Application of VR and AR Tools for Technical Drawing Education

Try the app

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University of HUDDERSFIELD
Inspiring tomorrow's professionals

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

Dr Unver, 2019, Bursa, Turkey

Contents

University of Huddersfield

Chancellor :
HRH Duke of York

Previous Chancellor :
Professor Sir Patrick Stewart

- **History:**
- 1825: Huddersfield Scientific and Mechanic Institute
- 1841: Young Men's Mental Improvement Society
- 1844: Huddersfield Mechanics Institute formed
- 1884: Huddersfield Technical School
- 1896: Technical College
- 1902: First graduates
- 1958: College of Technology
- 1970: Huddersfield Polytechnic
- 1992: **University of Huddersfield**

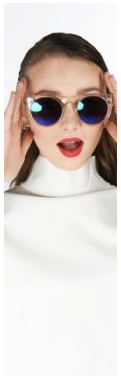
Schools: (Faculties)

- ***School of Art, Design and Architecture***
- School of Music, Humanities and Media
- School of Education & Professional Development
- Business School
- School of Human and Health Sciences
- School of Applied Sciences
- School of Computing and Engineering

Ranking / Numbers:

- 20.000 Students, 20:1 Student staff ratio
- 601–800th World University Rankings 2020, 151–200th Young University Rankings 2019

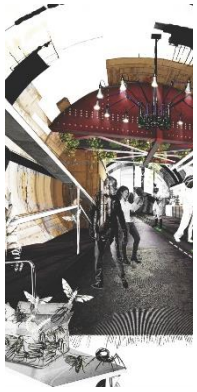
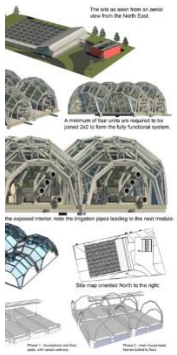
School of Art, Design and Architecture:









Research Centres:

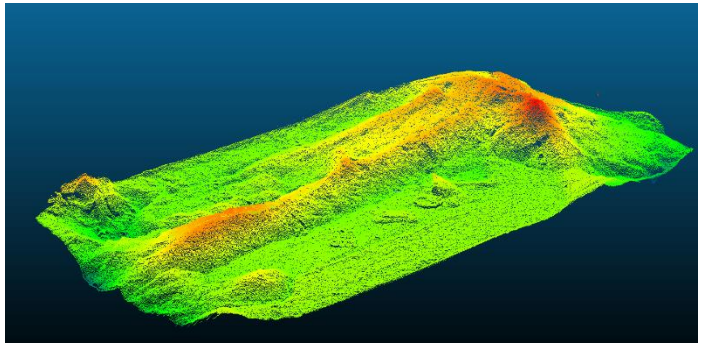
- Centre for Urban Design, Architecture and Sustainability (CUDAS)
- Global Disaster Resilience Centre (GDRC)
- Centre for Sculptural Thinking: G
- Fashion and Costume Thinking Textile Thinking
- ***Innovative Design Lab (IDL)***

UG/PG Courses:

- Architectural Technology BSc(Hons)
- Architecture/Architecture (International) BA(Hons)
- Interior Design BA(Hons)
- Product Design BA/BSc(Hons)
- Animation BA(Hons)
- Contemporary Art and Illustration BA(Hons)
- Graphic Design and Animation BA(Hons)
- Photography BA(Hons)
- Costume with Textiles BA(Hons)
- Fashion Brand Marketing BA(Hons)
- Fashion Design with Textiles BA(Hons)
- International Fashion Buying Management BA(Hons)
- Textiles BA/BSc(Hons)

Selected Research Projects:

Metal 3D printing



BHF / Duchess of York Live Project

Huddersfield and Waldeck digital capture technologies, including the use of (UAV) Drones:

