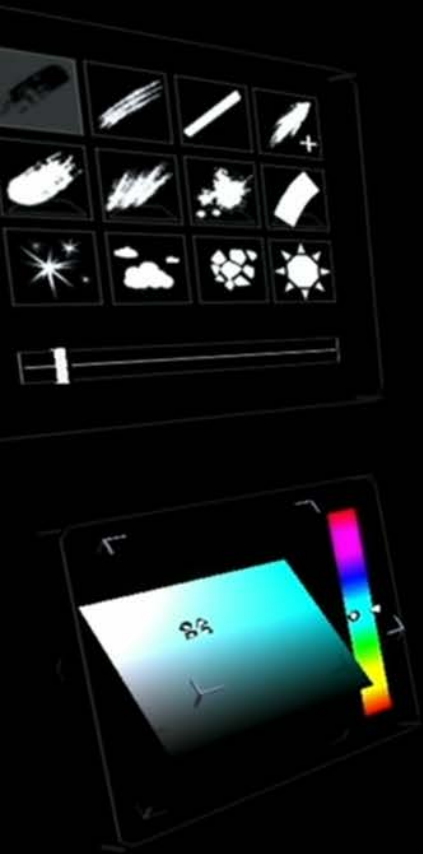
Today there is a set of technologies for expansion of the real world by virtual objects or its full replacement.

Reality can be expanded as two-dimensional and three-dimensional virtual objects, have their own user interfaces.

Virtual objects can be associated with real-world objects or can be linked to a specific location.



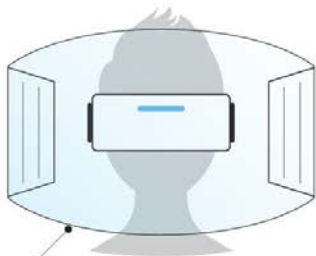
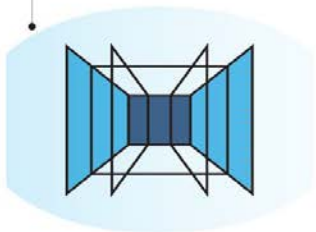
Object + Interface



The technology of augmented reality

VIRTUAL REALITY (VR)

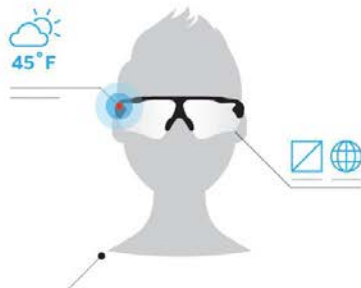
Completely digital environment



Fully enclosed, synthetic experience with no sense of the real world.

AUGMENTED REALITY (AR)

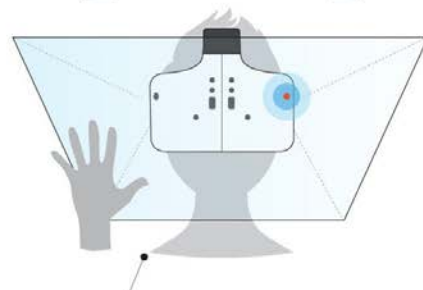
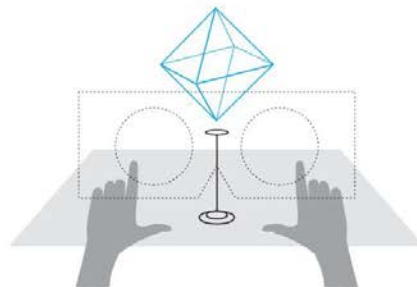
Real world with digital information overlay



Real world remains central to the experience, enhanced by virtual details.

