



Erasmus+

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Augmented Reality Applications Course Instructor's Guide (O3. Augmented Reality Applications Course)

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

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Augmented Reality Applications Lesson Teacher Guide

Note: Week 1 will be taught according to the same schedule as the Virtual Art Course.

2. and 3. WEEK

NAME OF THE EVENT: Unity Development Environment for Augmented Reality

OBJECTIVE: Introducing the Unity Development environment and setup for augmented reality (AR).

LEARNING OUTPUT: Participants;

- Have information about Unity Game Engine,
- Get information about Unity Game Engine installation,
- Learn about the installation of Vuforia Engine for Unity,

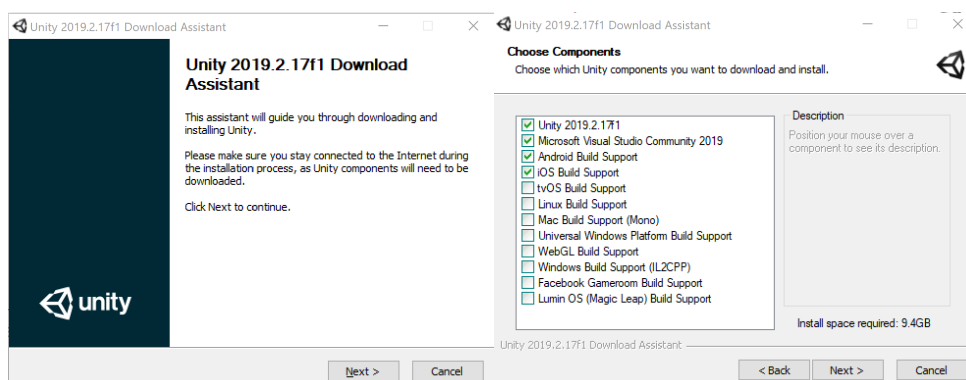
MATERIAL: “Unity_Kurulumu.PPT” , “Vuforia_Kurulumu.PPT”

DURATION: 150 mins. (10-minute breaks in every 50 minutes.)

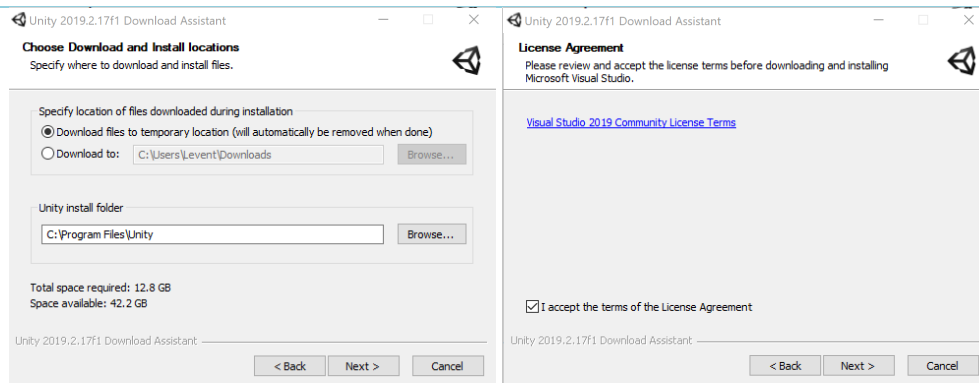
PROCEDURE:

1. It starts with the following explanation about the application of Unity to students;
This course will focus on developing AR application with Unity and Vuforia software. Unity software is a popular development environment for developing desktop, mobile and console games. You can develop 2D and 3D games. Although Unity is not a tool for direct AR applications, it can be turned into a tool where you can develop AR application with some plugins.
2. “Unity kurulumu.PPT” presentation is opened and the steps related to the installation of Unity software are introduced to the students: *In this course, the steps for the installation of software and plug-ins such as Unity, Vuforia SDK (software development kit), Android SDK (for Android devices), Xcode (for iOS devices) and Java Development package will be introduced.*

First, download and run the Unity download assistant software from the given web address. “<https://unity3d.com/get-unity/download/archive>”. Choose the Android or iOS compilation support according to which mobile device type you plan to perform the application test from Unity components.

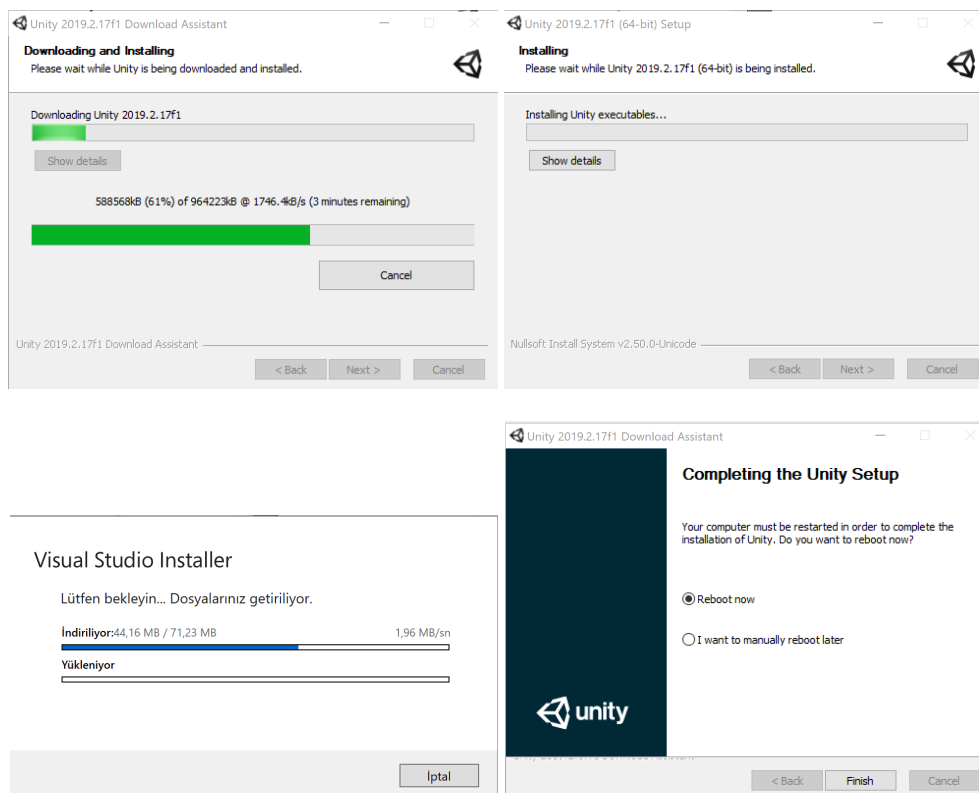


Visual 1. Unity software download assistant screens.



