AR & VR in design for manufacture

Project number: 2017-1-TR01-KA202-045941

DR E. UNVER, DR O. HUERTA, M. DAWOOD

Innovative Design Lab Workshop, University of Huddersfield, 5 Feb 2019, Room: OA3/13, Time: 12:30-17:00

Co-funded by the Erasmus+ Programme of the European Union

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PARTNERS

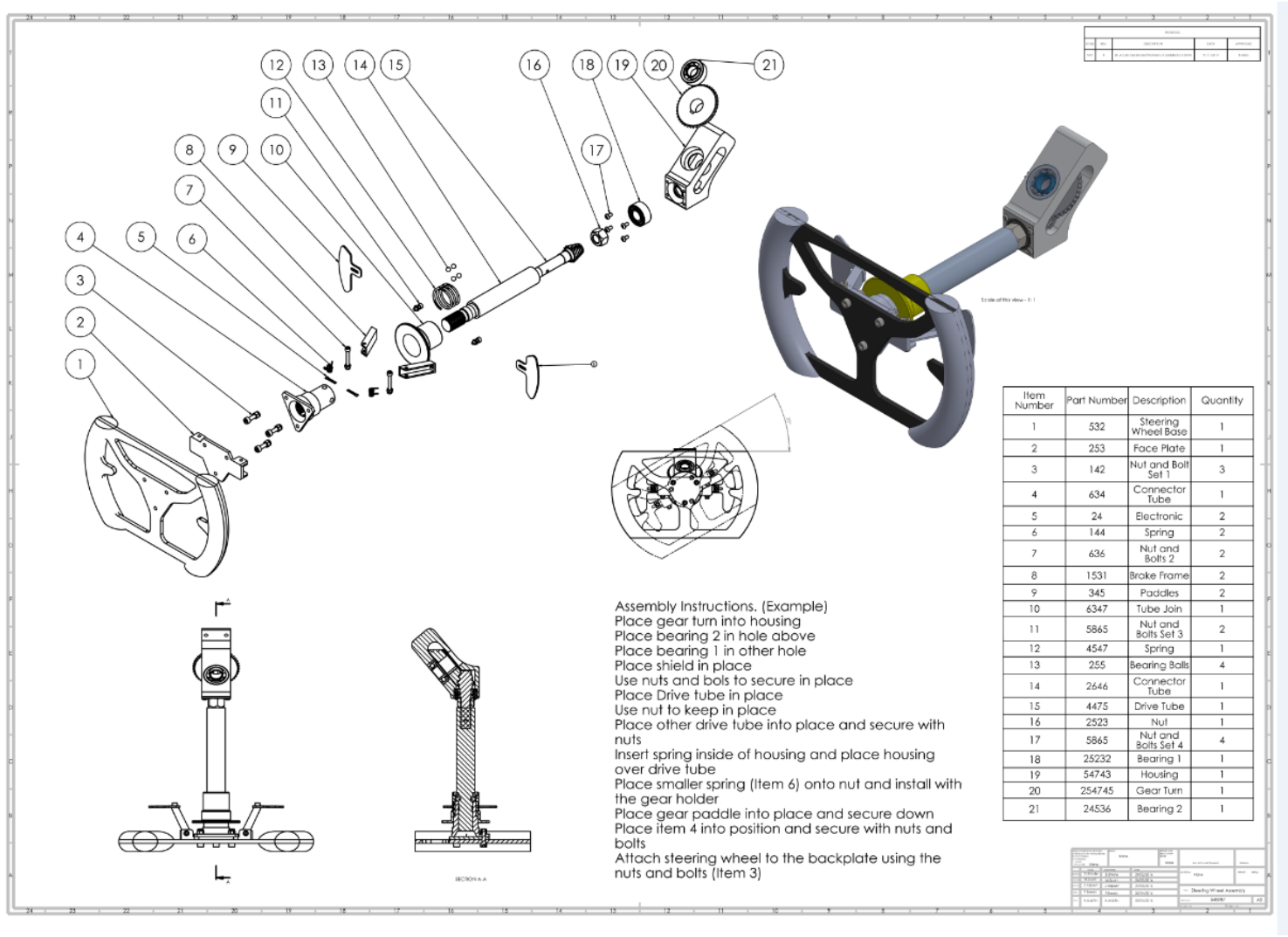
- University of Huddersfield (Academic)
- https://www.hud.ac.uk/

- Bulgarian Partner (Academic)
- https://tu-sofia.bg/

- Turkish Partner (Academic)
- http://www.uludag.edu.tr/

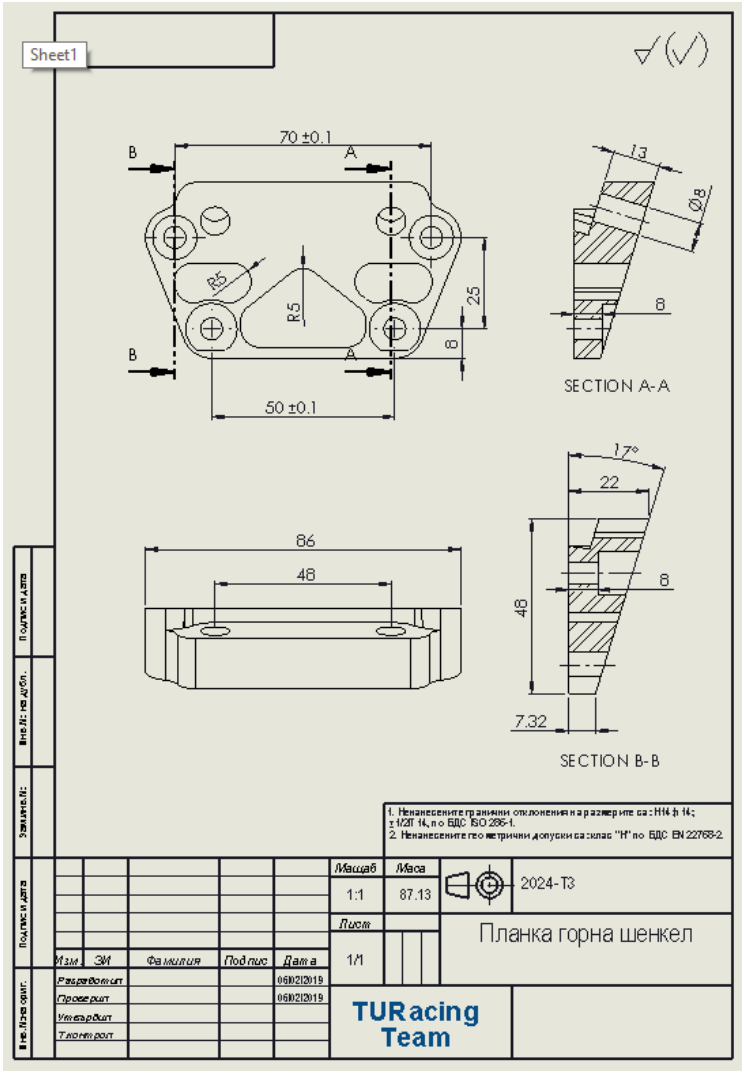
- Turkish Partner (Commercial)
- http://www.bizpark.com.tr/lab/

WHAT ARE TECHNICAL DRAWINGS (GA, DETAIL, BOM, BS-8888)



Item Number	Part Number	Description	Quantity
1	532	Steering Wheel Base	1
2	253	Face Plate	1
3	142	Nut and Bolt Set 1	3
4	634	Connector Tube	1
5	24	Electronic	2
6	144	Spring	2
7	636	Nut and Bolts 2	2
8	1531	Brake Frame	2
9	345	Paddles	2
10	6347	Tube Join	1
11	5865	Nut and Bolts Set 3	2
12	4547	Spring	1
13	255	Bearing Balls	4
14	2646	Connector Tube	1
15	4475	Drive Tube	1
16	2523	Nut	1
17	5865	Nut and Bolts Set 4	4
18	25232	Bearing 1	1
19	54743	Housing	1
20	254745	Gear Turn	1
21	24536	Bearing 2	1

Assembly Instructions. (Example)
Place gear turn into housing
Place bearing 2 in hole above
Place bearing 1 in other hole
Place shield in place
Use nuts and bols to secure in place
Place Drive tube in place
Use nut to keep in place
Place other drive tube into place and secure with nuts
Insert spring inside of housing and place housing over drive tube
Place smaller spring (Item 6) onto nut and install with the gear holder
Place gear paddle into place and secure down
Place item 4 into position and secure with nuts and bolts
Attach steering wheel to the backplate using the nuts and bolts (Item 3)



