



"CDICAE - Collaboration to Design an Innovative Curriculum for Animation Education - 2017-1-TR01-KA203-046117 " project carried out by Republic of Turkey Ministry of EU Affairs, Education and Youth Programs Center Presidency and Erciyes University Faculty of Fine Arts, Visual Communication Design Department within the scope of the Collaboration for Innovation and Exchange of Good Practices within the framework of Strategic Partnerships for ERASMUS+ Program KA2 Higher Education Programs.



Virtual Art Applications Course Instructor's Guide (O3. Virtual ART Course)

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"Erasmus+ Programı kapsamında Avrupa Komisyonu tarafından desteklenmektedir. Ancak burada yer alan görüşlerden Avrupa Komisyonu ve Türkiye Ulusal Ajansı sorumlu tutulamaz."

1. Week

NAME OF THE EVENT: About the Future of Virtual Reality

OBJECTIVE: To gain an overview of Virtual / Augmented / Mixed (VR / AR / MR) reality.

LEARNING OUTPUTS: Participants;

- Have awareness about the usage areas of VR,
- Have awareness about the usage areas of AR,
- Have awareness about the usage areas of MR,
- Have information about Extended Reality (XR).
- Realize the strengths and weaknesses of VR / AR / MR.

MATERIAL: Sanal_Gerçeklik_Nedir.PPT, Mentimeter Çevrimiçi Etkileşimli Sunum, Video 1,2,3

DURATION: 150 mins

PROCEDURE:

1. The presentation coded as “336468” previously prepared by Mentimeter web application is reflected on the projector or smart board screen.
2. Participants are asked to enter “menti.com” on their phones.
3. Then, they are asked to enter the presentation code (336468) on the screen.

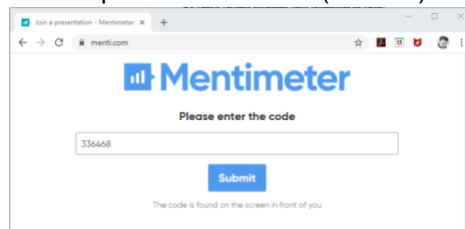


Figure 1.Mentimeter student screen.

4. They are asked to give the shortest answer to the question "What is Virtual Reality?".

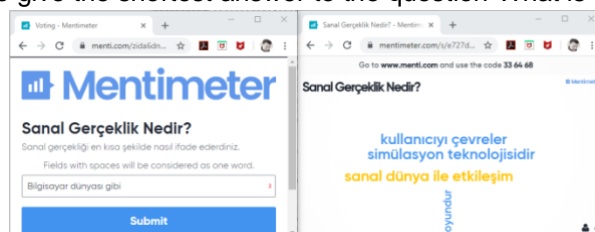


Figure 2.Mentimeter response and presentation screens.

5. The feedback of the participants is reflected to the presentation in real time through the application. Thus, it is ensured that all of the participants get answers at the same time and everyone sees each other's answers instead of getting answers from each individual.
6. A few of the answers are read, and to start the discussion, "What is the difference between Augmented Reality-Virtual Reality-Mixed Reality?" The question is directed to get feedback?
7. “Sanal_Gerçeklik_Nedir.PPT” presentation is made. The points to be considered during this presentation are as follows;
 - **Brief descriptions of Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) are given as follows and Figure 3 is displayed;**
 - Virtual reality (VR) puts users in a completely artificial digital Field.
 - Augmented reality (AR) shows virtual objects on the real world view.
 - Mixed reality (MR) not only places virtual objects in the real world, but also fixes virtual objects.

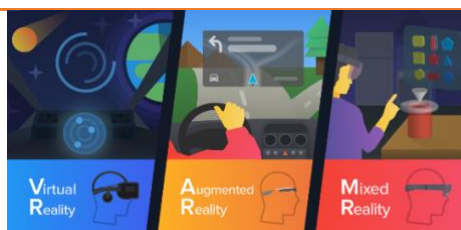


Figure 3. Virtual / Augmented / Mixed Reality info-graphics.

Source: https://8ar.appearition.com/wp-content/uploads/2017/03/blog_illustrations_VRDifferences_2016-06-_VR_AR_MR_-_Horizontal_Feature.png

8. The following explanation is made to give more detailed information about these technologies. "Virtual Reality technologies is the name given to the technologies used to create digital Fields that give users the feeling of entering a completely virtual digital Field, and in a sense, surround the user with digital content. Users can watch their surroundings, hear sounds, move, and even interact with digital media objects in this digital Field. For images and sounds, computer-connected screen and headset titles (OculusRift, HTC Vive, Playstation VR) or standalone titles (Google Cardboard etc.) used with smartphones are used. Motion sensors in the device head, controls and externally placed in the space are used to detect user movement. Various controls (touchcontroller etc.) or data gloves are used to interact with the virtual world. Data gloves can transfer user movements to the hands in the virtual world, as well as some gloves have a touch feedback feature, and thanks to this feature, reverse force is applied to the movement we make in an amount that makes us feel like we are in the real world (for example, gripping a sphere). Similarly, there are clothes for the whole body that provide feedback. "

What is Virtual Reality and How Does It Work? The video named is opened and watched from the internet connection below. Video subtitles are activated and the desired language (Turkish for example) is selected by opening the automatic translation option.

"What Is Virtual Reality& How DoesItWork?"