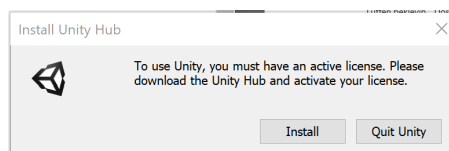
Visual 2. Unity download folder selection and license agreement screens.

Select the download folder and select I accept the terms of the Visual Studio License agreement and click next.

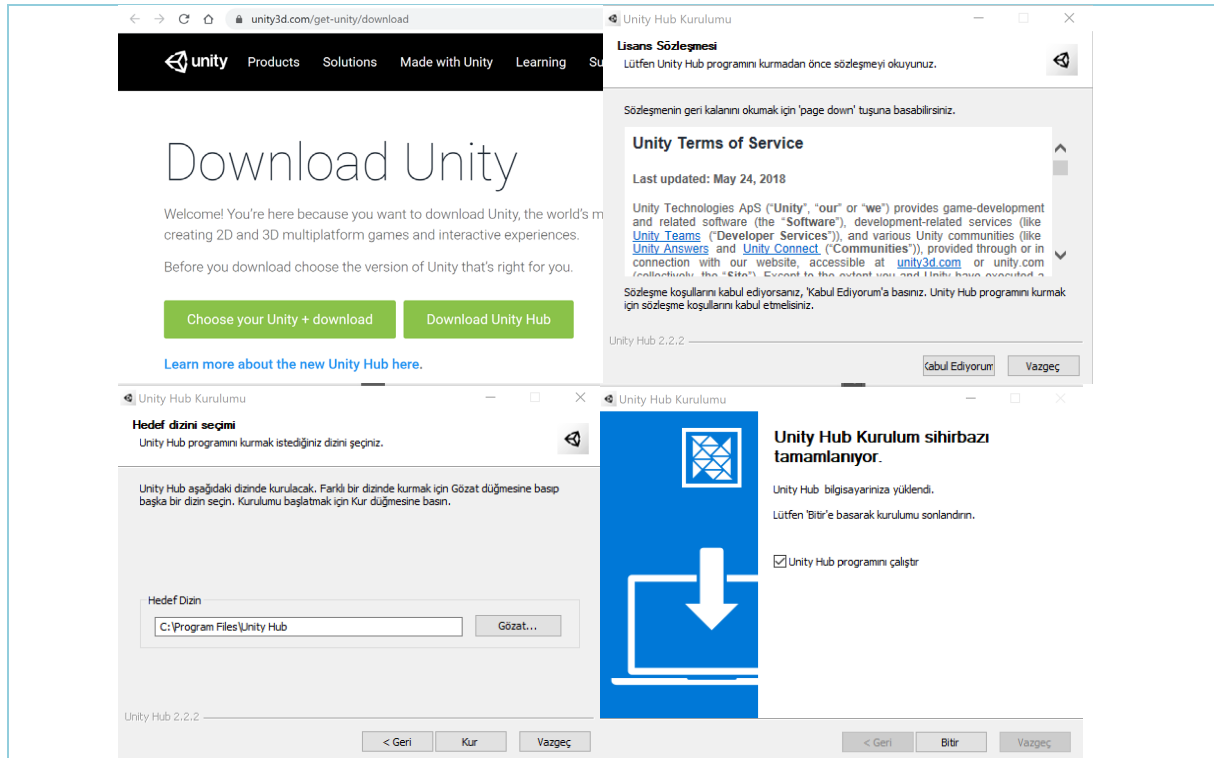


Visual 3. Unity installation steps.

Install the software by following the installation steps. When you run Unity for the first time, Unity Hub will issue a license warning if it is not already installed on your computer. Install option is selected and Hub is downloaded from the Unity web page and installed.

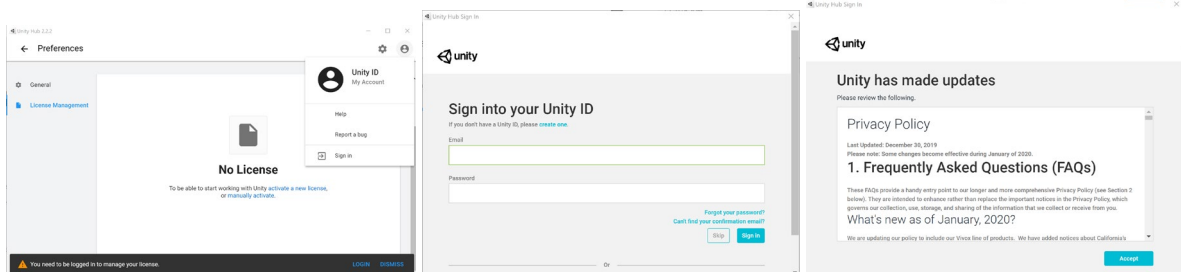


Visual 4. Unity Hub license warning.



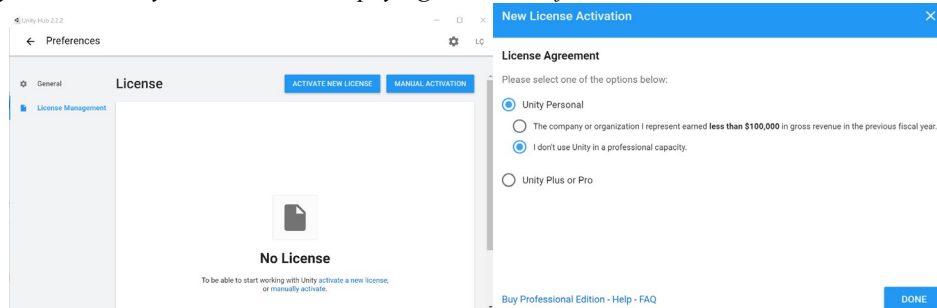
Visual 5. Unity Hub installation steps.

3. 3. After the installation is completed, ask the students to open a Unity account. After opening an account, ask them member to log in to their accounts using their e-mail addresses and passwords from "Sign in" menu.

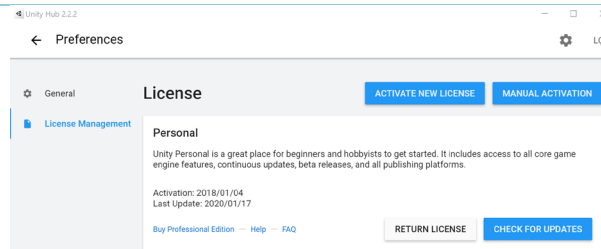


Visual 6. Unity software first run login screens.