PROJECT BACKGROUND

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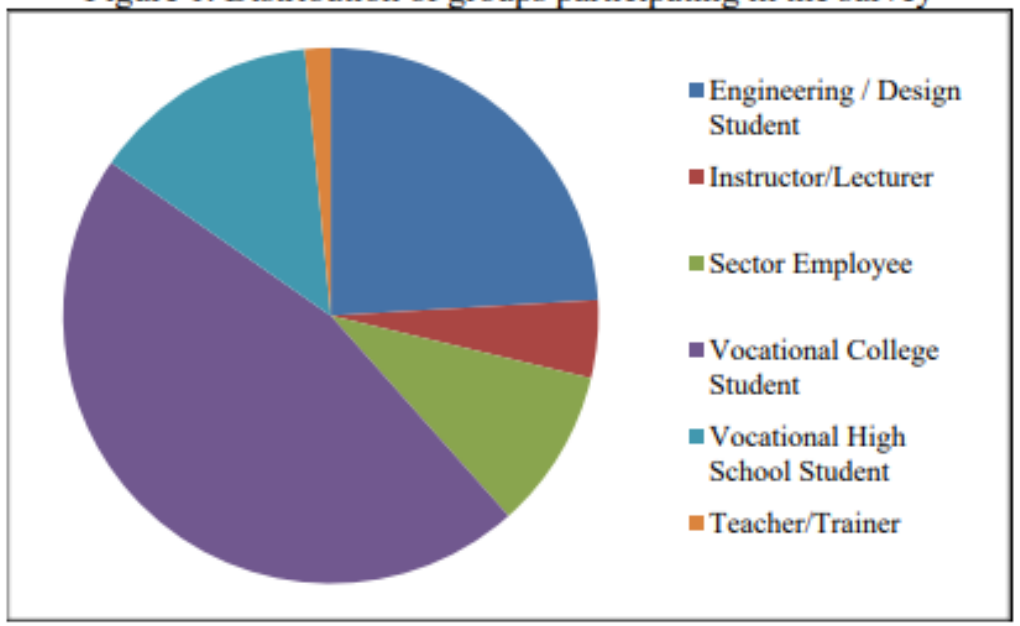
- **Project title:** Enhancing Technical Drawing Skills in Design & Engineering Education Using AR and VR Tools
- **Problem Statement:** There are concerns from higher education (HE) institutions and industry about the decline in standards of technical drawings (TD) (BS-8888) due to the lack of understanding of basic geometric construction and the conventions of drafting skills that underpin the best practices.
- **Aim:** Using a multi-disciplinary design-based research methodology, this European funded research project combines pedagogy and technology to approach TDs education problems; and to develop an AR/VR education solution to address learning difficulties.
- **Funding:** €156k (Co Funded by the Erasmus+ Programme of the European Union)
- **Duration:** 2 Years
- **Outputs:**
  - Animations / Simulations
  - VR app development for HTC Vive
  - AR / VR Development for Android Mobile platform

RESEARCH: NEEDS ANALYSIS

As well as comprehensive literature review, we carried out a "Needs Analysis*" where 25 Likert-type scale (five-point) and 5 open-ended questions were asked in a survey with 320 people in different education and sectoral positions in three different countries. In this survey, 252 people from Turkey, 58 people from Bulgaria and 10 people from the UK participated.

Figure 1. Distribution of groups participating in the survey



- **1 – Dimensioning and Tolerances**
- **2 – Sectioning, Projections and Perspective Drawings**
- **3 – Dimensional Tolerances, Edge Tolerances, Shaft and Hole Tolerances**
- **4 – Geometric Tolerance/Form-Position Tolerances**
- **5 – Surface Treatment Markings/Surface Roughness**
- **6 – Production and Assembly Drawings**

*Needs analysis is an element of designing or reviewing a curriculum. Its purpose is to establish key learning outcomes and requirements in the design and delivery of a course or learning activity.

RESEARCH: NEEDS ANALYSIS

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As an example, **"Analysis of the perception of Technical Drawings questions"** showed that:

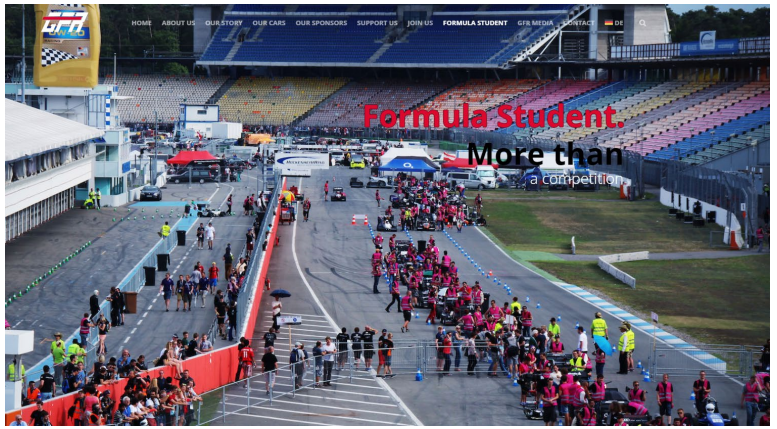
1. 76% of the participants believe they have **"*efficient Technical Drawing knowledge and skills required by their profession*"**
2. 70% find themselves confident for **"*using a common language in technical drawings and awareness of standards such as BS, ASME, ISO, DIN*".**
3. 73% said they have good skill in ***"Practical TD to support their theoretical technique knowledge".***
4. 88% of participants think that it is vital ***"to have technical drawing reading skills for technical staff"***
5. 84% of participants are aware of the importance of TD perception due to ***" technical drawing reading mistakes which cause discarded or low quality products"***

TOOLS

- **Software:**
  - SOLIDWORKS and 3DS Max (3D Modelling and Animation)
  - Photoshop, Illustrator and InDesign (Storyboarding and Editing)
  - Unity and Programming (C#) (VR/AR Applications)
  - Adobe Premiere and After Effects (Video and Sound Editing)
  - Keyshot (Rendering of Animations)
- **Hardware:**
  - HTC Vive
  - Android 7.0+ Smartphone
  - Samsung Gear VR
- **Work:**
  - Huddersfield – Design, Ideation, Storyboarding, Digital Modelling, Animation, Technical Drawings
  - Bulgaria – Car in production by Bulgaria, VR Development in Technical Content
  - Bizpark – Web Development, AR Application
  - Uludag – Engineering Knowledge, Technical Requirements

CAR MODEL

Vehicle being produced by Bulgaria for Formula student race team used as the centrepiece of the project to show real world applications.