<https://www.youtube.com/watch?v=HBNH8tssfVM>(Video 1)

"Augmented Reality (AR) is the technology that works mostly on mobile devices such as tablets, smartphones, smart glasses (Google Glass etc.) and where digital content is reported / presented and presented together. Digital content can take a video, 3D model, animation, audio in various forms. AR's applications are based on defining a part that will trigger AR application from the real world view and aligning the digital content to this part. Three types of methods are used for alignment; a) real-world photographed pointers can be used, or b) in AR application, virtual objects are positioned on planes that are positioned by the user or defined as a result of analysis of real-time data from the application's device camera (Vuforia and Groundplane method, etc.). c) In the location-based method, objects in the AR application are connected to real-world GPS data. Examples of the fact that the things on that street are displayed on the real image in the AR application while you are traveling around the city with your phone, or that the objects of the game appear in those locations, such as the AR-Pokemon game, can help to understand the subject. "

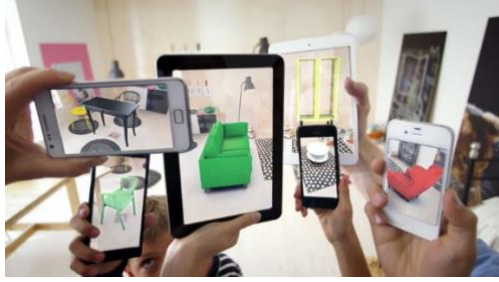


Figure 3. AR based furniture placement application.

<https://blog.csiro.au/reality-bytes-how-augmented-reality-will-change-our-lives/>

The promotional video of the IKEA furniture installation AR application, which shows how Augmented Reality works, is opened and watched from the internet link below.

<https://youtu.be/vDNzTasuYEW>(Video 2)

Figure 4 is shown before we begin to explain the subject of Mixed Reality.

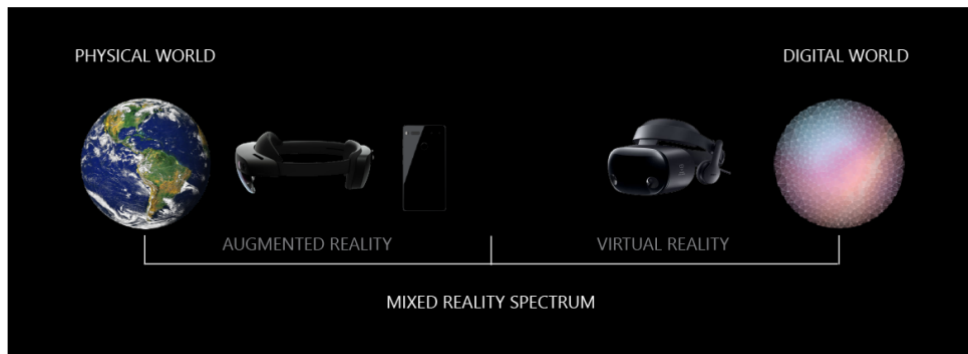


Figure 4. Positions of Devices in the Mixed Reality spectrum.

Source: <https://docs.microsoft.com/en-us/windows/mixed-reality/mixed-reality>

Mixed Reality (MR), a subclass of VR-related technologies, is a new kind of combination where virtual Field and real world objects (numerical and physical objects) can all come together and interact with each other in real time. This composition covers augmented reality / virtuality and is a hybrid technology with virtual reality. Unlike VR, the titles used for this technology are designed not to isolate the user from the physical world. The screens of the titles are translucent and computer production simultaneously allows to see the world and the physical world in a row. In this technology, the places placed to protect the position of virtual objects with objects in real spaces are fixed. So when we look at the place where we put the virtual objects from another perspective, we can see that it is still there or if it has the animation, it is positioned accordingly. Thanks to MR, the relationship between AR and the real world can be established more realistic.



Figure 6. Mixed Reality

Microsoft Hololens2 promotional video about Mixed Reality is opened and watched from the internet link below. Video subtitles are activated and the desired language (Turkish for example) is selected by opening the automatic translation option.

<https://www.youtube.com/watch?v=e-n90xrVXh8>(Video 3)

9. One of the students is selected and what are the differences of these three technologies that are mentioned to the other students? The question is asked. The selected student is asked to write these differences on the board in list form..
10. The following statement is made about XR-ExtendedReality technologies; The concept of XR can be defined as a general term covering all Virtual / Augmented / Mixed (VR / AR / MR) realities. Container 5 is given with VR / AR / MR in Figure 5.

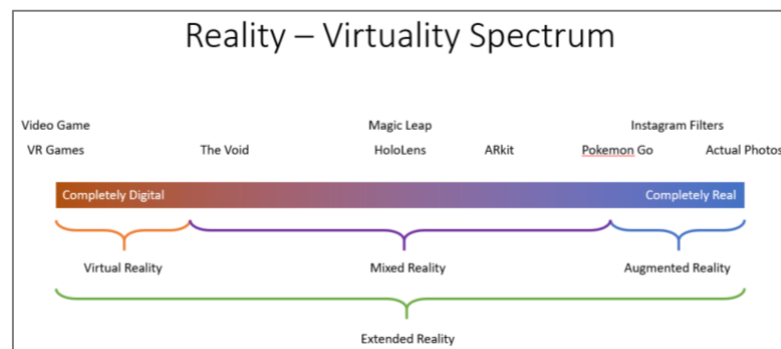


Figure 5. Reality - Virtuality Spectrum

Source: <https://innov8tiv.com/wp-content/uploads/2018/02/Windows-Mixed-Reality-Developer-750x400.png>

11. Class discussion is started about the future of Extended Reality (XR) technologies, student views are asked and the course is completed.