After logging into your account, you need to activate the license. To do this, click on the "Activate License" button, as you can see in the next step. Select personal use as shown in the license options. Thus, you can make your trials without paying the license fee.

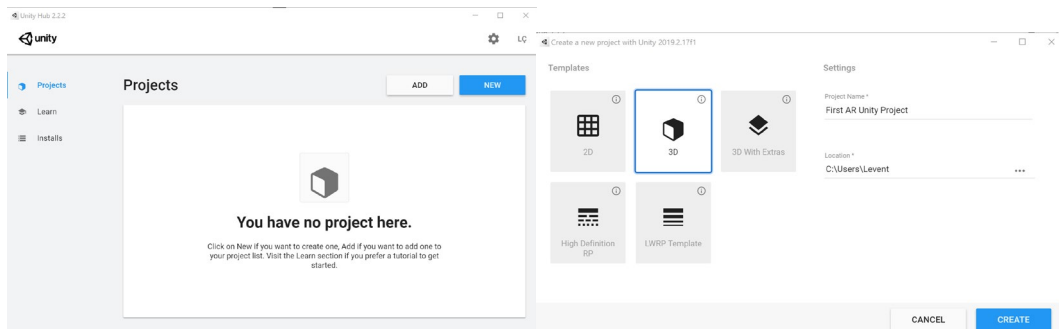


Visual 7. Unity software license activation screens.



Visual 8. Unity software completed license screen.

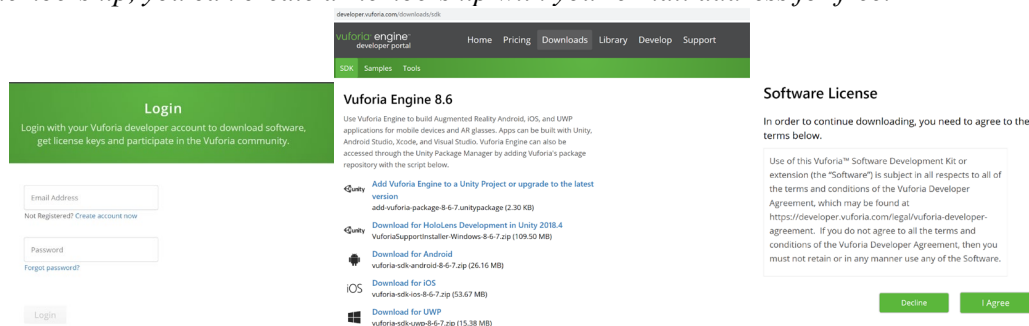
4. 4. After the license process is completed, ask the students to create a new project from the Project selection / creation screen by clicking the back arrow in the upper left corner of the screen.



Visual 9. Unity software new project creation screens.

5. 5. "Vuforia kurulumu.PPT " presentation is opened and the steps related to the installation of Vuforia software are introduced to the students: *Vuforia is an Augmented Reality development tool with highly advanced features (SDK-software development kit). It provides the opportunity to develop AR applications for mobile devices thanks to its ability to recognize and track images and 3D objects in real time. Thanks to its tracking capabilities, it can show the content created in the digital world (for example, an animation, video, photo or 3D model) with real-world objects and display these two types of images as real-time images in superimposed layers.*

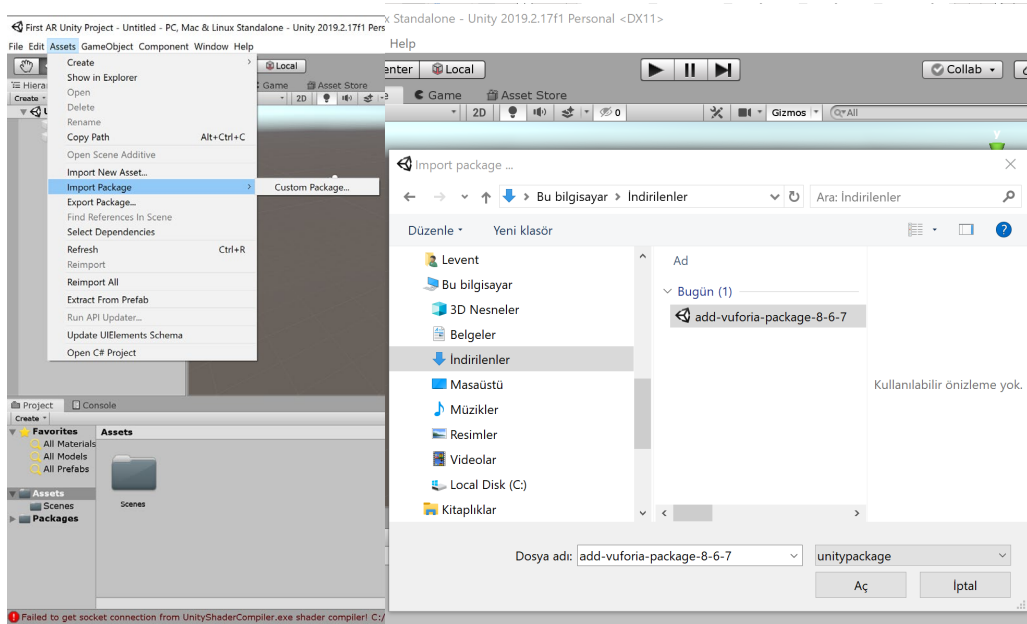
To download and install the software, you need to login to the Vuforia website (developer.vuforia.com) with your username and password. If you do not have a membership, you can create a membership with your e-mail address for free.