METHODS:
DESIGN THINKING / DESIGN COUNCIL DOUBLE DIAMOND

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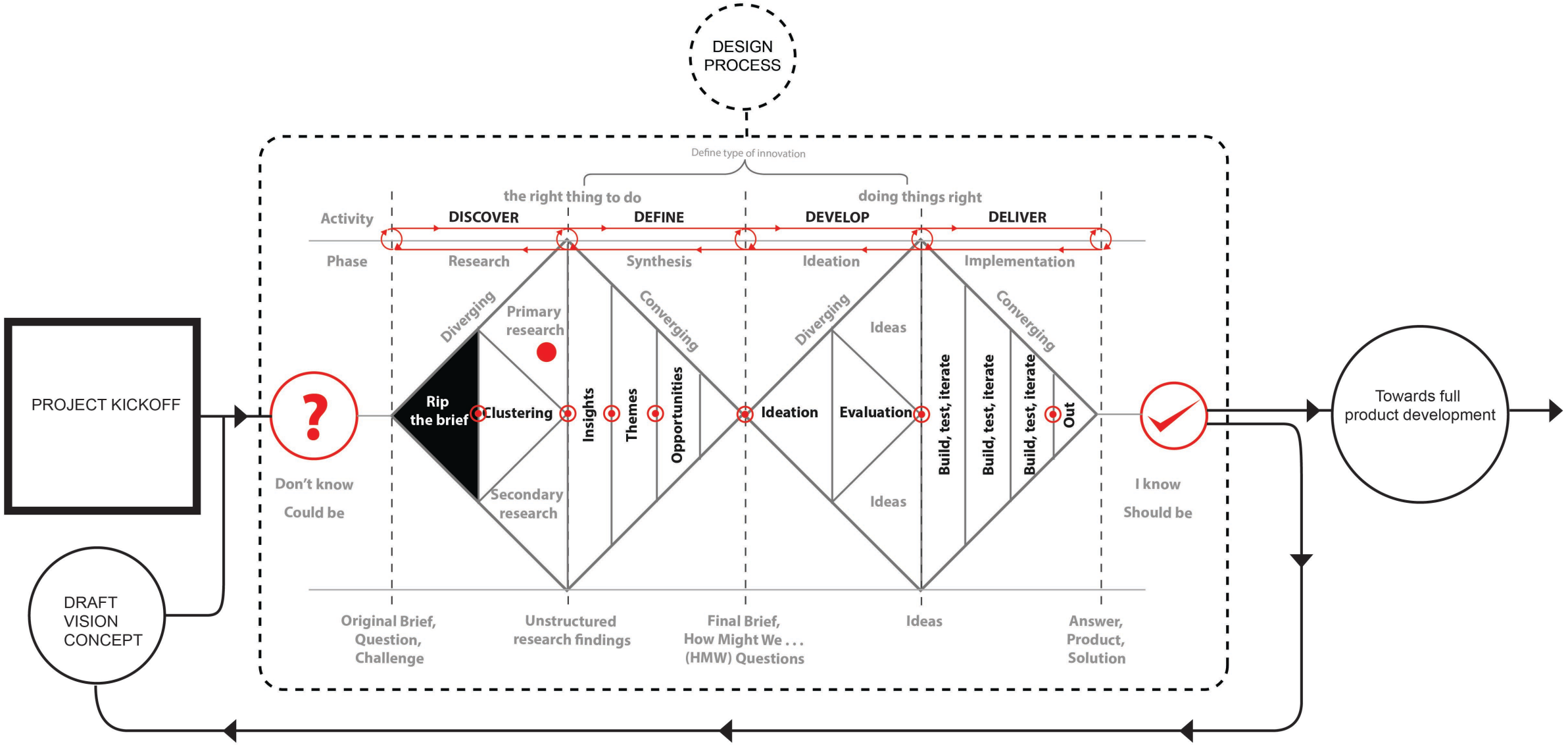
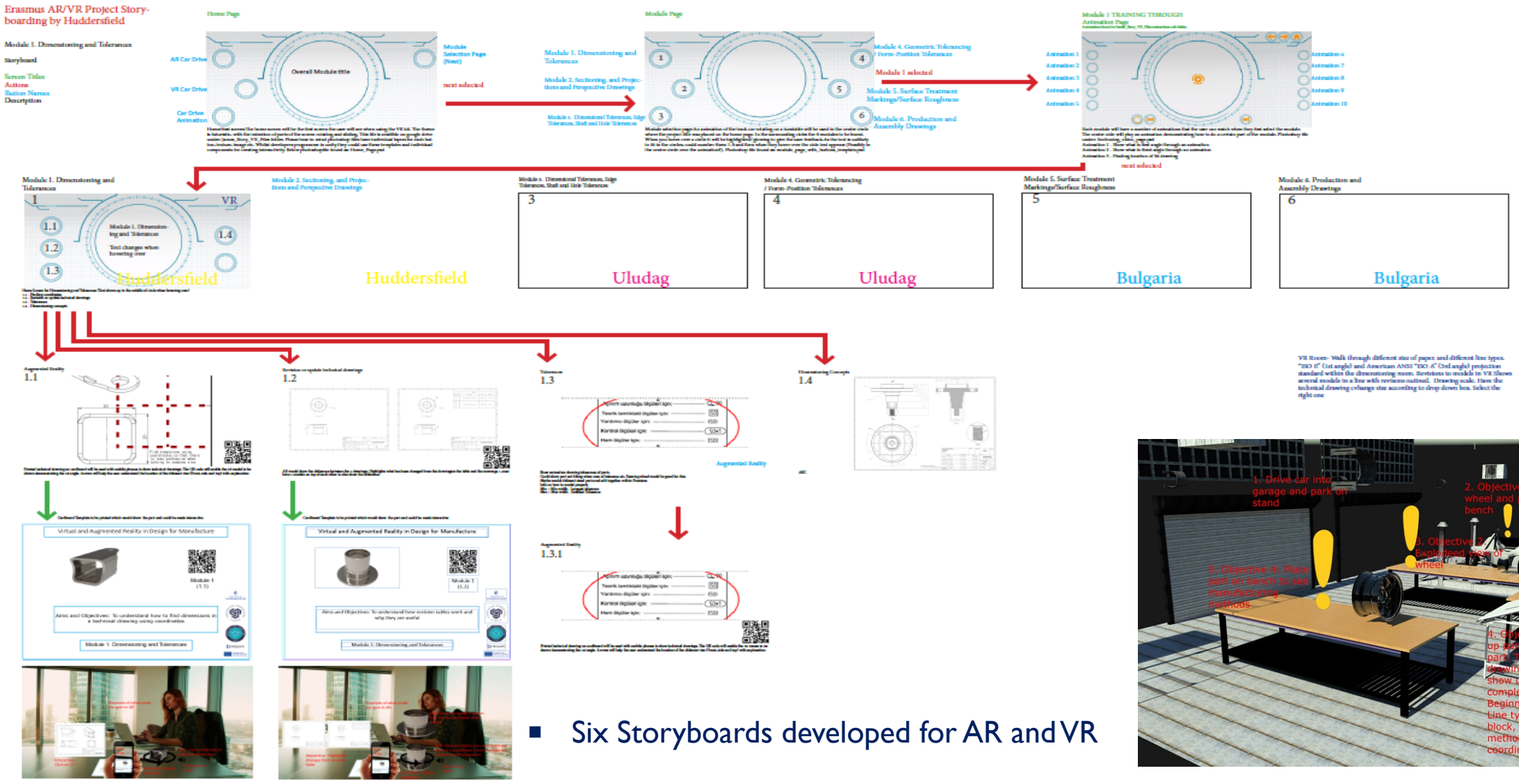
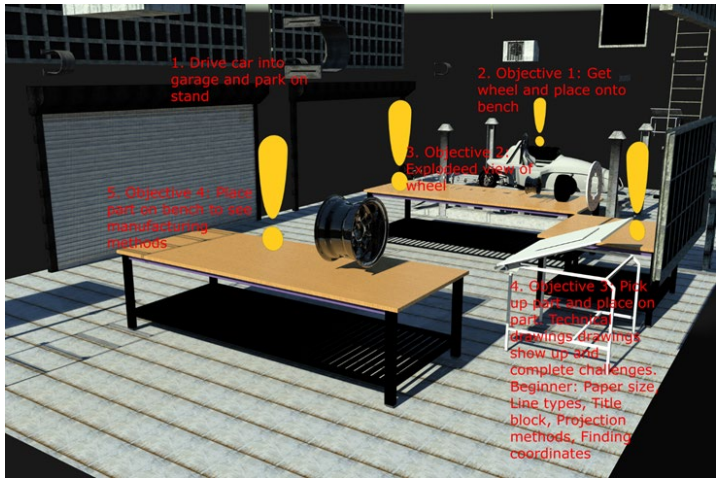


STORYBOARDING AND IDEATION





- Six Storyboards developed for AR and VR

ANIMATION PROCESS

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- https://www.youtube.com/watch?v=OwzmQS4yubI&list=PLRzfaYGqHLCrGfX7M-CtC-MI5GCWGn-3r&index=3
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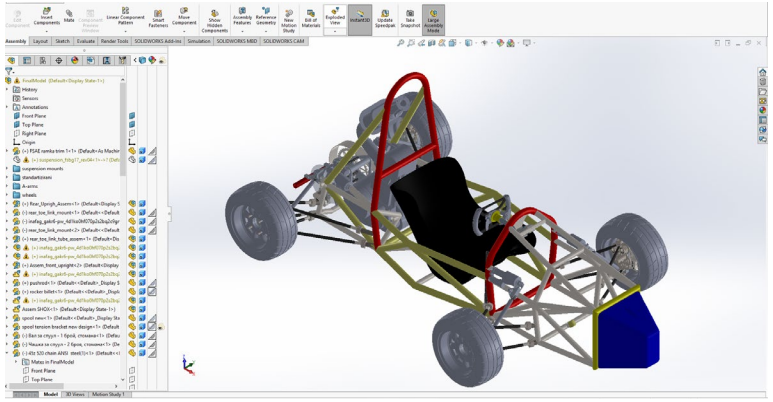