2. WEEK

NAME OF THE EVENT: About the Future of Virtual Reality

OBJECTIVE: Introducing the concepts related to Virtual Reality (VR / VR).

LEARNING OUTCOMES: Participants;

- Understand the concepts related to VR,

MATERIAL: “VR-Kavramlar.PPT”, Kahoot Online“Sanal Gerçeklik ile ilgili KavramlarQuiz”

DURATION: 150 mins

PROCEDURE:

1. Figure 1 for DOF is shown.

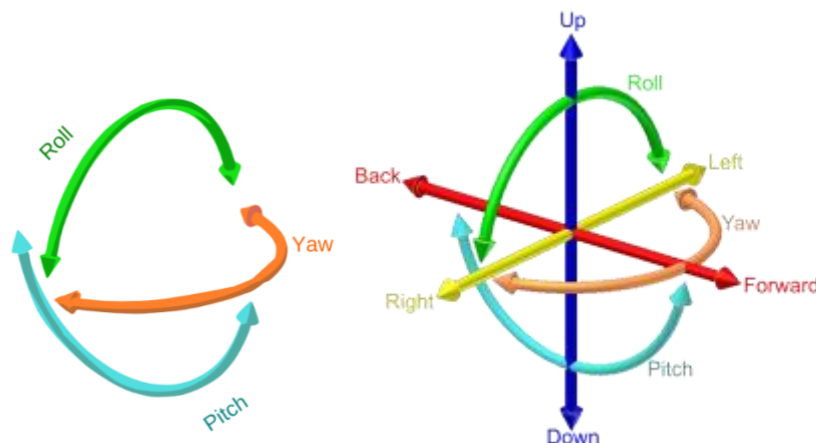


Figure 1. a) Rotation (3DoF) axes, b) Motion and rotation (6DoF) axes.

Source: <https://01.org/sites/default/files/users/u71223/3dof-fig.png>

<https://i1.wp.com/packet39.com/blog/uploads/2018/02/Untitled-1-1.png?resize=768%2C289&ssl=1>

2. The concept of DoF (Degrees of Freedom) is explained to students as follows;

“DoF means how many different directions (degrees of freedom) an object will move in a 3D virtual Field. It is available in two types, 3DoF and 6DoF. Rotation around Yaw, Roll and Pitch axes in Figure 1a is available in 3DoF. So at some point, you can stop and look around, but you cannot move forward. In 6DoF, orientation and location are also tracked. Movement tracking technologies such as axonometers, gyroscopes and external infrared cameras inside the hood can detect where you are looking and where you are in the room. So you can both look around and go to the side you want (Image 1.b). 360 degree videos are also 3DoF.”

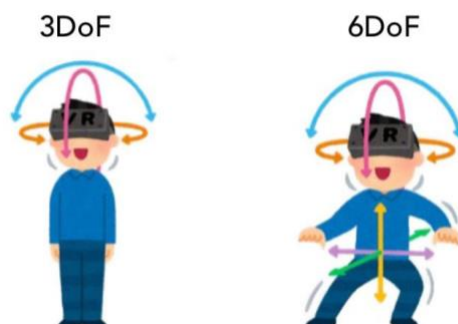


Figure 2. Point position (3DoF) and Moving (6DoF).

3. The concept of stereoscopic to students is explained as follows.

A photo or video is taken from two angles that mimic the angle of our eyes. Thus, when it is played side by side with devices such as screened titles for both eyes, the three-

dimensional sense will increase. But this is not really a 3D situation. A photo of a stereoscopic object was given in Figure 3.

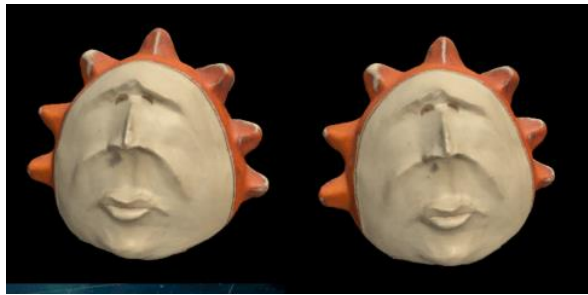


Figure 3. Stereoscopic shooting.

Source: <https://i1.wp.com/packet39.com/blog/uploads/2018/02/Capture-1.png?resize=768%2C378&ssl=1>

4. **Students are shown Figure 4.**
5. **The concepts of immersion and presence in the virtual world are explained to the students as follows:**

The sense of realism of the virtual reality Field is due to the surrounding of the user, giving the user the feeling that it exists in a different world and interacting with the virtual Field. This containment can be at different levels. As given in Figure 4, there can be a rather low level of enclosure with just one screen, or a medium level of enclosure with 3 adjacent screens, as well as the feeling of being completely surrounded by the virtual Field with the screened header such as OculusRift or HTC Vive also supports.



Figure 4. Systems that surround the user at different levels / give a feeling of immersion.

Credit: ChoroPhronesis https://www.e-education.psu.edu/geogvr/sites/www.e-education.psu.edu/geogvr/files/Lesson_01/Images/levelsOfImmersion.png

6. **The concept of interaction to students is explained as follows;**

“Interaction is another key to the feeling of being in VR Fields. It is important whether the scene can be navigated, whether it is possible to interact with the objects and the Field on the stage, and to what level of interaction with which devices, if any. Can the user touch objects on the scene, change their positions or formats? At this point, it would not be wrong to say that the interaction is directly related with the devices used as well as the feeling of immersion.