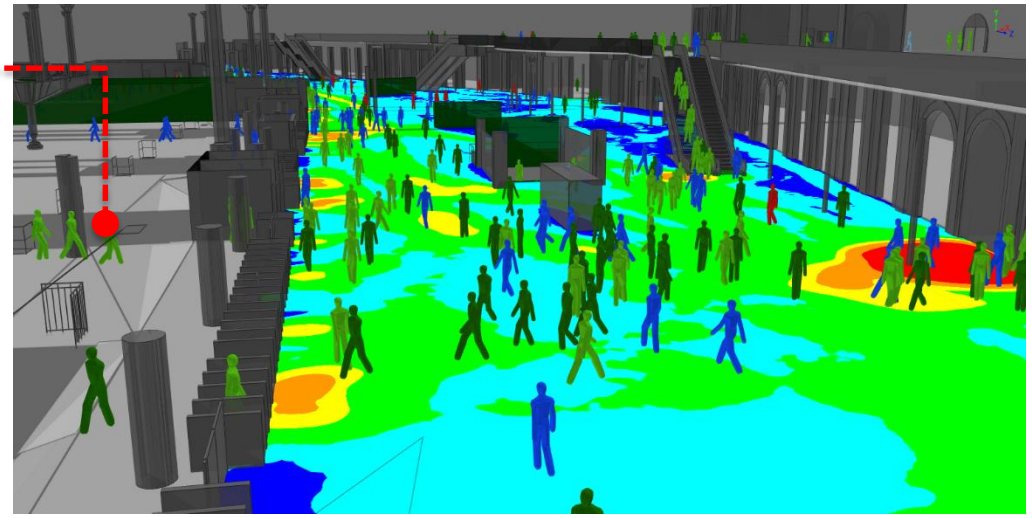
- ✓ Civil Aviation Authority (CAA) approved pilots
- ✓ Permission for Commercial Operations (PfCO)
- ✓ Advanced Data Processing Capability

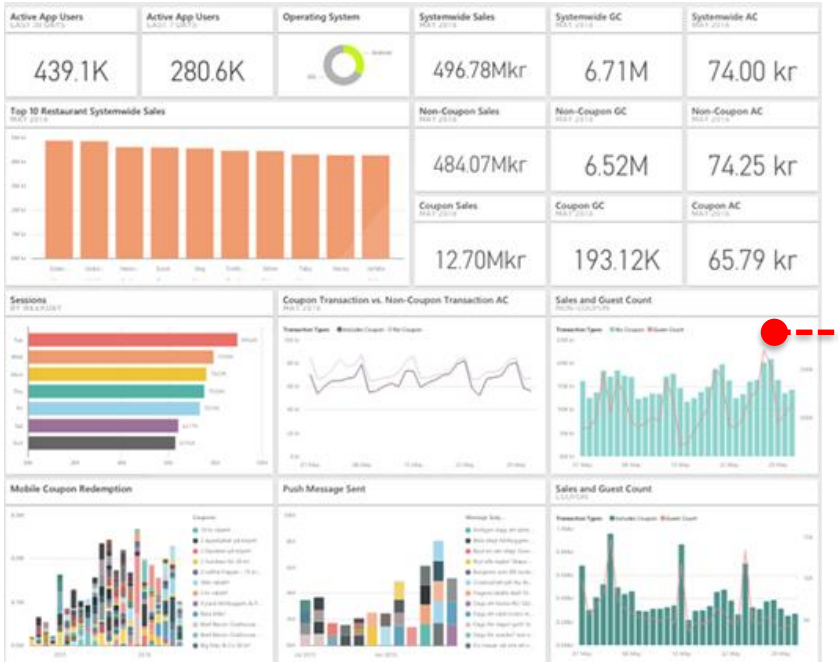
Selected Research Areas:

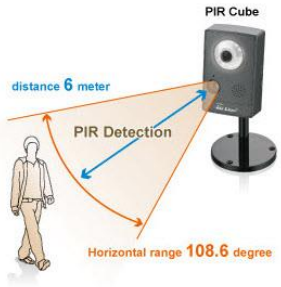
Occupant energy behaviour simulation; Design implications for healthcare building; BIM Protocol; Lean Construction at Highways SMEs

Comfortable environment: Light; Sound; Temperature ; Air quality, Well-functioning healing space: Safety; Control feeling; Flexibility
Relaxing atmosphere: Display; Links to nature; Multi sensory stimulus

ML & Crowd Analysis







IoT Occupants detection

Selected Research Projects: Paxman Scalp Cooling

Scalp cooling is a simple treatment that can **prevent hair loss** caused by certain **chemotherapy** drugs. The use of scalp cooling or 'cold caps' is proven to be an effective way of combatting chemotherapy-induced hair loss

Rapid Tooling: SLS Printing, 3D Anthropometric data.