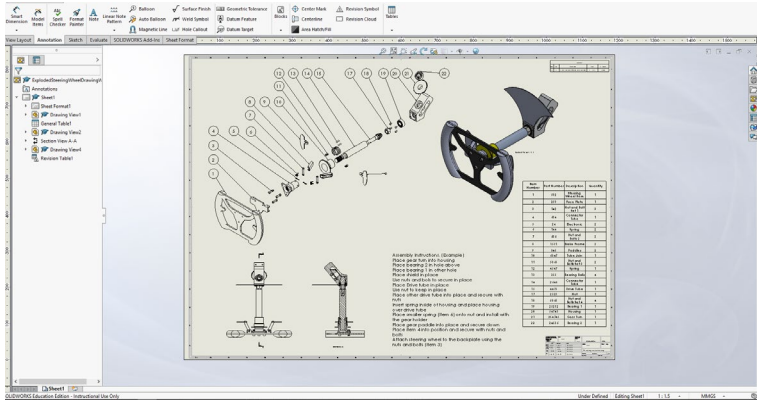

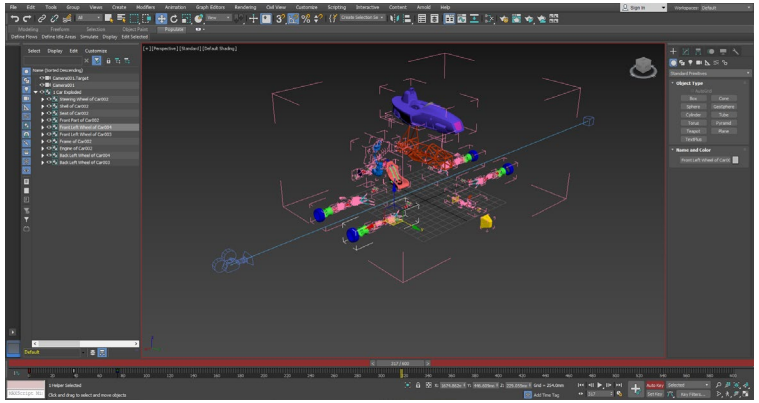

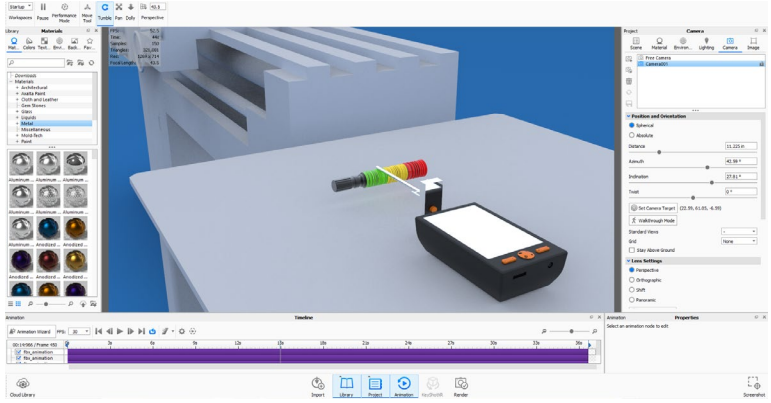

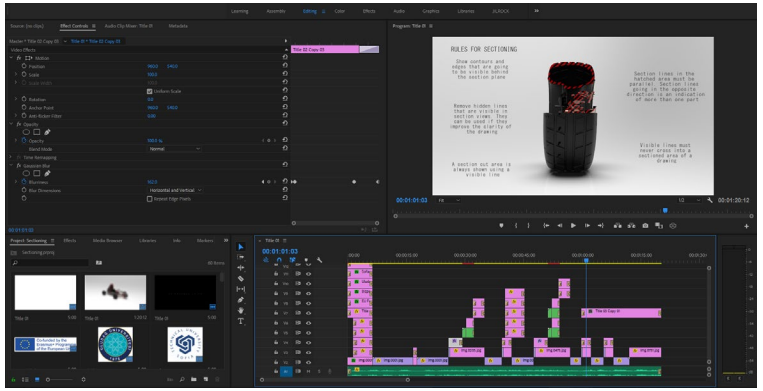

- SOLIDWORKS Car Model (Model assets if needed)
- SOLIDWORKS Drawing of part needed in Animation
- Key frame Animation in 3DS Max
- Export from 3DS Max to Keyshot to Render
- Import frames into Adobe Premiere
- Edit any frames in Photoshop to add information
- Add Sound and Information to animation
- Export
- Feedback
- Improve

ANIMATIONS

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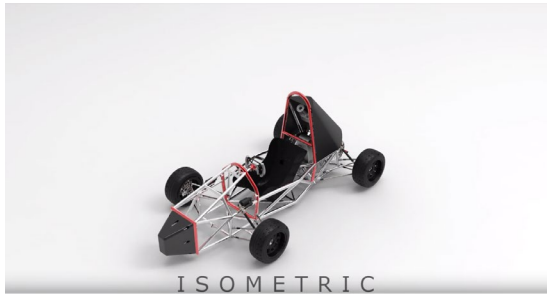
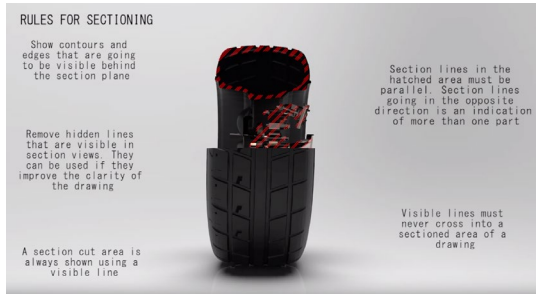
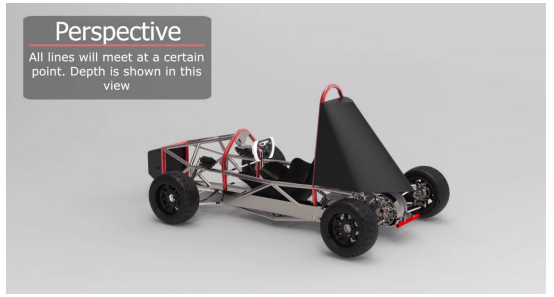
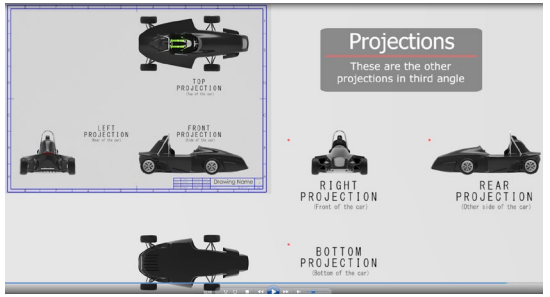
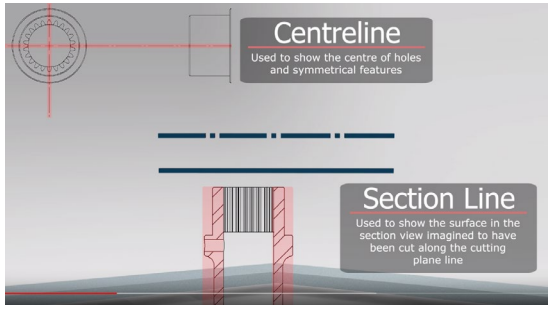
- Animations available on website. Link: http://vrindesign.org/en/Courses