7. Students are shown a fishbone chart in Figure 5 and a volunteer student is asked to explain the scheme.

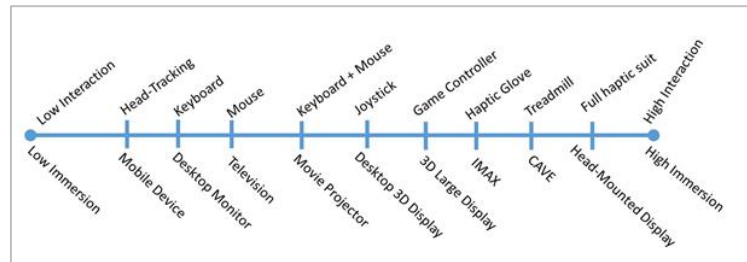


Figure 5. According to technologies, low-to-high interaction and diving feeling.

8. About the concept of delay in rendering, first of all, "Have you had any LAG status while playing a computer game?" is asked and feedback is received. Then, the students are given the following explanation regarding the concept of "Image Delay":

"When VR users move their heads or controls, what needs to be displayed on the scene will have changed. When he turns his head to the side, what is left to his right in the virtual world should now be displayed. From the moment the user makes any movement that requires image change, the wait until this change is calculated by the computer, created and displayed on the screens is called motion-photon delay. As this delay starts to be above about 300ms, the user will start to feel this delay and sensory conflict will begin between the data from the sense of vision and the data from the balance organs (middle ear and deep sense). As a result, symptoms of simulator stiffness may start to appear, which is similar to vehicle stiffness. For the solution of this problem, investigate the asynchronous mirroring process."

Source: <https://developers.google.com/vr/discover/fundamentals>

9. Students are given the following explanation regarding the permanence of the image (waiting time on the screen):

"Sequential images such as video and animation are called frames. This concept expresses how long each frame will remain on the screen. If the squares remain on the screen for a long time, they will decrease the realism as it will cause motion blur. Therefore, as the number of frames shown in 1 second increases, the effect of VR increases. If there is an inability to quickly refresh the image on the screen (due to display technology or not producing enough images, etc.), this is overcome by a method that displays the frames called low standby mode for a very short time and the remaining time is shown in black.."

Source: <https://developers.google.com/vr/discover/fundamentals>

10. First, students are shown Figure 6.

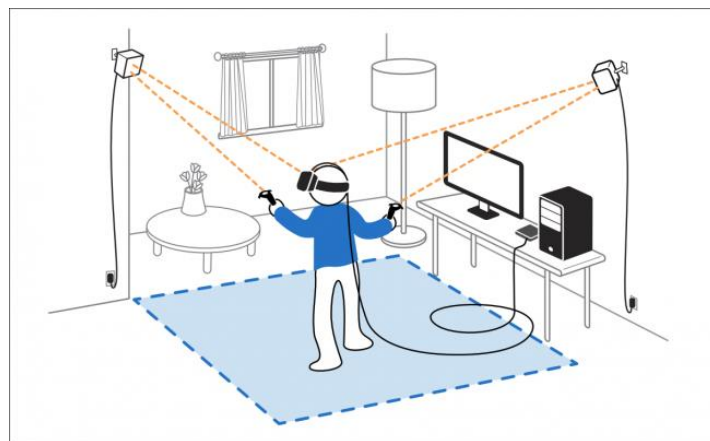


Figure 6. External motion sensors.

11. The following explanation is given to the students regarding Movement Tracking:

“VR equipment includes motion sensors such as inertial meters (gyroscopes) and axonometers. Apart from these sensors, infrared etc. are used to increase sensitivity. External sensors working with technologies are used. Thus, position and direction information such as the direction of the user's head or its controls and which position it rotates are accessed. This information is transferred to the cameras and controls in the virtual world and the images and sounds to be displayed according to the new situation there are calculated in milliseconds. Since the motion tracking is done very fast, there is a lot of noise in the data obtained, filtering the parasitic data, softer motion curves are obtained and used in this way.

- 12.** Before completing the activity, students are asked to open the Kahoot application on their phones. Students who open the previously prepared Virtual Reality Concepts Quiz Game are asked to be included using the game entry code on the screen (5695015). The quiz game is played together and students are provided to evaluate the situation of themselves and their peers.