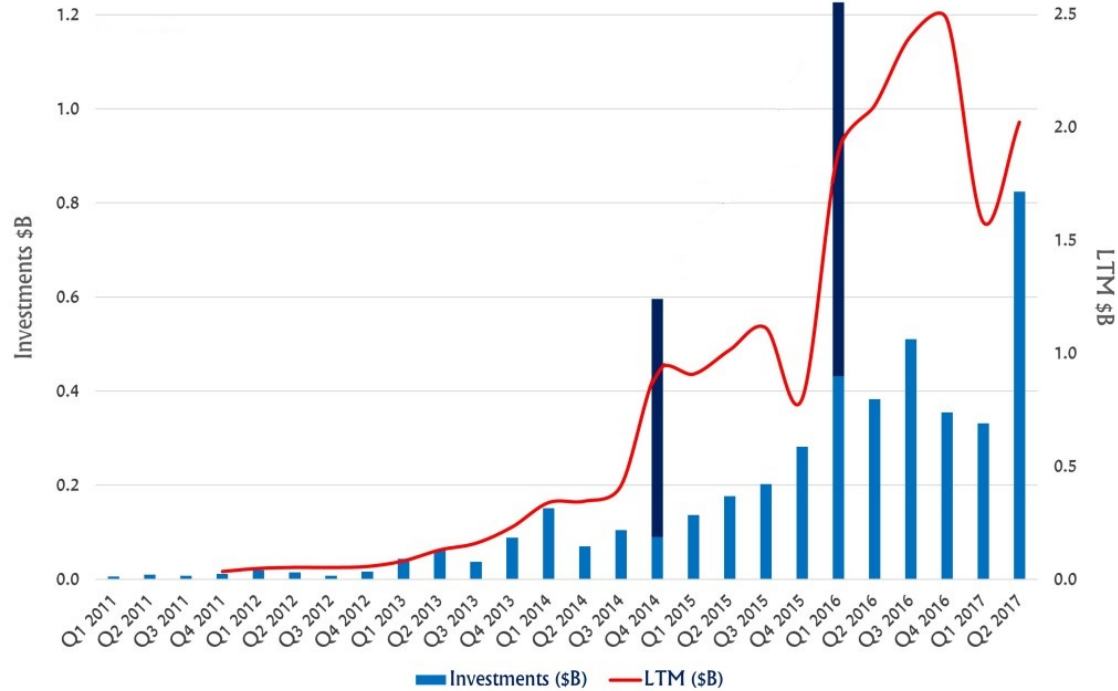
MERGED REALITY (MR)

Real and the virtual are intertwined



Interaction with and manipulation of both the physical and virtual environment.

Digi-Capital™ VR/AR investments (\$B)



Problem

The development of this technology can not make a qualitative leap, due to the lack of communication between developers and common tools and approaches.

Objective

To develop a standardized system for creating universal user interfaces in various augmented reality systems based on created markup language.

The relevance of the work

The relevance of this work is that with the help of the developed system it will be possible to unite the formed community of web developers and promising technology on the basis of a standardized set of tools.

This will have a positive impact on both the convenience of developers and the pace of technology development. Every year the technology of augmented reality penetrate into new areas of our lives and there is a problem of standardization of developed solutions.

The system requirements

- The versatility of the developed markup
- Ability to work independently of platform and display device
- Identical behavior and display of the interface
- Ability to create your own interface elements
- Possibility to use three-dimensional objects
- The use of the unified structure of components and grid
- Ease of entry for new developers
- Ability to work with the system without having the skills to develop three-dimensional applications
- The ability to associate interface elements with real-world objects
- Using two-dimensional interface elements

Stages development of the system

- 1 Development of the positioning system, data structure for 3-dimensional interface
- 2 To develop a markup language for creating three-dimensional interfaces.
- 3 To describe the resulting language and develop a demonstration interpreter of the language
- 4 To develop a set of standard user interface components with the ability to inherit from them
- 5 To develop a unified user interface with components and component groups.