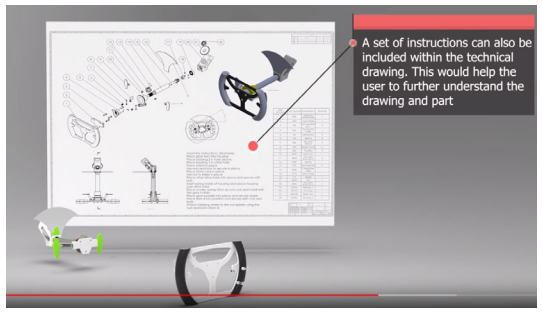


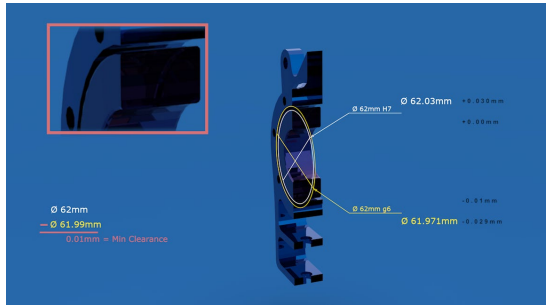


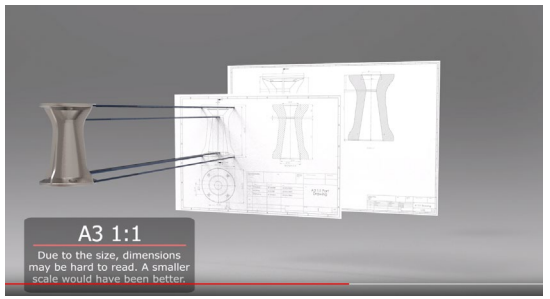




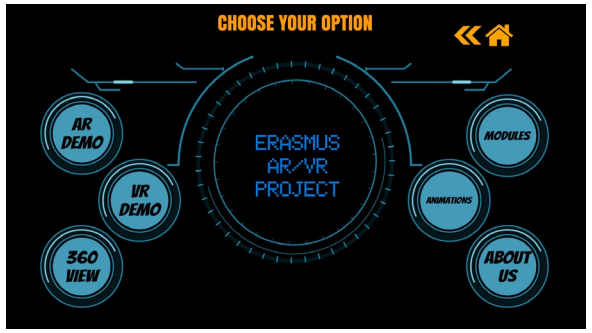


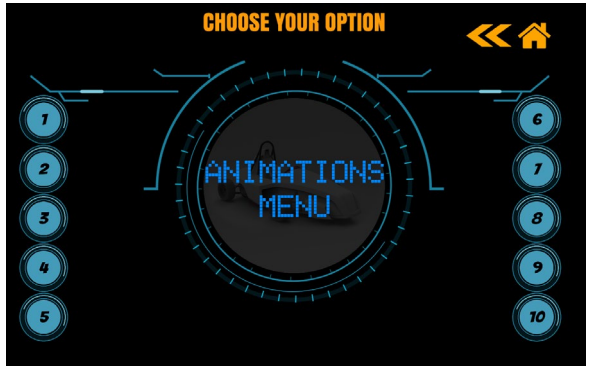


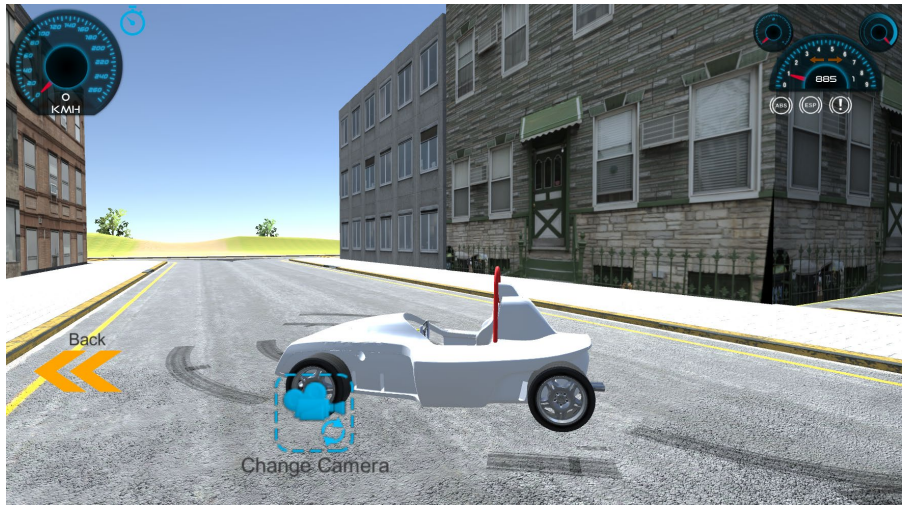


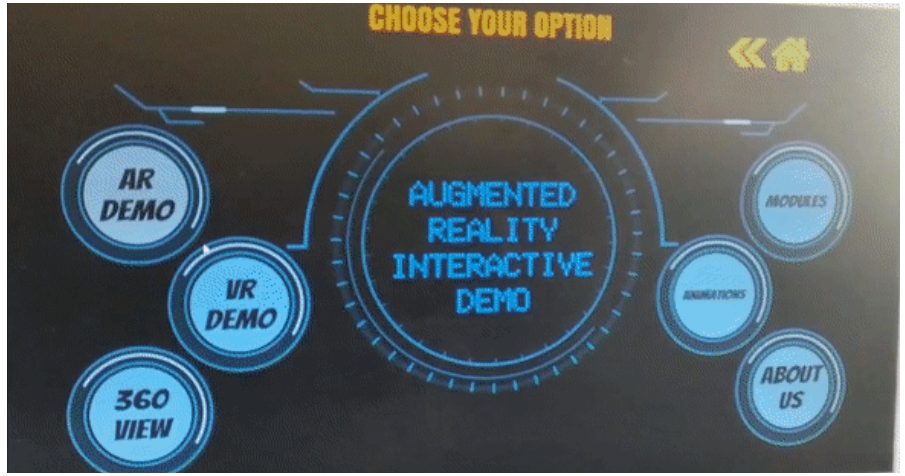


APPLICATION







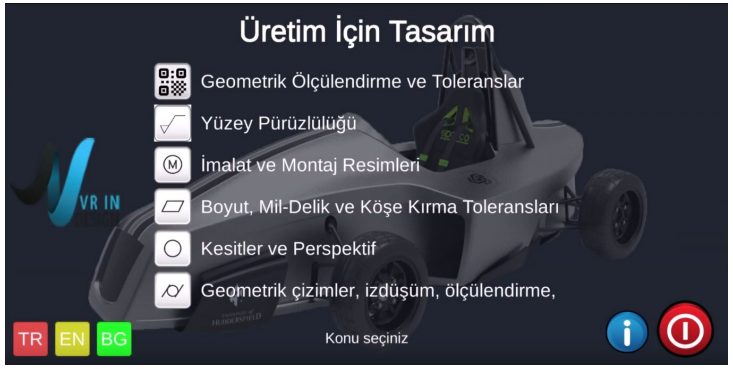


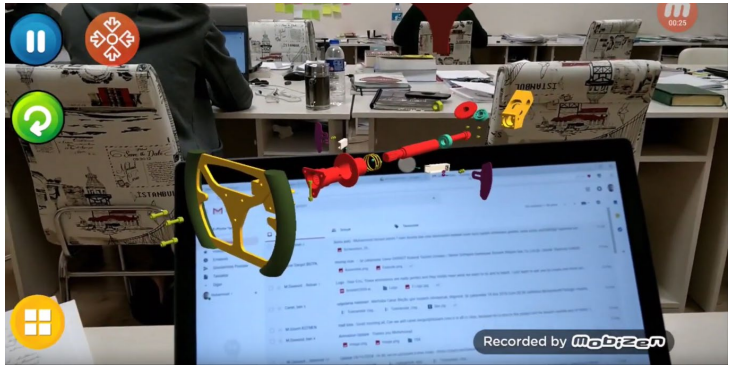
- Gamification exploration done in Unity to understand the impact on T&L

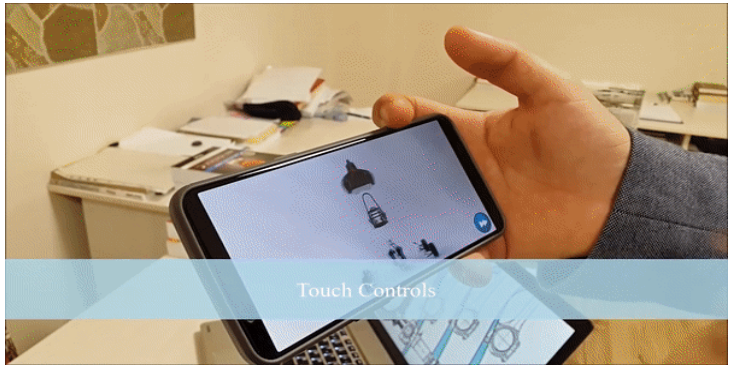
  (Credit: Navid Azhar – Digital 3D Designer)