PAXMAN and the University of Huddersfield have signed a *five-year research and collaboration agreement* covering the PAXMAN Scalp Cooling Research Centre (PSC), a new multi-disciplinary research group based at the University with the ***£1 million investment***.

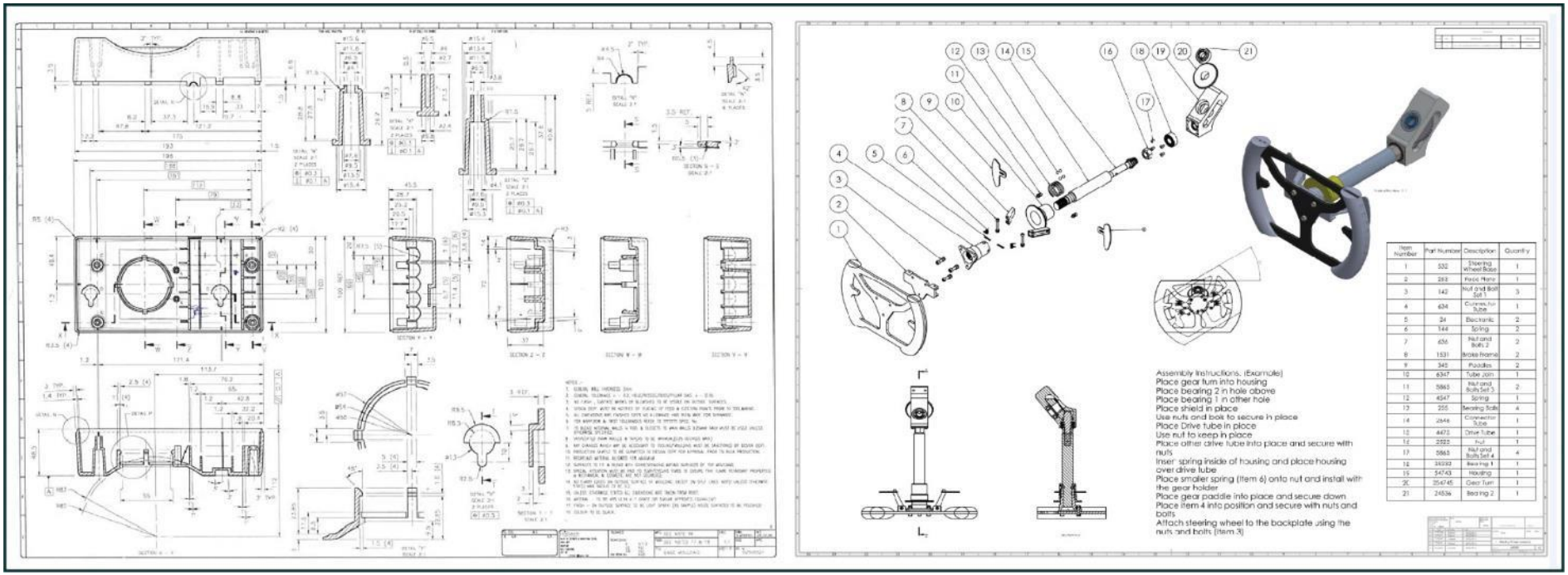
The Centre will focus **on biological hair follicle research** as well as developing innovative scalp cooling-related treatments and **individual 3D-printed cooling caps**

Awards:
Winner of Medtec Ireland Exhibitor Innovations Accolade Award (4-5 Oct 2015)
Medilink Partnership with Academia Award 2016
Made in Yorkshire Healthcare Manufacturer Award 2016
British American Business Transatlantic Growth (TAG) Award for Export 2018
EEF Manufacturer of the Year Award2019
EEF Business Growth and Strategy Award 2019
InnovateUK Outstanding KTP Award

Shortlists:
Times Higher Education Awards
Finalist of the INDEX: Design to Improve Life Award 2015
EEF Innovation Award Recognition 2019