Current state of works

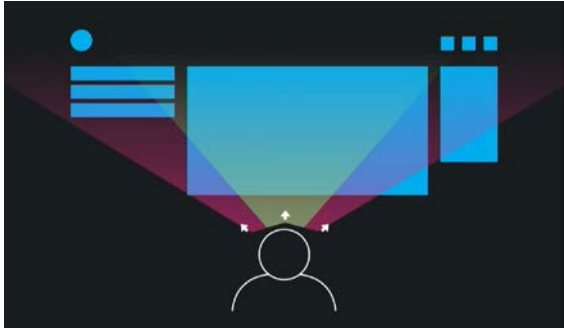
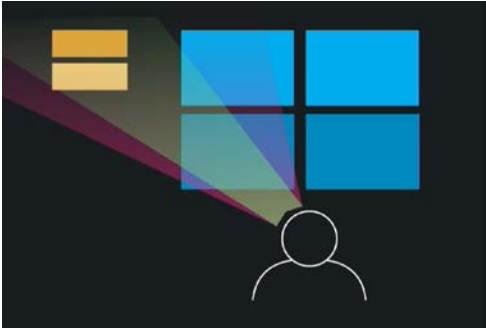
-
- The primary analysis of existing solutions is carried out
 - The main functional requirements to the system are formed
 - At the moment there is a system design, the choice of standards and technologies
 - Had been examined solutions in the field of creating user interfaces for augmented reality are studied
 - A suitable coordinate system was chosen
 - Was created an internal system for positioning objects and interface elements
 - Is being developed markup language and a core set of components of the user interface

Unified system of positioning

Unified system of objects location will allow the interface elements to be displayed identically regardless of used hardware, development platform and screen resolution of the device.