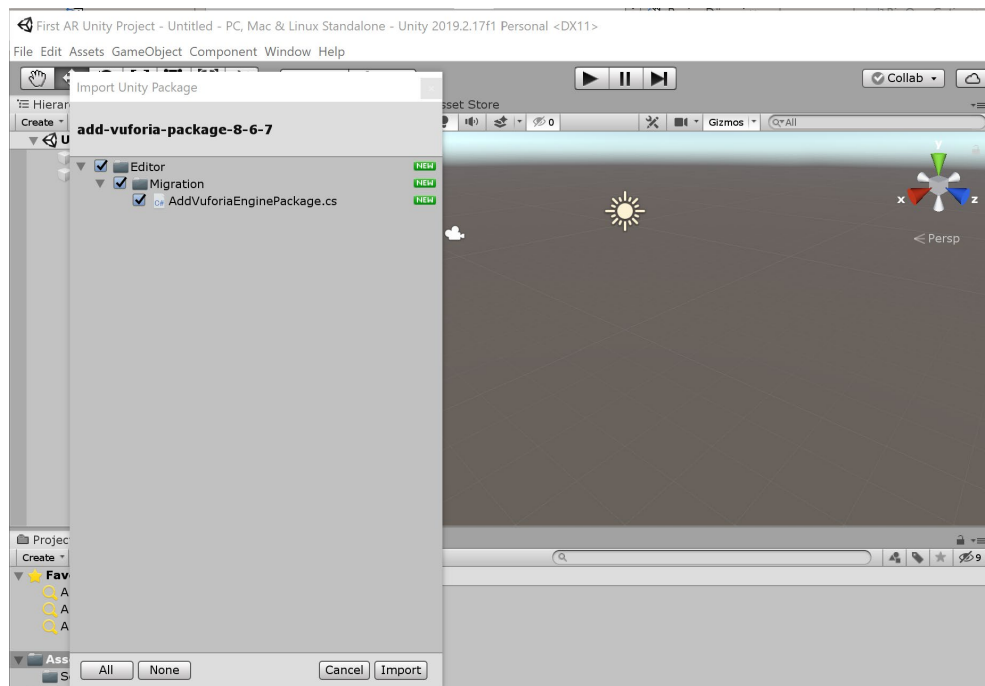
Visual 10. Downloading and installing the Vuforia package.

6. 6. After logging in, you should download the updated Vuforia Engine for Unity from the "Download" menu. Select "Add Vuforia Engine to a Unity Project or upgrade to the latest version" from this screen, and then accept the software license terms.

7. 7. When the download is completed, click the "Assets / Import Package / Custom Package..." menu option to include the Vuforia package in the Unity scene..

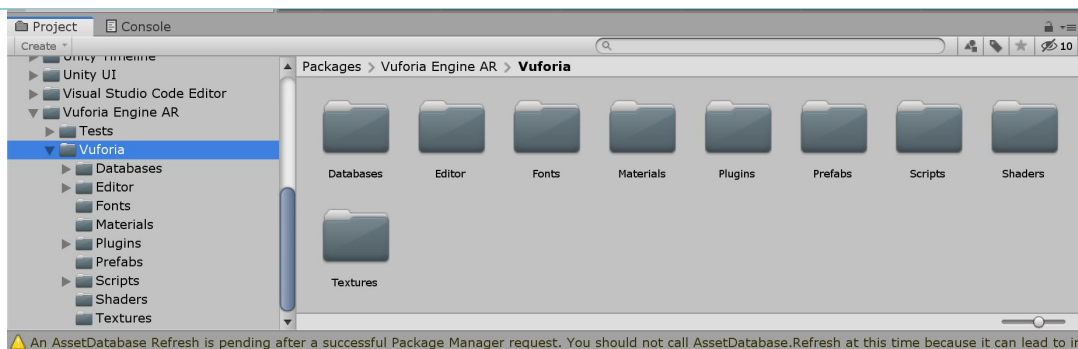


Visual 11. Adding Vuforia engine to Unity software.



Visual 12. Adding Vuforia package to Unity software.

When the installation of the Vuforia package is complete, the Vuforia folders will appear on the project screen as shown in Visual 13.



Visual 13. Uploaded Vuforia folders.

4. WEEK

NAME OF THE EVENT: Unity Stage and Vuforia Operations for Augmented Reality

OBJECTIVE: Creating the Unity Stage for augmented reality (AR) and introducing Vuforia operations.

LEARNING OUTPUT: Participants;

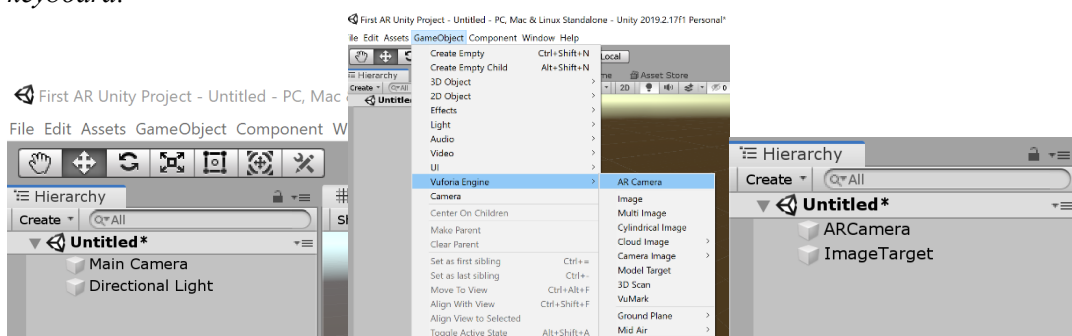
- Have sufficient information on the preparation of the Unity AR scene,
- Have sufficient knowledge about creating a license key with Vuforia,
- Have enough information about converting Vuforia target images into datasets,

MATERIAL: Unity software, Vuforia plugin, internet connected computer (win/mac).

DURATION: 150 mins. (10-minute breaks in every 50 minutes.)

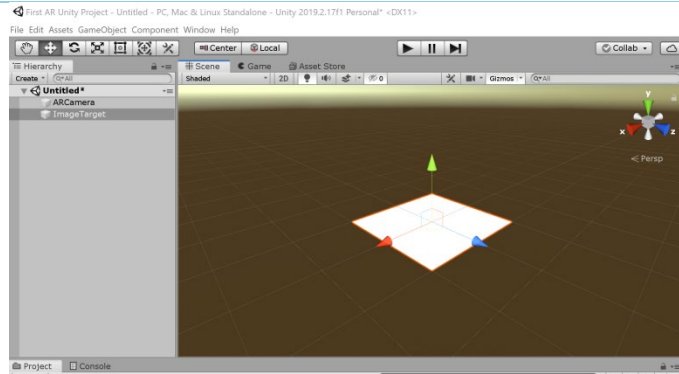
PROCEDURE:

1. **Make the following explanation to students about preparing Unity scene for AR application:** *As the Vuforia engine will use its own components, there is no need for the "Main Camera" and "Directional Light" objects that come as default on the Unity scene. You can delete these objects under the "Hierarchy" panel and press the "Delete" key on the keyboard.*



Visual 1. Adding Vuforia components to the stage.

Then add the "AR Camera" and "Image (Target)" components from the "GameObject / Vuforia Engine" menu to the hierarchy list. Create a target plane to the scene by double-clicking the ImageTarget object. To see this plane on stage, you must make sure that the 2D option is turned off.



Visual 2. Adding the ImageTarget object to the stage.

2. Give the students the following explanation regarding the issue of creating a Vuforia license key: A license key is required to use the Vuforia tool in Unity. To create this key, go to the Vuforia developer portal website and login.