Note: *The game is publicly accessible. You can login using the code above..*

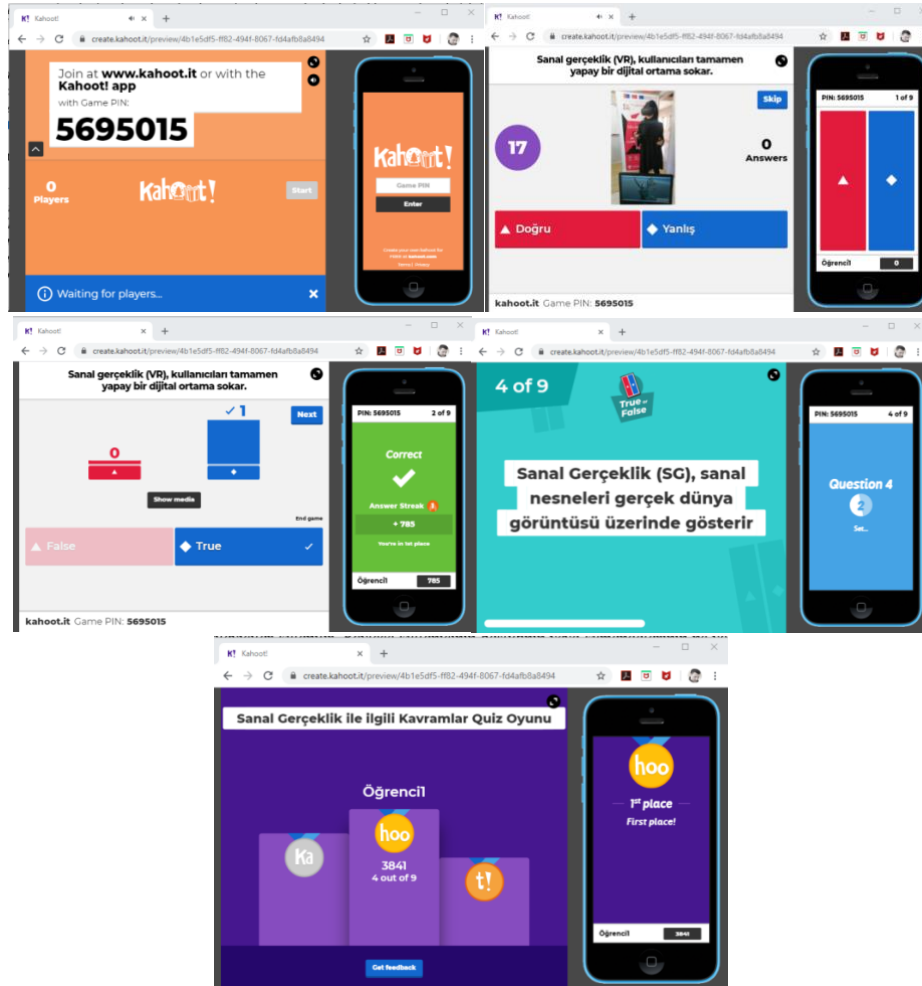


Figure 7.Kahoot “Virtual Reality Concepts Quiz” application screen captures.

3. WEEK

NAME OF THE EVENT: About the Future of Virtual Reality

OBJECTIVE: Introduction of virtual reality (VR / VR) equipment.

LEARNING OUTPUTS: Participants;

- Understand the issues related to the installation of VR equipment,
- Understand the issues related to calibration of VR equipment.
- Understand the basic concepts of using VR equipment.

MATERIAL: “VR-Ekipmanlari.PPT”, “Çalışma-Alani-Belirleme(Video)”
“Sensör-takibini-kurma (Video)”, “Sensör-takibini-baslat(Video)”,
“Basligin-oturuşunu-özelleştir (Video)”

DURATION: 150 mins

PROCEDURE:

1. OculusRift Installation steps are introduced as follows:

Ask students to download and run the installation software from the Oculus website (https://www.oculus.com/setup/?locale=tr_TR). Show how to make HDMI and USB connections as shown in Figure 1b.

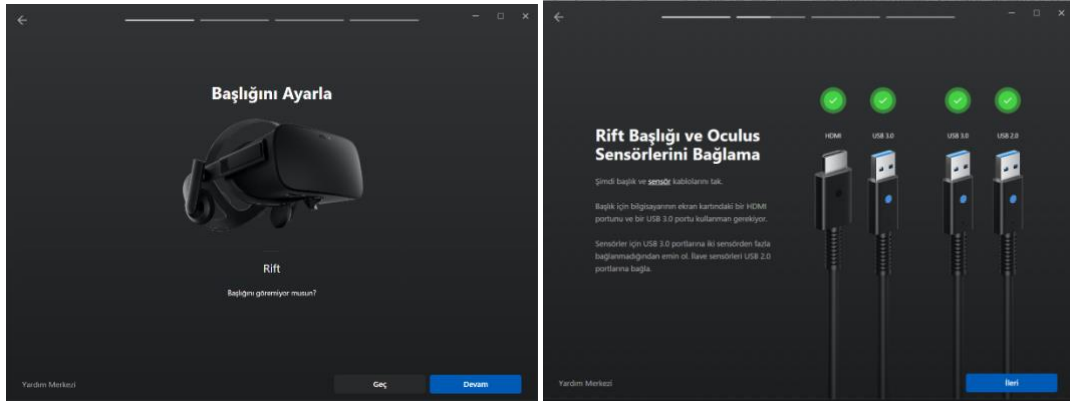


Figure 1.a) Rift Cap, b) Connections of cap and motion sensors.

2. Ask students to choose tactile controls as input devices.

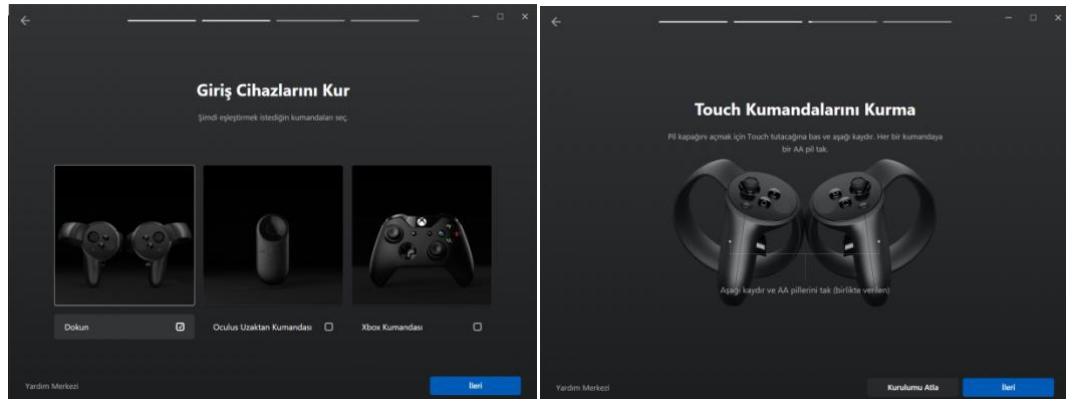


Figure 2.a) Input Device (Control) selection, b) Tactile controls.