System parameters will be transmitted directly from the markup

Types of interfaces



Static interface

Tied to the real world object



1. FLAT



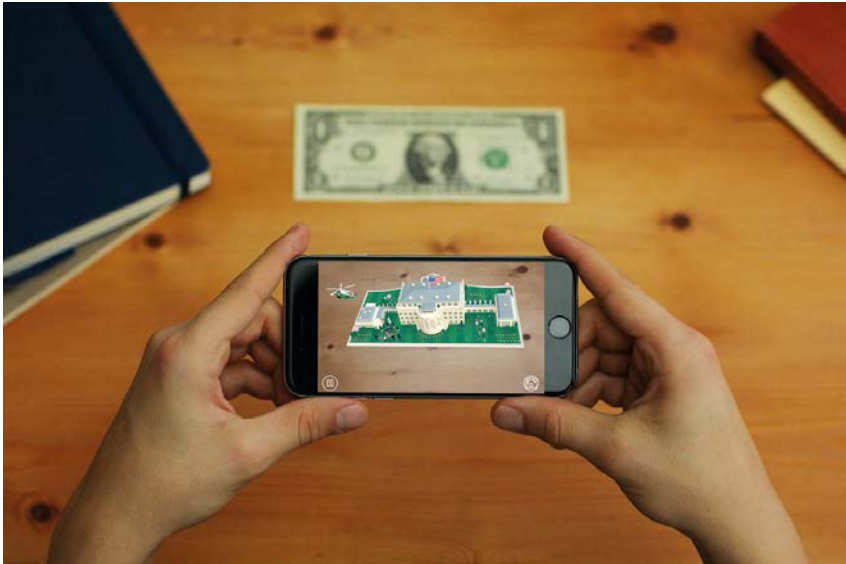
2. CURVED



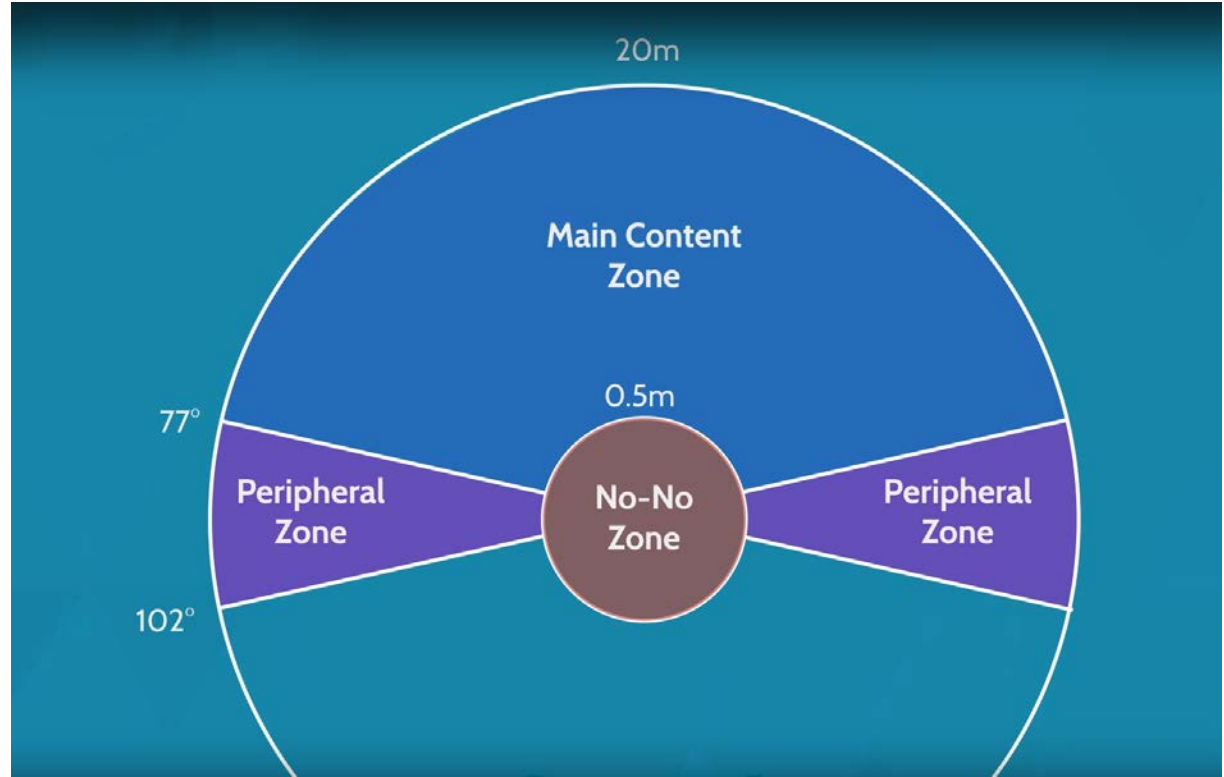
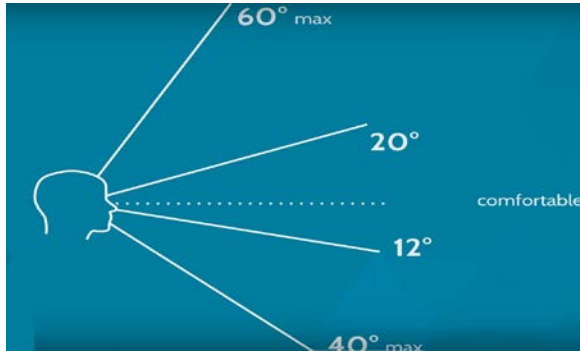
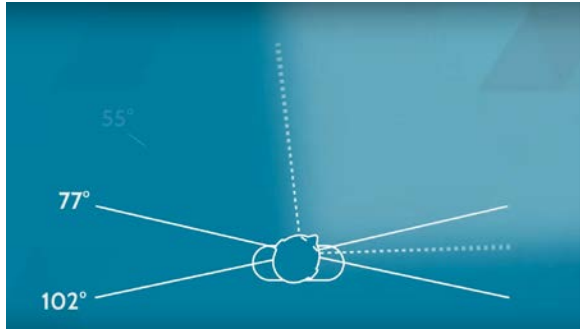
3. LESS CONTENT