Click on the "License Manager" under the "Develop" menu. On this page, select the "Add Development Key" option. Give your application a name. Click on the "License Manager" under the "Develop" menu. On this page, select the "Add Development Key" option. Give your application a name.

The screenshot shows the 'License Manager' tab in the Vuforia Developer Portal. It includes a form to 'Add a free Development License Key' with a 'License Name' field containing 'ilk_AR_uygulamam'. Below the form, it lists license details: 'Develop', 'Price: No Charge', 'Reco Usage: 1,000 per month', 'Cloud Targets: 1,000', 'VuMark Templates: 1 Active', and 'VuMarks: 100'. A checkbox is checked, acknowledging the terms and conditions. 'Cancel' and 'Confirm' buttons are at the bottom.

Visual 3. Steps to create a Vuforia license key.

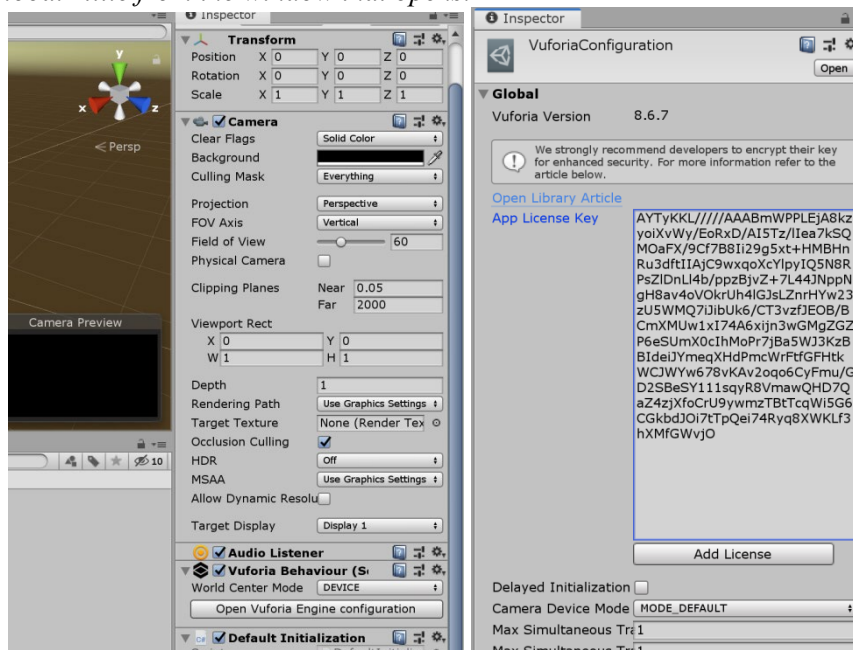
After the license key is created, click on the list. You will see the license key in mixed numbers. The license key has been created but has not yet been linked to the scene in Unity software. To make the connection, first copy the license key automatically by clicking on it..

The screenshot shows the 'License Manager' tab with a table of created license keys. The key 'ilk_AR_uygulamam' is listed with a 'Primary UUID' of 'N/A', 'Type' of 'Develop', and 'Status' of 'Active'. A 'Copy' button is next to the key. Below the table, the 'License Key' is displayed as a long alphanumeric string: 'AVTyKRL/...'. The 'Plan Type' is 'Develop' and the 'Status' is 'Active'.

Visual 4. Vuforia license key.

Switch to Unity to paste the license key you copied. Select "ARCamera" from the hierarchy

panel, find the “Vuforia Behavior” section in the “Inspector” panel. Click the “Open Vuforia Engine Configuration” button from here. Paste it to the “Add License Key” section of the “Global” title from the window that opens.



Visual 4. Adding Vuforia license key to the Unity scene.

3. Students are asked to record their scenes. Unity saves files by default in the Assets folder..
4. They are asked to find images that will be used as markers for the next lesson. The following statement is made about the pointer images: A real world image is required to trigger the AR application. You can find this image on the internet and print it on paper, or even a photo taken from outside.

The first thing to note is that you will need this image (photo or that piece of space) later to test the application. For example, if you took a photo of a carpet in your home, your device camera will need to see either the carpet or the photo printed on paper during the test phase. Another issue related to the pointer visuals is that the recognition and follow-up works of the images with irregular, unsymmetrical textures were done much more successfully by Vuforia.

5. WEEK

ACTIVITY NAME: Creating Image Data Sets with Vuforia

OBJECTIVE: Understanding the information about adding Vuforia image datasets for augmented reality (AR).

LEARNING OUTPUT: Participants;

- Have sufficient information on the preparation of the Unity AR scene,
- Have sufficient knowledge about creating a license key with Vuforia,
- Have enough information about converting Vuforia target images into datasets,

MATERIAL: Unity software, Vuforia plugin, internet-connected computer (win / mac), Pointer image file (max 2,5 mb, .JPG/.PNG)

DURATION: 150 mins. (10-minute breaks in every 50 minutes.)

PROCEDURE:

1. The students are given the following explanation regarding the subject of

converting the images to be used as a pointer image into Vuforia data sets: *Image files must be in .JPG or .PNG format. It should also be less than 2.5 MB in size. Therefore, if the photos taken with smartphones are in HEIC format, convert them to one of these formats before transferring them to the computer.*



Visual 1. Bill Bryson's Short History of Just About Everything book cover.

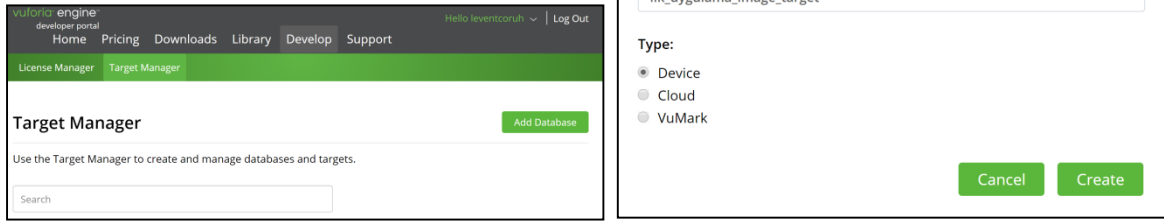
The first thing to consider when choosing an image is that you will need this image (photo or that piece of space) later to test the application. For example, if you took a photo of a carpet in your home, your device camera will need to see either the carpet or the photo printed on paper during the test phase. Another issue about pointer images is that color contrast is sufficient and the recognition and follow-up works of visuals with irregular, unsymmetrical textures are done much more successfully by Vuforia.