3. Watch the Video about determining the OculusRift workspace (Oculus_kurulum_4.mp4).

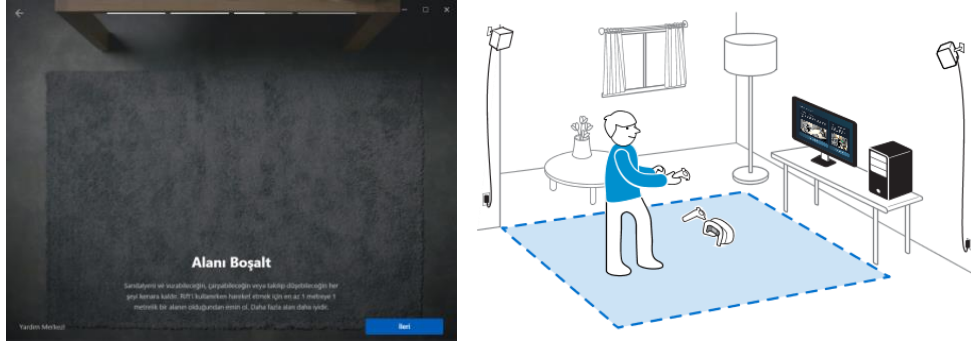


Figure 3. Determining safe workspace.

Source: <https://01.org/sites/default/files/users/u71223/htc-vive-cal-playarea.png>

4. Demonstrate the matching of left and right tactile controls practically.

“Press and hold the Menu + X and Menu + B buttons on the controls for 2 seconds.” If you skip the installation, you will not be able to access the controls within the applications. If there is no pairing process, make sure that the control batteries are installed properly.”

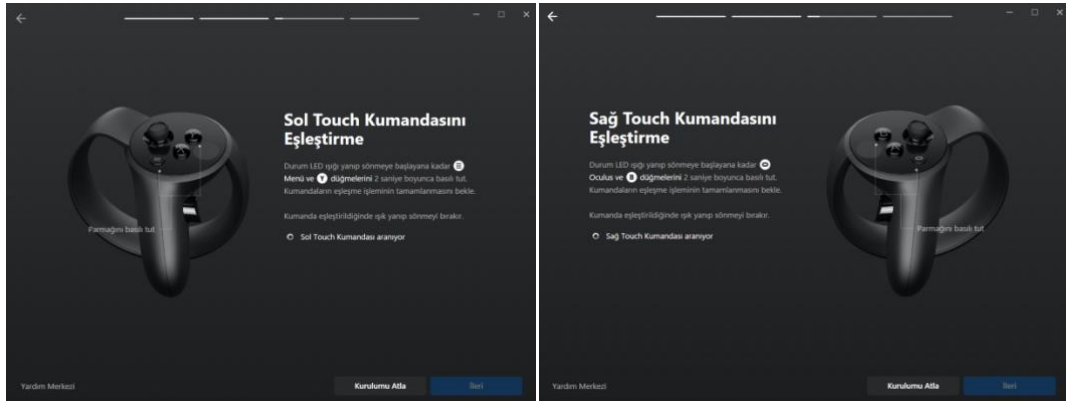


Figure 4. Matching tactile controls to the system.

5. Describe the general functions of the buttons on the controls.

“Both controls include a joystick, side grip (hold) buttons, triggers, X-Y and A-B buttons, and menu buttons, each controlled by a thumb. Since the functions of these buttons change from software to software, their detailed functions will be done again during the software promotion phase.”



Figure 5. Control Button Functions.

6. Make the following explanation to students about Oculus sensors:

If you are using a model with sensors such as Rift-S, skip this step. "It is recommended to complete this step with precision, since skipping the sensor setup will affect the tracking accuracy of the movements later on during the application. Otherwise, when you start to practice, too much jumping, loss of sensitivity, etc. situations may occur."

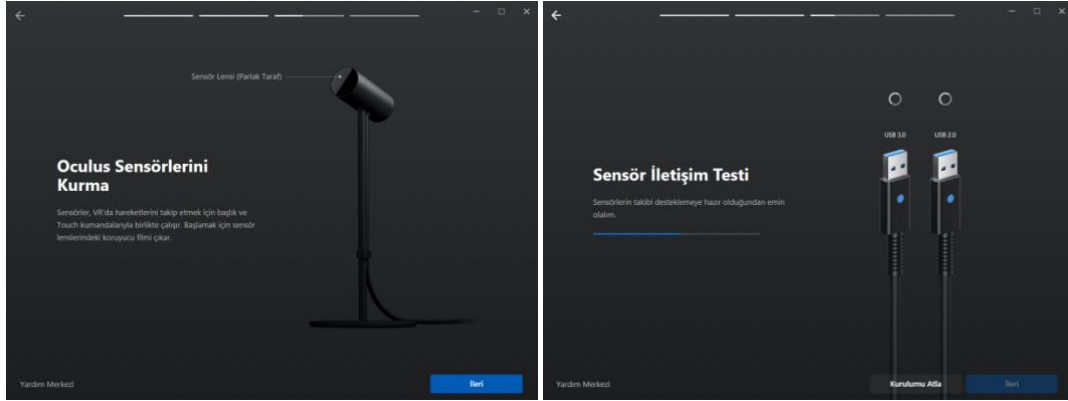


Figure 6. Installation of motion sensors.