AR DEVELOPMENT

- Car in AR – Virtual car in a real environment with the use of a phone camera

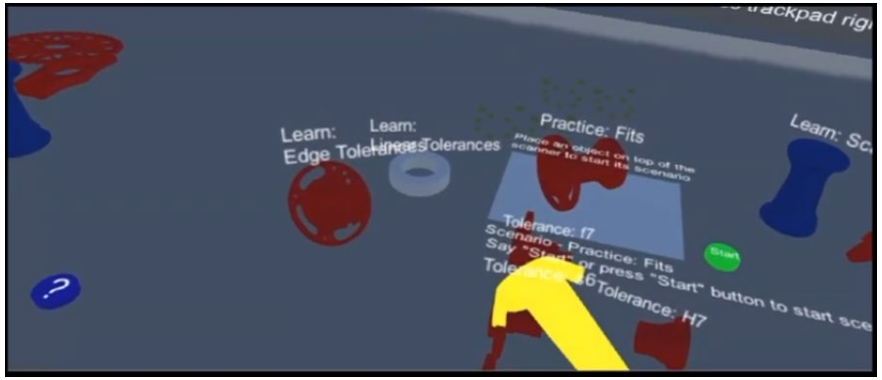


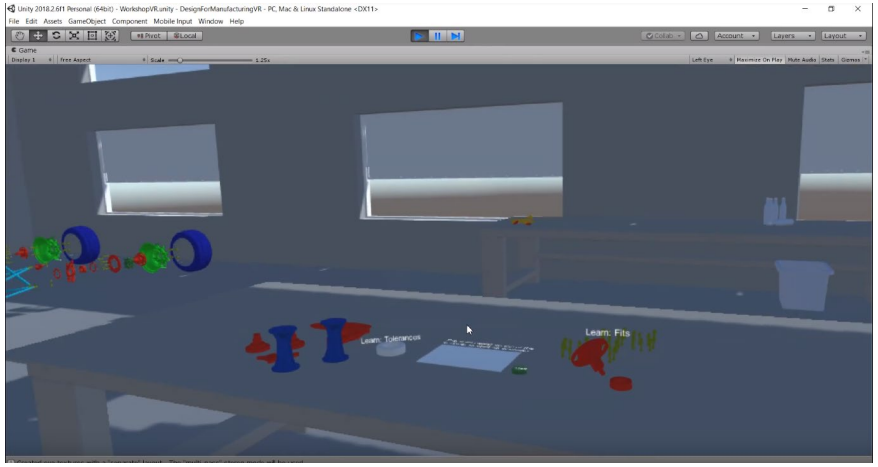


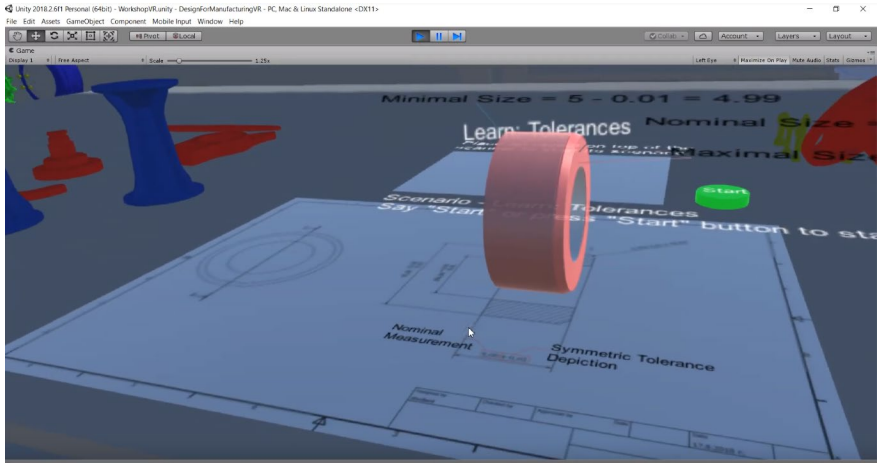


- AR application produced by Bizpark

VR DEVELOPMENT



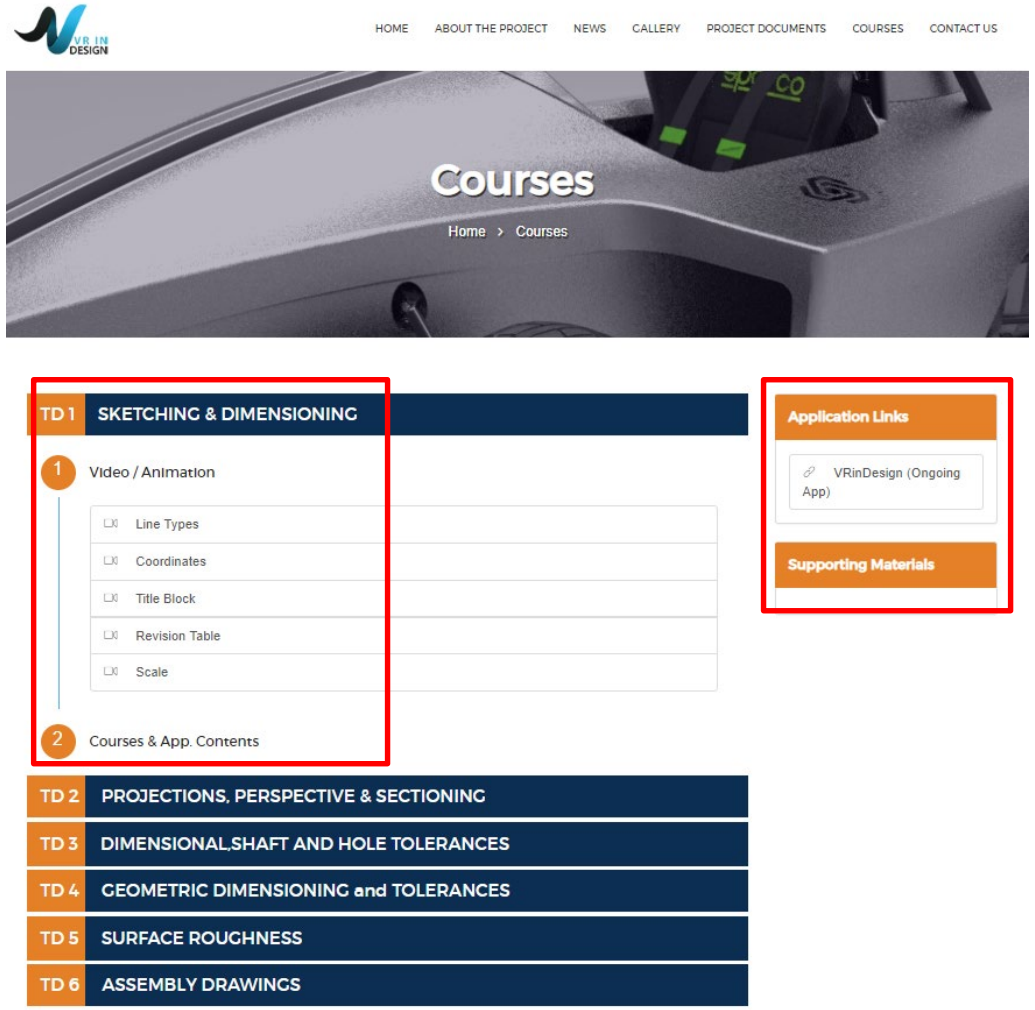




- VR Development done by Bulgaria for use with the HTC Vive (Unity and C# Programming) See: https://www.youtube.com/watch?v=tJn91VWsfaw

WEBSITE

http://vrindesign.org/



- Choose a module.
- Watch animations and see course content

- Download application for your android 7.0+ phone to test

CURRENT RESEARCH OUTPUTS

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- Conference Paper: XXVII International Scientific and Technical Conference Automation of Discrete Production ADP - 2018 21-24 June 2018 Sozopol, Bulgaria
- Conference Paper: IVAPP 2019 10TH International Conference on Information Visualization Theory and Applications – Prague
- Conference Paper (Planned) An international conference connecting people in CAD research, education and business CAD'19, June 24-26, 2019, Singapore
- Journal Papers (Planned) Journal of Computer-Aided Design and Applications - ISSN: 1686-4360
- Journal Papers (Planned) Journal of Mechanical Engineering Research in Turkey

BEST PRACTICES

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Communication and Data sharing:

- Facebook (Closed Group)
- WhatsApp, Skype and Facebook Messenger for conference calls (Weekly or Bi-Weekly)
- Google Drive (Data sharing for Non-confidential Data)
- Visit to partners (2 x Turkey, 1 x Bulgaria and 2 x UK for all Partners paid by EU)
- YouTube (Video based progress report)

Difficulty with international partnership

- Language, methods, management, deadlines, workload
- Access to the tools, hardware and skillset available

Final Conclusion

- Project is ongoing. The tools developed have not been used for T&L. This will be done in the evaluation phase which will be in the next 6 months..