Visual 2. AR application: 3D Model associated with Pointer image.

Source: <https://arpost.co/wp-content/uploads/2018/06/unnamed.png>

- 2. Give the students the following explanation about creating a database and ask them to create a database with their own visuals:** *The image files you choose should be converted into databases that Vuforia can follow. To do this, first open the Vuforia website and click the "Add Database" button in the "Target Manager" menu.*

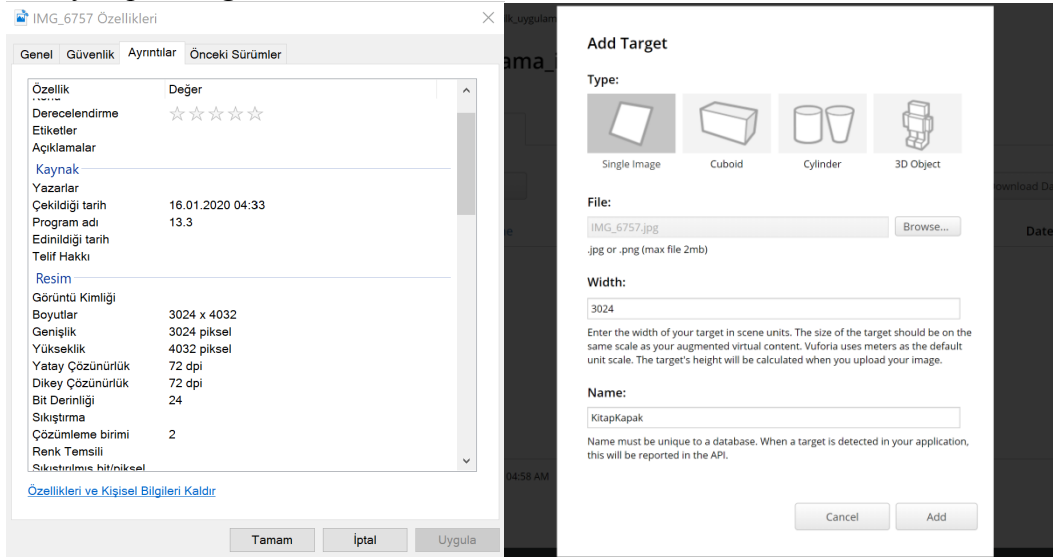


Visual 3. Creating a database.

3. Make the following explanations about the database name / type and image upload to the students: Give the database a unique (not listed) name, and select the "Device" for the database type.

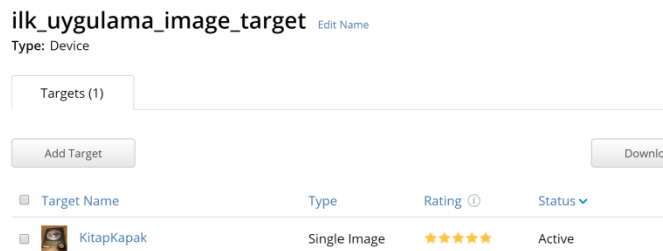
Select "Single Image" for the pointer type from the "Add Target" window that opens after pressing the create button, and upload the image file on your computer from the Browse button.

To find the width (with) value of the image, right click on your JPG / PNG file and select the "properties" menu option. You can see the Width value by switching to the Details tab from the window that opens. You must give a unique name to the name part. After pressing the add button, the database will be created.



Visual 4. Properties window and target image loading window.

The resulting database recognition and tracking quality can be seen from the number of stars in the "Rating" column and the "show features" option on the page that opens when you click on the database name.



Visual 5. Database recognition and tracking quality.

KitapKapak

Edit Name Remove



Update Target Hide Features

Visual 5. Database recognition and tracking points.

4. **Make the following explanation to students about follow-up points and follow-up quality and get feedback on the number of follow-up points of their visuals:** *The yellow dots on the cover of the book show the points that Vuforia will follow. The more the number of these points, the more successful the tracking will be.*

6. and 7. WEEK

ACTIVITY NAME: Creating Image Data Sets and Using Digital Content with Vuforia

OBJECTIVE: To comprehend information about creating Vuforia image datasets for augmented reality (AR) and adding digital content to AR application.

LEARNING OUTPUT: Participants;

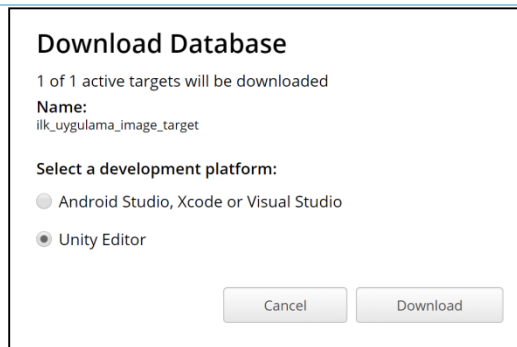
- Have sufficient information on the preparation of the Unity AR scene,
- have sufficient information about using Vuforia pointer database,
- have enough information about converting Vuforia target images into datasets,

MATERIAL: Unity software, Vuforia plugin, internet connected computer (win/mac).

DURATION: 150 mins. (10-minute breaks in every 50 minutes.)

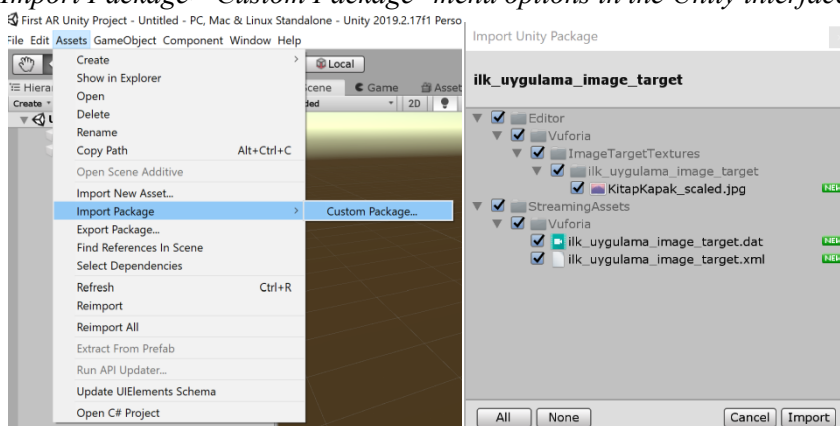
PROCEDURE:

1. **Make the following explanations about downloading the database created in the previous week to the students:** *You can download the databases you have created to your computer with the "Develop / Target Manager / Download Database" options. At the time of download, answer the question related to the development platform with "Unity Editor" and click the "Download" button. The database will be compiled and the download will take place.*