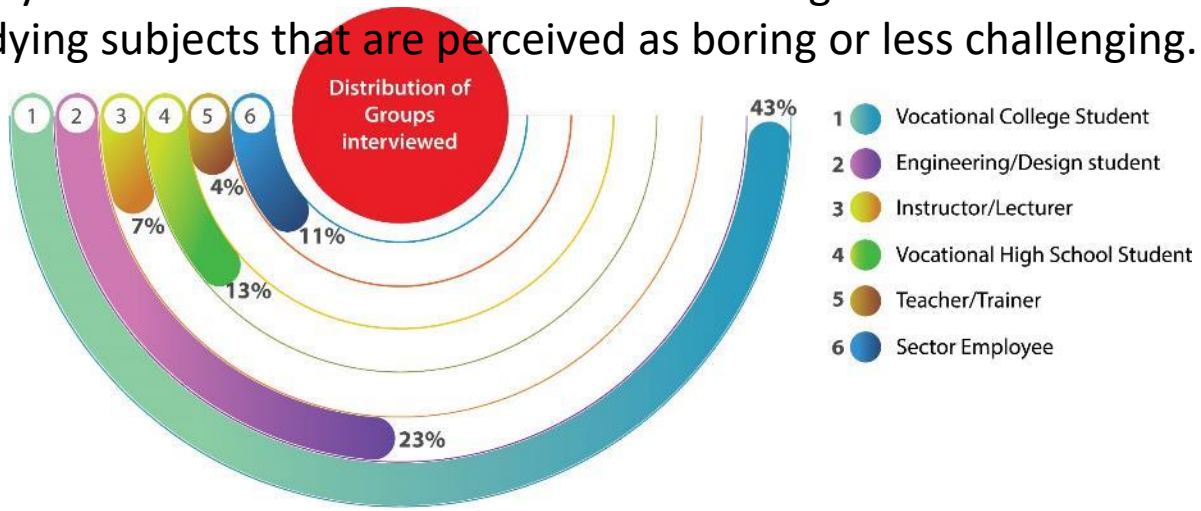
The AR/VR Project Background

There are concerns from Higher Education (HE) institutions and industry about the decline in standards of Technical Drawings (TD) due to the lack of understanding of basic principles and conventions that underpin the best practices.



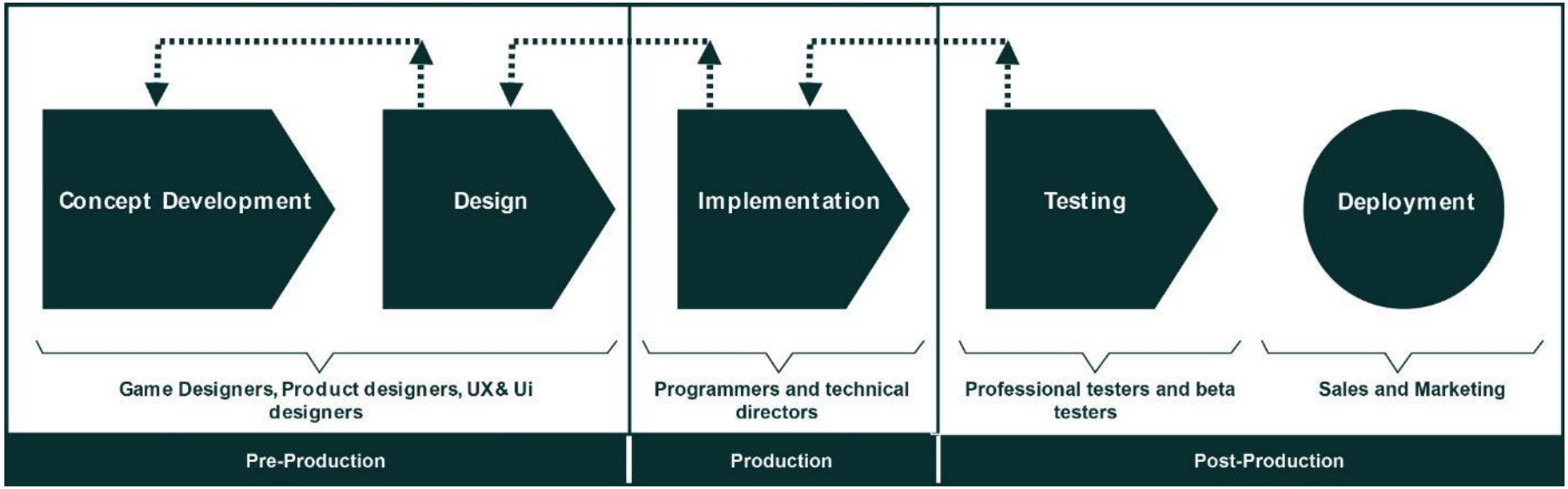
The Problem

Students experience difficulties learning complex technical subjects therefore new, innovative engaging methods and technologies are needed. Students prefer to learn in interactive ways rather than the traditional teaching methods and are less interested in studying subjects that are perceived as boring or less challenging.