QUESTIONNAIRE

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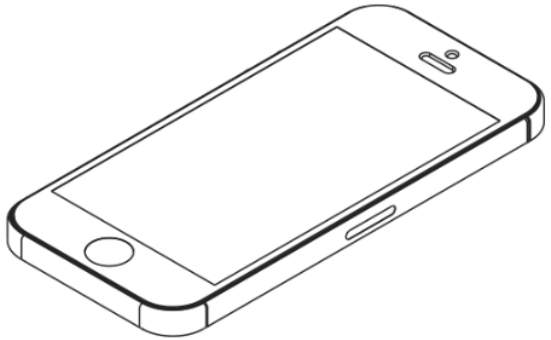
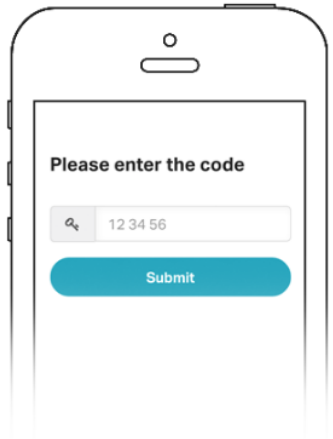
https://www.menti.com/

- Code: 79 16 0





1. Grab your phone
2. Go to www.menti.com
3. Enter the code 79 16 0 and vote!

QUESTIONNAIRE

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- Generic Questions (2)
  - Question 1: Which improvements would you recommend for this project? (Max 5 words)
  - Question 2: Are you interested in collaborating in a similar subject area which uses AR/VR and Animations? If so, which project ideas (Max 5 works)

- Quiz Questions (5)
  - Question 1: Which platform/technology do you think this application should be developed further (Android, Apple, Windows, Others)
  - Question 2: Have you used AR/VR applications for teaching and learning? (Yes, No, Briefly, Not Interested)
  - Question 3: To what extent do you agree with the following statement: Computer generated animations gives user a better understanding of the subject (Yes, No, Maybe, Not Interested)
  - Question 4: Which part of this project interests you more? (AR, VR, Animations, All, None)
  - Question 5: Which of the following communication have you used more for research and collaboration purposes? (Facebook, WhatsApp/Skype/Messenger, Personal visits, others)

THANK YOU

Contact us: info@vrindesign.org

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QUESTIONNAIRE ANSWERS

Go to **www.menti.com** and use the code **79 16 0**

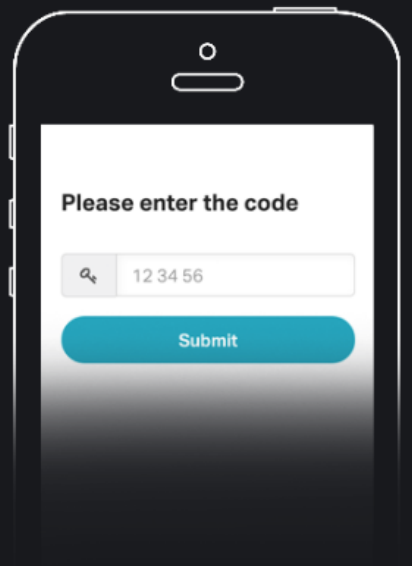
1

Grab your phone

www.menti.com

2

Go to www.menti.com



3

Enter the code 79 16 0 and vote!

Which improvements would you recommend for this project? (Max 5 Words)

Mentimeter

It would be good to have an evaluation of the implementation of the tools - did they effective helped learning and how?

Softwares: Nuke

Vr/ar collaboration

Drawing/modelling techniques

bring devices to presentation

Colaborativo teching

Healthcare

7

Are you interested in collaborating in a similar subject area which uses AR/VR and Animation? If so, which project ideas? (Max 5 Words)

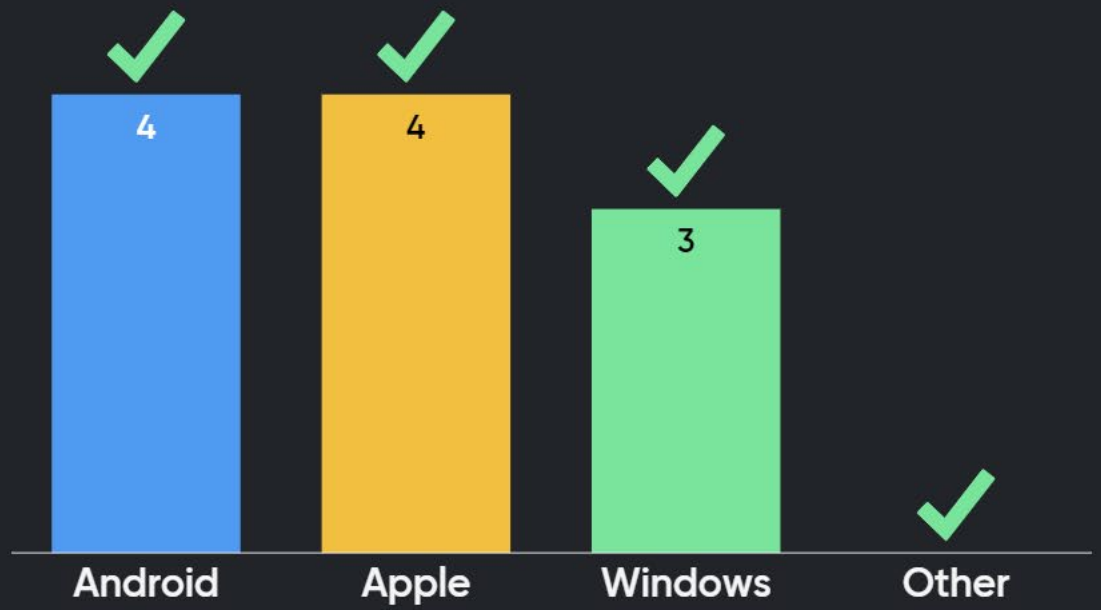
Mentimeter

- Yes. Construction details
- Yes - looking at other design ateas
- In architecture
- Wellbeing
- Mix reality
- healthcare design
- Pass
- Construction críticas processes
- On site visualization
- Social housing

10

Which platform do you think should be used for the further development of this application?

Mentimeter

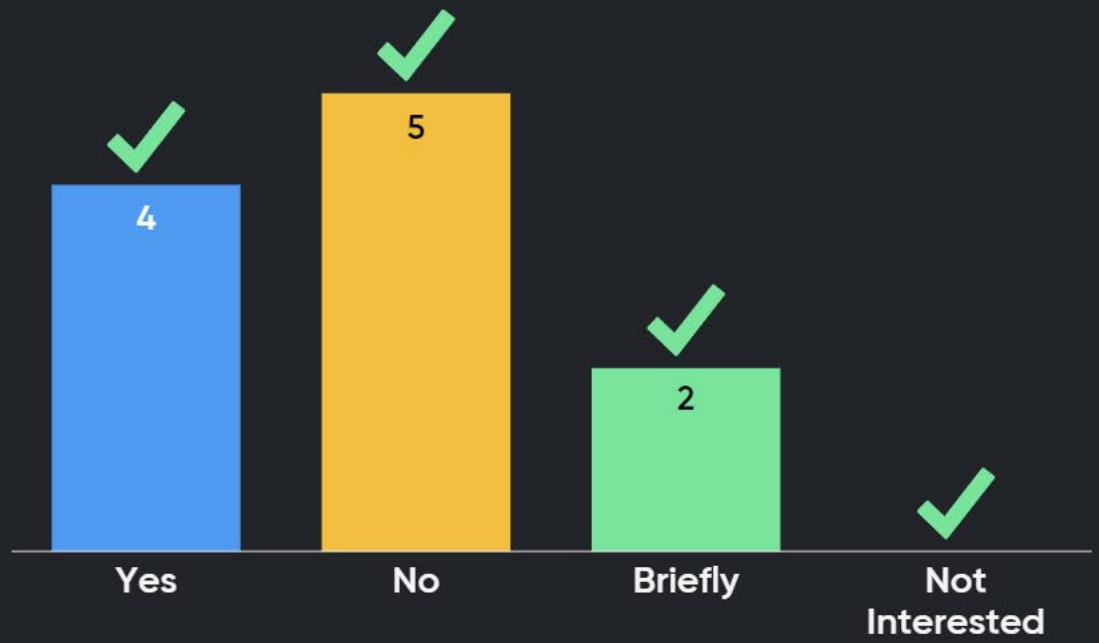


Continue → to next question

11

Have you used AR/VR applications for teaching and learning?