4. SURROUNDED



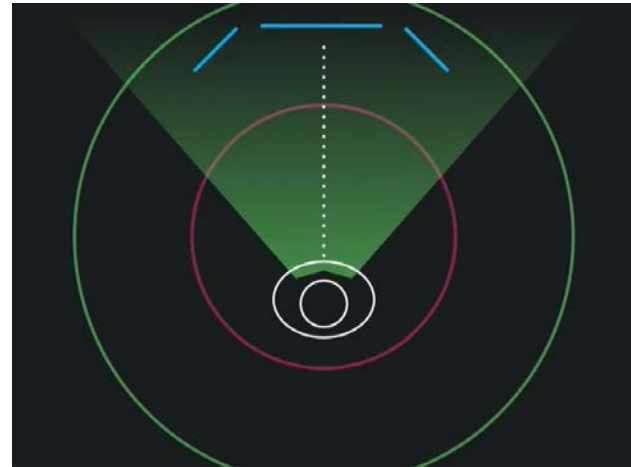
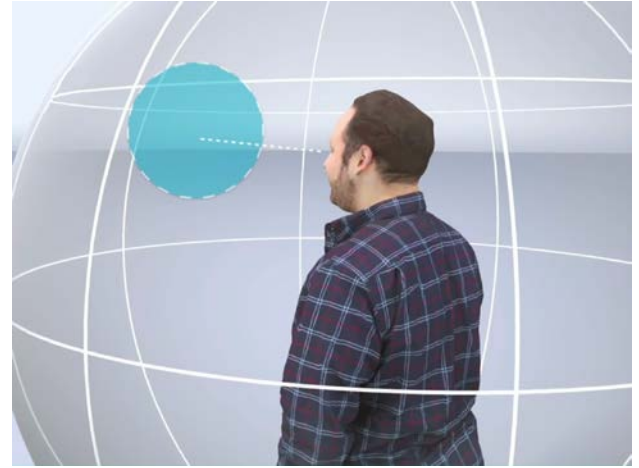
Search for the optimal coordinate system