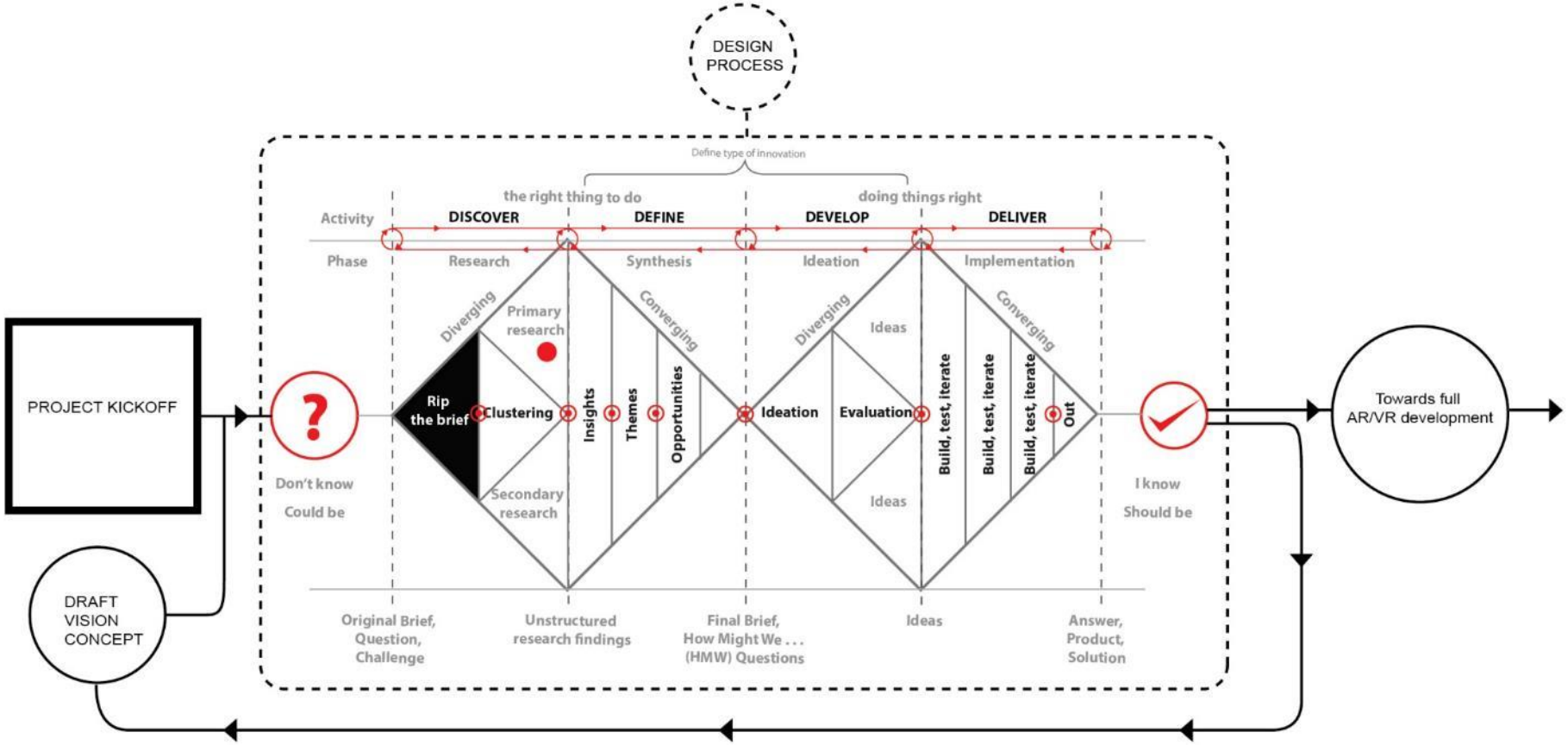


- **1 – Dimensioning and Tolerances**
- **2 – Sectioning, Projections and Perspective Drawings**
- **3 – Dimensional Tolerances, Edge Tolerances, Shaft and Hole Tolerances**
- **4 – Geometric Tolerance/Form-Position Tolerances**
- **5 – Surface Treatment Markings/Surface Roughness**
- **6 – Production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