7. Watch the students watch the " Sensör_takibini_kurma" and "Sensör_takibini_baslat" videos and make the following statement regarding the positioning of the motion sensors:
"Motion sensors should be placed at the center of the working area at 1.2 m distance from each other, centered. Now please position the bright faces of the sensors to the front and the parts with the logo to the back."

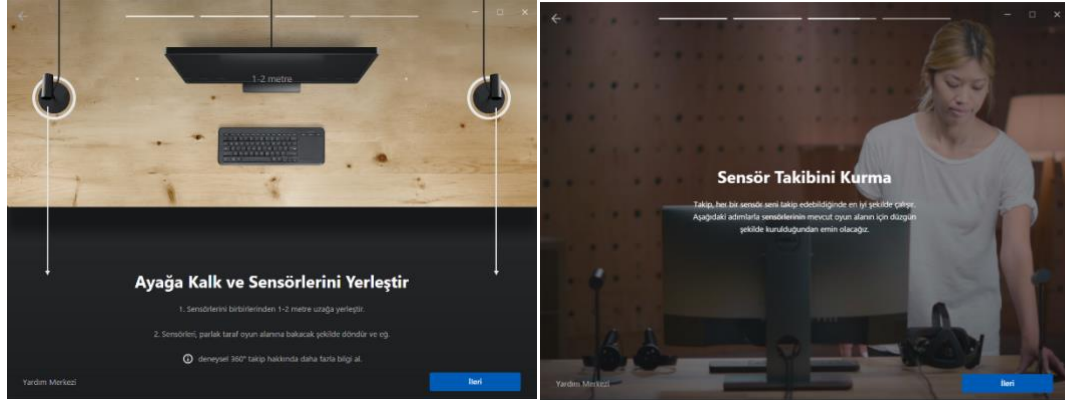


Figure 7. Positioning of Motion Sensors.

8. Have the students watch the video of the title "Basligin-oturuşunu-özelleştir1 and 2" about wearing and customizing the title. Then call a volunteer student and show that the title should be adjusted. Make the following explanation to the students:

"The OculusRift header has a lens slider at the bottom right. With this button, you can increase or decrease the distance of the lenses and find the most suitable distance for your own eyes. Do this process after wearing the headgear until the image becomes clearest with the image on the screen. You can also use the side and top straps for the hood to fit on your head."

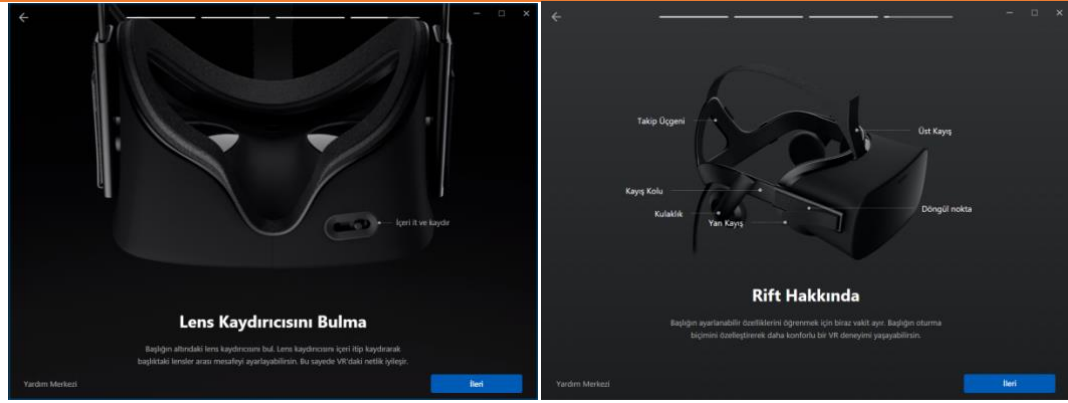


Figure 8.Lens Slider and title features.

9. After the students have completed the installation, ask them to run the "Oculus First Contact" application so that they can become familiar with the use of the system. Support them to gain basic competencies by completing the application at least once in the remaining period until the end of the lesson..



Figure 8.Oculus First Contact application screenshots.

Source: <https://www.hudsandguis.com/home/2017/9/10/first-contact>

4. Week

NAME OF THE EVENT: About the Future of Virtual Reality

OBJECTIVE: Introduction of Virtual Reality (VR / VR) Painting Tools.

LEARNING OUTPUTS: Participants;

- have information about VR Artists and their work,
- Grasp the issues related to Google TiltBrush software,
- Understand the issues related to VR color selection.
- Students will be able to comprehend issues related to virtual brushes.

MATERIAL: “VR-Sanatçilari.PPT”, Video 1,2,3

DURATION: 150 mins

PROCEDURE:

1. “VR- Sanatçilari.PPT” presentation opens. In the first 50 minutes of the lesson, VR artists are introduced. Using the artist's website links in the presentation, the works of the artists are tracked, and the methods of production are discussed in the classroom.