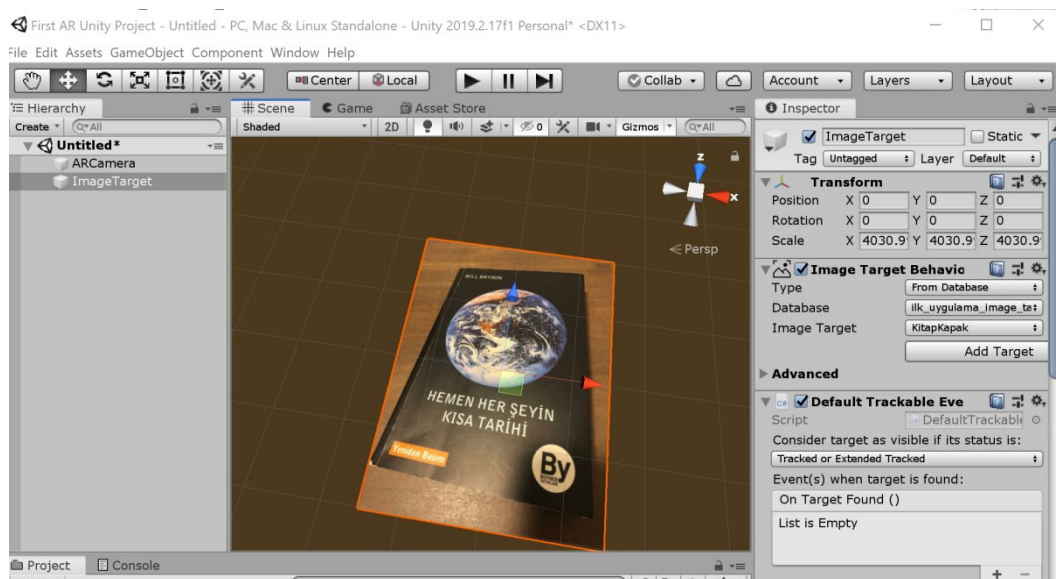
Visual 1. Download of Vuforia Image Target database for Unity.

2. Give the following explanation to the students about the inclusion of the database on the Unity stage: *You can add the completed database to your scene by clicking the "Assets> Import Package> Custom Package" menu options in the Unity interface.*



Visual 2. Import menu for Unity prefabs.

After the database is imported, select "Image Target" from the hierarchy menu and select "Type: Database", "Database: name you give", "Image Target: name you give" from the "Image Target Behavior" option group in the "Inspector" panel. So you can see the book cover on the stage. ARCamera will automatically recognize ImageTarget.



Visual 3. Database linked to Image Target prefab object.

3. **Make the following statement regarding the subject of adding digital content to the students:** *You can align (associate) various digital contents with the "Image Target" object on the stage. These contents can be photos, videos, 3D models (still or animation) etc.*



Visual 4. Paper.Plus AR application showing video content on newspaper.

Source: https://www.paper.plus/en/wp-content/uploads/sites/2/2018/05/Handy_You_Tube_2.jpg

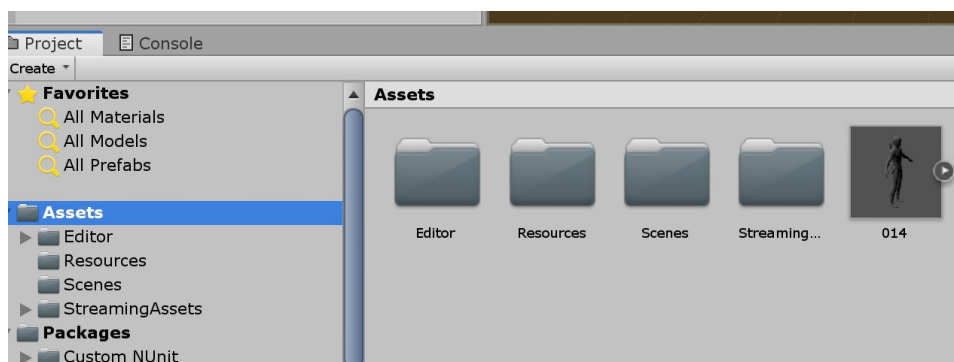


Visual 5. AR application using 3D model as digital content.

Source: <https://blog.novoda.com/content/images/2018/02/BlogPostPicButBetter.png>

4. **Please make the following explanations to the students about the 3D model usage within the Unity AR scene:** *It supports common 3D model file formats such as Unity .FBX, .OBJ. Models produced in design and animation software such as Autodesk 3DsMax, Maya; geometry, texture or animations can easily be transferred to Unity as Asset.*

This course will focus on how to incorporate a computer-generated 3D character model into the AR scene. First, make sure that the model file is in one of the formats supported by Unity. This example uses a .OBJ file. Copy the relevant file to the "Asset" folder in your project folder. When you return to Unity, you will see the file appear in the Asset folder. In this example, the file name is "014.OBJ".

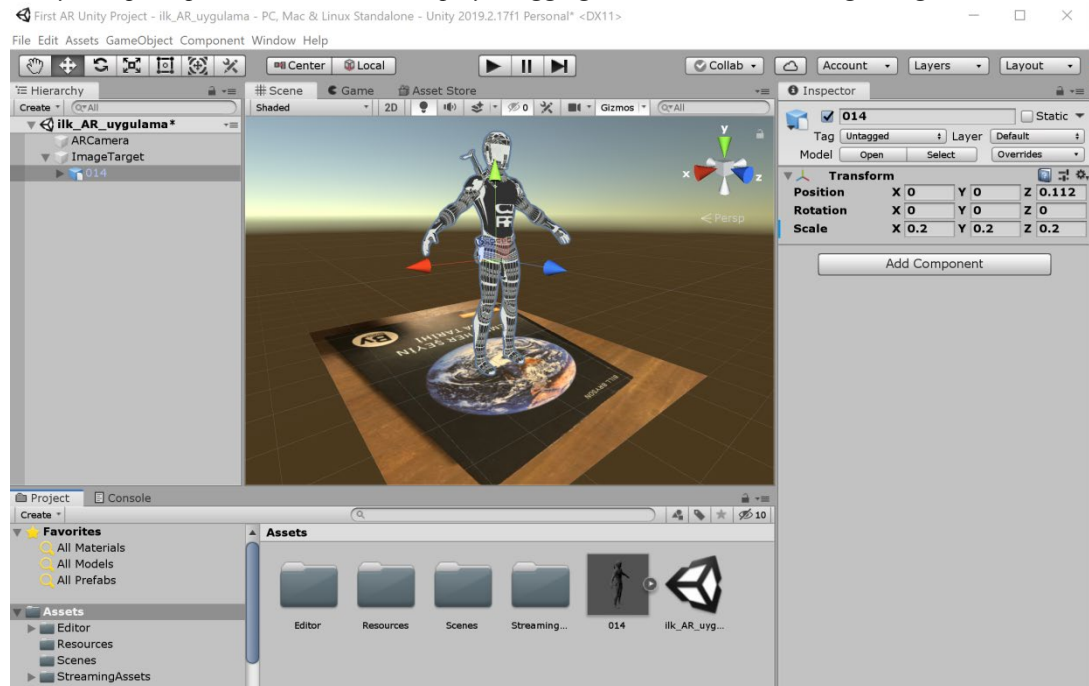


Visual 6. 3D model geometry added to Asset folder.