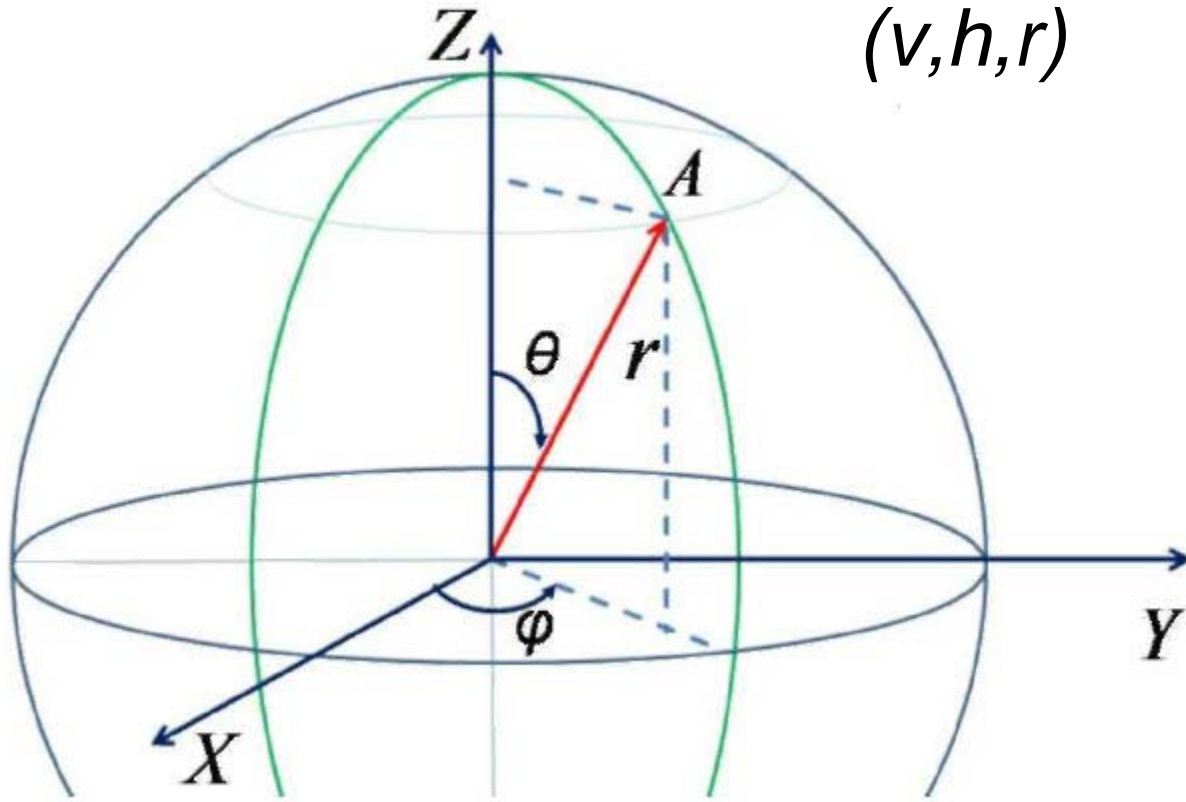
Development of positioning system

For general management interface has been
selected spherical coordinate system

Interfaces linked to a specific object will use the
Cartesian coordinates



Coordinate transformations



$$\begin{cases} x = r \sin \theta \cos \varphi, \\ y = r \sin \theta \sin \varphi, \\ z = r \cos \theta. \end{cases}$$

$$\theta = 180/100 * v$$

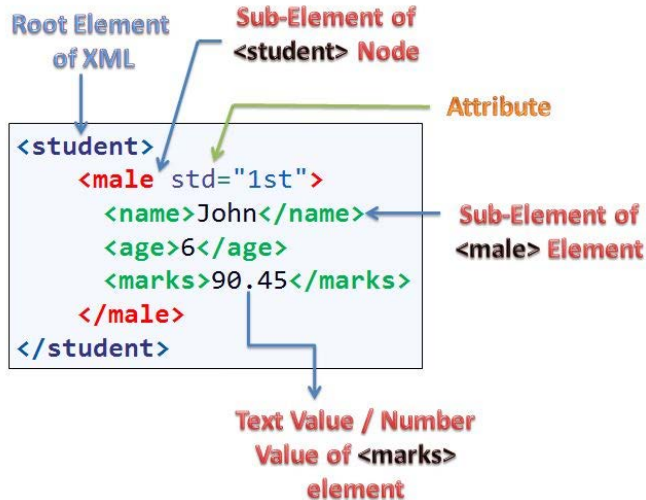
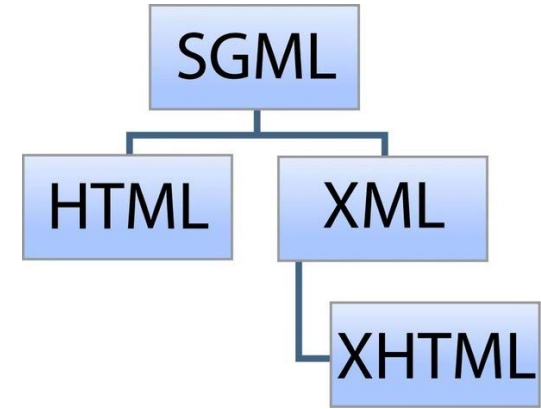
$$\varphi = 180/100 * h$$

The possible choices are

- Perpendicular at left
- Under maximum viewing angle
- In the center of initial position

Markup language

SGML (Standard Generalized Markup Language) is a standard for how to specify a document markup language or tag set.



The SGML standard was chosen for the future markup language. This choice is based on the fact that

- It provides a clear structure and provides an unlimited number attributes on objects
- It is the basis of the HTML language. This will allow to decrease an entry barrier of developed markup language.

ERML

ERML (*Extended Reality Markup Language*) – Markup language to create interfaces in augmented, mixed and virtual reality applications.

```
<erml>
  <interface type="sphere" target="mainCamera">
    <panel width="20" height="50" b-color="#136fd8" b-tranparency="20">
      <text type="header" size="2" font="Arial">
        Hello World!
      </text>
    </panel>
  </interface>

  <interface type="plain" target="point" offsetY="10" width="4" height="2">
    <panel width="100" height="100" b-color="#5g7a2d" border-color="black"
      border-size="2" border-type="solid">
      <text type="smallText" size="1">Targeted interface</text>
      <button y="50" x="30" width="40" height="50" id="button1">
        Click Me!
      </button>
    </panel>
  </interface>
</erml>
```

Markup is based on HTML and SGML. It makes it easy to start development for other developers

Now, specification for different UI elements is developed

Specification is layered and gives an ability to make different interface types.

The Future of Augmented Reality



Thank you for your attention !