Mentimeter

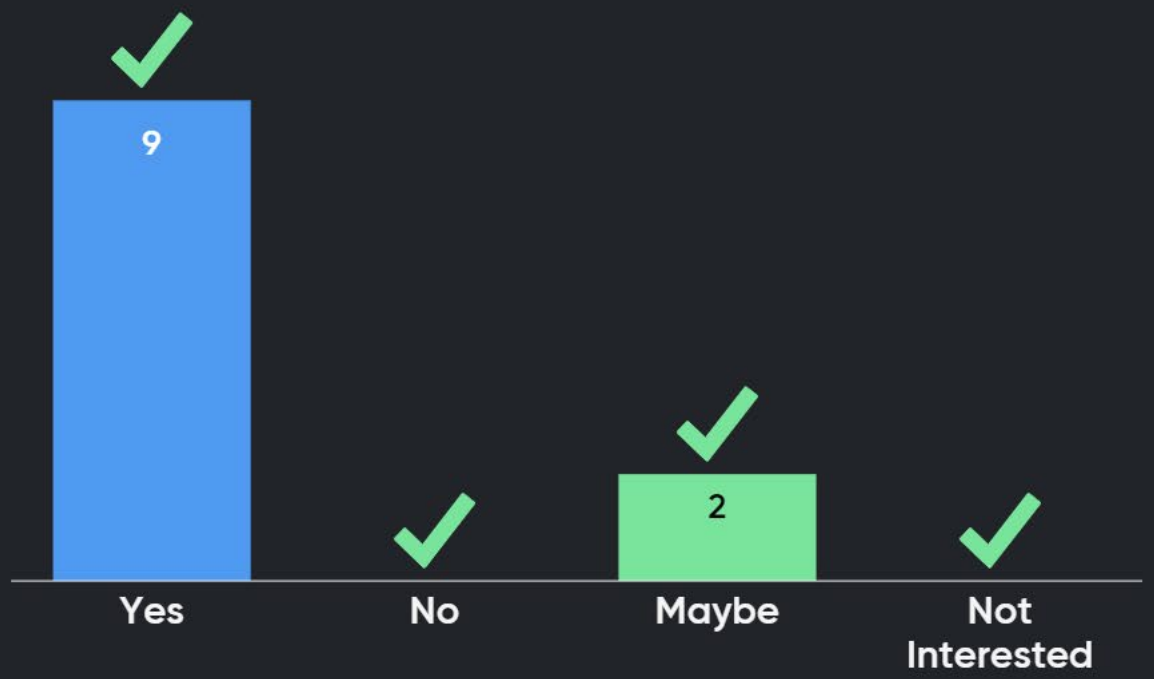


Continue → to next question

11

To what extent do you agree with the following statement: Computer generated animations give users a better understanding of the subject

Mentimeter

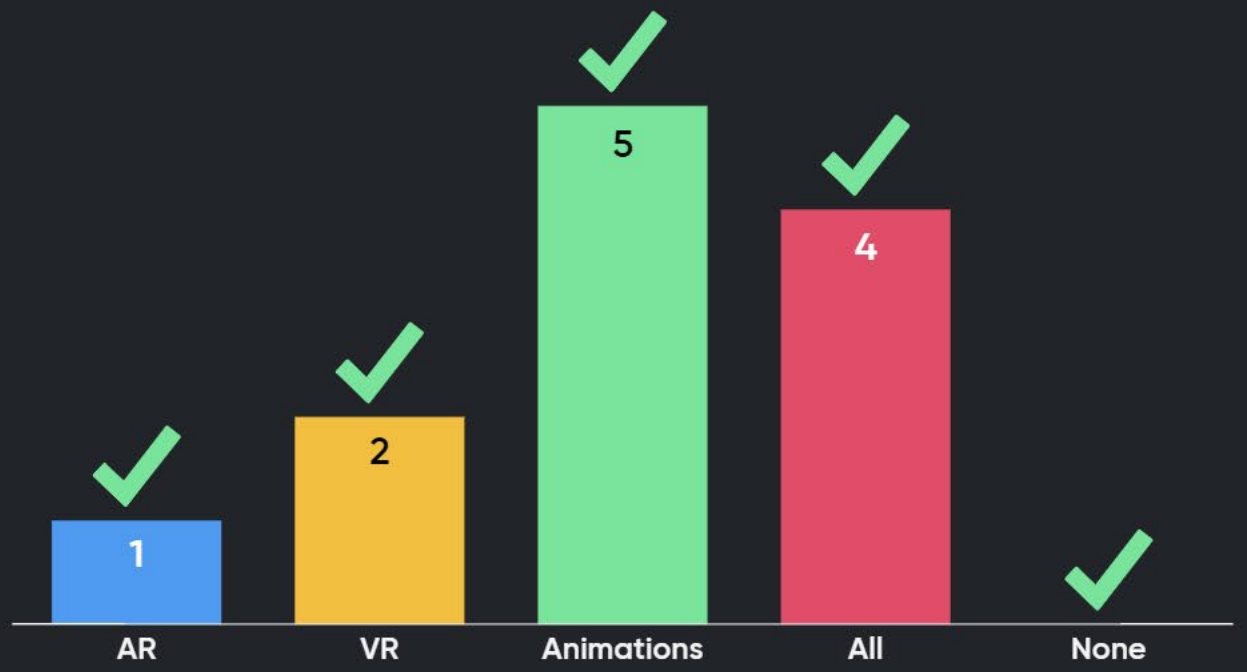


Continue → to next question

11

Which part of the project interests you more?

Mentimeter

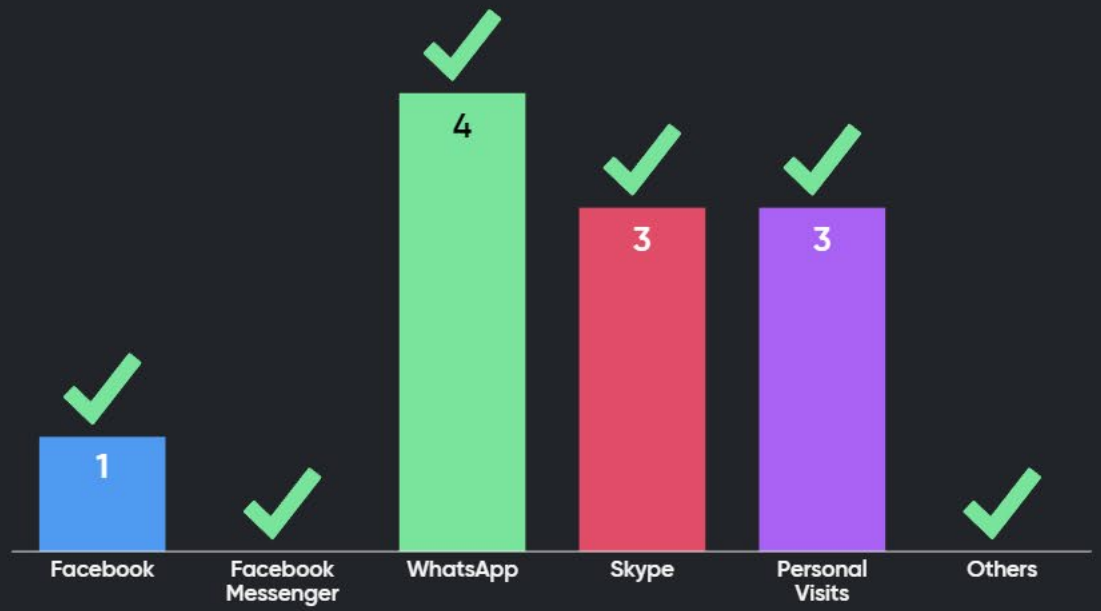


Continue → to next question

12

Mentimeter

Which of the following communication platforms have you used more for research and collaboration purposes?



Show the winner

11