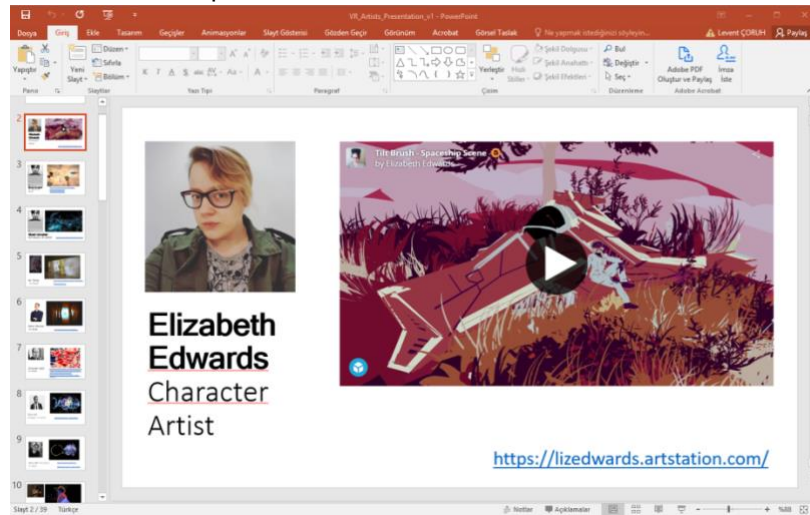


Figure 1.VR Artists presentation.

2. “VR-Boyama_Araclari.PPT” presentation is opened. Only pages related to the GoogleTilt Brush software are shown in the presentation. The software is introduced to the students briefly by presentation.

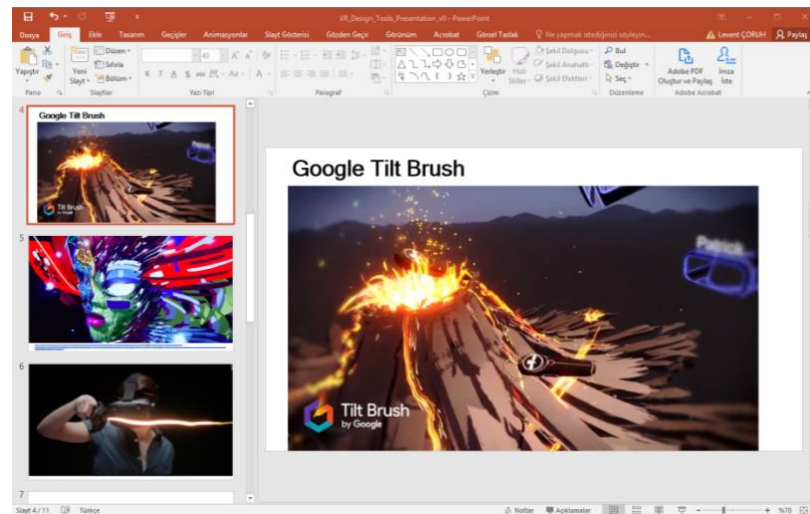


Figure 2.VR Painting tools presentation.

3. Before starting the study, TiltBrush “change the right-hand and left-hand controls”, “palette properties”, “brush selection and various brush effects”, “change the brush size”, “color palette” on the CDICAE project website. color selection ”is asked if they watch the training videos. Videos they do not watch are watched together.
4. Ask students to run the GoogleTilt Brush software and wear their heads to enter the VR Field. Run the software by wearing your own title at the same time.
5. Introduce students to the palette of brushes as follows::
“Select various brushes from the palette on your left hand (if you are not left-handed) by pointing with the primary control (right hand) trigger button. Then start drawing by pressing the trigger button of the remote in your right hand.”



Figure 3. Tiltbrush brushes palette.

Source: <https://thevirtualinstructor.com/blog/wp-content/uploads/2018/01/brushespalette tiltbrush.jpg>

<https://i1.wp.com/veer.tv/blog/wp-content/uploads/2018/01/Tilt-Brush-brush-panel.png?fit=1024%2C592&ssl=1>

6. Explain the students the color selection process as follows:
“Move the joystick left and right with your left thumb. You will see that the palette of brushes in your hand alternates between the color palette and the menu palettes. Now open the color palette, mark the color essence from the color wheel with the trigger button of your right hand controller. Then apply the light value on the right side of the palette for the color essence you choose between black and white.”



Figure 4.a) TiltBrush Color Palette, b) TiltBrush painting scene.

Source: <http://cdn.arstechnica.net/wp-content/uploads/2016/04/Screenshot-99.png>, [https://cdn.vox-cdn.com/thumbor/CQNIAB1T9nh0nRhsjpCV3p970Q=/0x0:780x439/920x613/filters:focal\(336x116:460x240\):format\(webp\)/cdn.vox-cdn.com/uploads/chorus_image/image/53347013/oculus.0.png](https://cdn.vox-cdn.com/thumbor/CQNIAB1T9nh0nRhsjpCV3p970Q=/0x0:780x439/920x613/filters:focal(336x116:460x240):format(webp)/cdn.vox-cdn.com/uploads/chorus_image/image/53347013/oculus.0.png)

7. Make the following explanation to the students about changing the right-hand and left-hand controls.:

“If you are left-handed or if a left-handed person last used your remote, simply swipe the bottom of the controls to change the right and left hand controls. So the controls will switch their primary and secondary features to another.”



Figure 5. Right-hand and Left-hand replacement.

8. Make the following explanation to the students about changing the brush size.:

“When you pull the joystick button on your right hand control left and right, you will see that the brush size has changed. Pulling the stick to the left makes the brush thinner, and pulling it to the right makes it thicker. You can also get thicker effects in a practical way by pressing the primary control trigger lightly and pressing hard. Now try painting with different brush sizes.”



Figure 6. Changing brush size with Trigger and Joystick

Source: <https://edition.cnn.com/style/article/google-tilt-brush/index.html>

9. Encourage students to practice with the tools introduced in the remaining time until the end of the lesson and to try other tools. Help them discover more of the possibilities of the software by asking questions and guiding them through the drawing screens.