Drag and place the model onto the Image Target object (in this example, the book cover) and size it. You can adjust the position, orientation and size settings from the transforms in the "Inspector"

panel.

In the hierarchy panel, the added model must be the child object of the Image Target object. You can easily set up the parent-child relationship by dragging the model onto the Image Target.



Visual 7. 3D character model aligned to the Image Target object.

- 5. Make the following explanation to students about testing the program, show it by applying:** *To test the program, the application is run by pressing the Play button. Then, by selecting the AR application to trigger it, the image database created by the image camera is positioned so that the alignment made with the Image Target path is checked.*



Visual 8. Test screen.

8. and 9. WEEK

NAME OF THE EVENT: MID-TERM EXAM

SUMMARY OF EVALUATION METHOD: Midterm evaluation of this course is based on a Mobile AR Application and process evaluation: Exams are measured over 100 points. A process evaluation form will be used for evaluation (Appendix). Compiling to the mobile devices is not expected in the midterm exam, the assignments will be delivered in the Google Classroom platform of this course as an Unity scene archive file.

EVALUATION PLAN

EXAM	SUBJECT		
Midterm Project 1	AR Mobile Application - I	%70	
General Performance	Individual Classroom Performance	%20	TOTAL %100
Exam Presentation	Visual Presentation Performance	%10	

EVALUATION CRITERIA:

- AR Mobile Application
 - Preparation (%25)
 - Developing Design Idea
 - Application Design
 - Preparation of Digital Content
 - Selection of suitable tool / software / tool (Brush etc.) to work
 - Timing (%10)
 - Working properly in lesson plan
 - Quality (%35)
 - Conclusion study and initial idea cohesion
 - Aesthetic quality
 - Originality and Creativity
 - Attention to Details and Touch-ups
 - Interaction quality of the application
 - Exam Presentation (10%)
 - General (In-Class Individual) Performance (20%)
 - Careful use of studios and equipment
 - Working discipline and independent performance
 - The complexity / level of digital technology used
 - Attendance to the course
 - Participation in activities related to the field

DURATION: 1. DAY art work and report submission.

2. DAY 15 min visual presentation + 5 min question answer time.

10, 11, 12, 13, 14 and 15. WEEKS

NAME OF THE EVENT: Development of the Final Project

OBJECTIVE: Understanding information about mobile application development, device testing and compilation with Augmented Reality (AR).

LEARNING OUTPUTS: Participants;

- They analyze mobile AR application development,
- They have in-depth knowledge of current mobile AR applications,
- Gain experience in developing a functional mobile AR application,
- They work together with their own discipline and different disciplines,

MATERIAL: Unity software, Vuforia plugin, internet connected computer (win/mac).

DURATION: 150 mins. (10-minute breaks in every 50 minutes.)

- 1. The end of term project covers a long period of 6 weeks. In this process, students are expected to develop a functional mobile AR application by fulfilling the work packages listed below.**
 - To analyze trends related to AR technology,
 - To search the literature about AR technology and applications,
 - To examine existing mobile AR applications in terms of their functions, target audiences, interface designs, interaction methods and visual quality of their content,
 - Presentation of the obtained data in the form of peer presentations,
 - Preparing the application design idea in written homework format,
 - Production of digital content in accordance with the idea,
 - AR application development / production / testing
 - Production of versions compiled for mobile devices
 - Delivery of Unity archive and mobile application files,
- 2. Applications to be developed are expected to be prepared in a subject and fiction that will meet a real need such as an art museum, an archeology museum, a hospital, an application integrated with the book, an application for the field of education (medicine, design, art, etc.).**
- 3. Students are asked to make self-assessment and peer assessment for their end-of-term studies. Feedback is received from students about the work of themselves and their peers.**
- 4. They continue their individual studies for 6 weeks in which students will develop their projects. The trainer monitors each student's work at weekly intervals and guides them as necessary. This guidance is done by giving and encouraging the critics that will carry each student forward individually according to the working speed, style and nature of the study.**
- 5. The trainer follows the students' processes through the process follow-up form, receives the projects of the student's project on weekly 16th and 17th week and evaluates student success with the criteria and approach detailed in the preparation method section of the preparation, quality of work, student performance in the process, project presentation, etc.**

16. and 17. WEEK

NAME OF THE ACTIVITY: FINAL EXAM

SUMMARY OF EVALUATION METHOD: Midterm evaluation of this course is based on a Mobile AR Application and process evaluation: Exams are measured over 100 points. A process evaluation form will be used for evaluation (Appendix). End of term application projects are expected to be compiled on Android or iOS mobile devices, assignments will be delivered in the Unity stage archive file and .APK on the Google Classroom platform of this course.

EVALUATION PLAN

EXAM	SUBJECT		
Midterm Project 1	AR Mobile Application - II	%70	
General Performance	Individual Classroom Performance	%20	
Exam Presentation	Visual Presentation Performance	%10	TOTAL %100

EVALUATION CRITERIA:

AR Mobile Application

- Preparation (%25)
 - Developing Design Idea
 - Application Design
 - Preparation of Digital Content
 - Selection of suitable tools / software / tools to work (Brush etc.)
- Timing (%10)
 - Working in accordance with the lesson plan
- Quality (%35)
 - Conclusion study and initial idea cohesion
 - Aesthetic quality
 - Originality and Creativity
 - Attention to Details and Touch-ups
 - Interaction quality of the application
- Exam Presentation (%10)
- General (In-Class Individual) Performance (20%)
 - Careful use of studios and equipment
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 - The complexity / level of digital technology used
 - Attendance to the course
 - Participation in activities related to the field

DURATION: 1. DAY art work and report submission.

2. DAY 15 min visual presentation + 5 min question answer time.