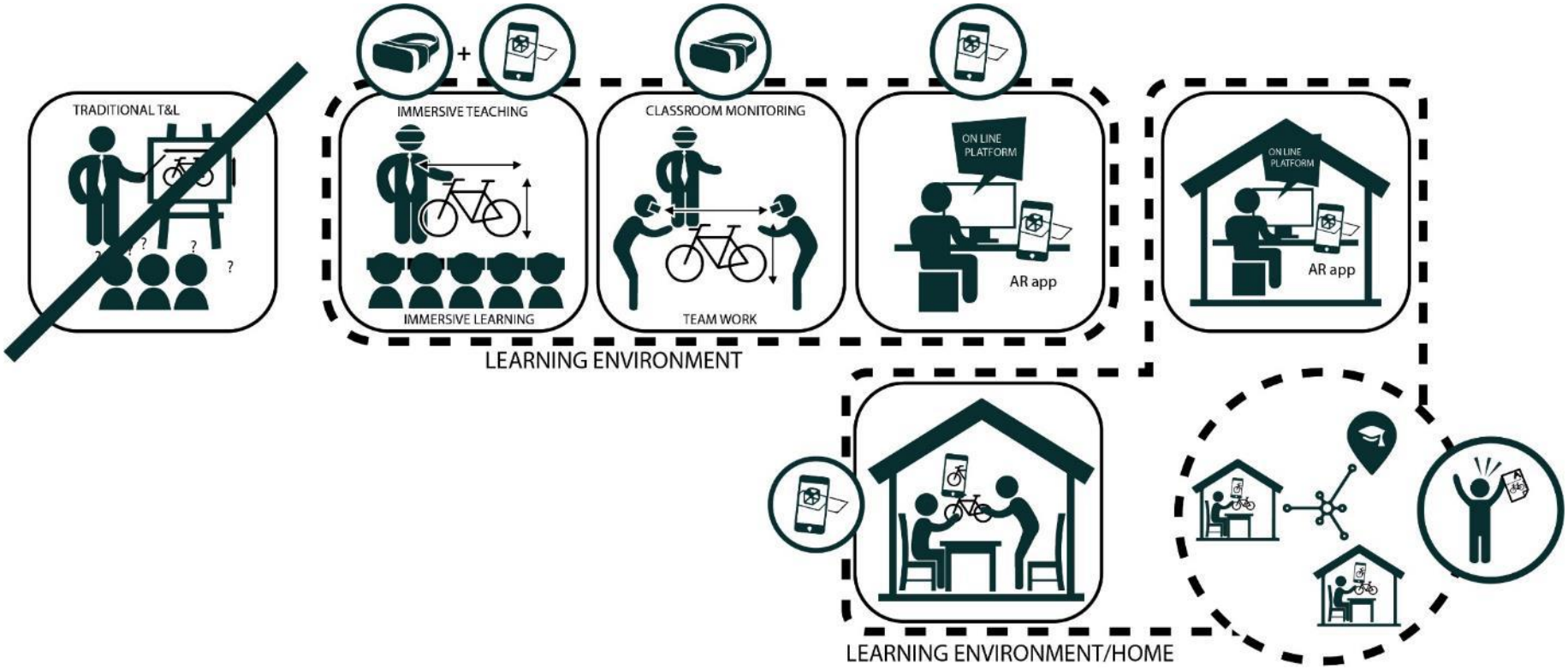
The Method


Concept Development
Design
Implementation
Testing
Deployment
Game Designers, Product designers, UX& Ui designers
Programmers and technical directors
Professional testers and beta testers
Sales and Marketing
Pre-Production
Production
Post-Production

The Method


DESIGN PROCESS
Define type of innovation
the right thing to do
doing things right
Activity
DISCOVER
DEFINE
DEVELOP
DELIVER
Phase
Research
Synthesis
Ideation
Implementation
PROJECT KICKOFF
DRAFT VISION CONCEPT
Don't know
Could be
Diverging
Primary research
Rip the brief
Clustering
Secondary research
Converging
Insights
Themes
Opportunities
Diverging
Ideas
Ideation
Evaluation
Ideas
Converging
Build, test, iterate
Build, test, iterate
Build, test, iterate
Out
I know
Should be
Towards full AR/VR development
Original Brief, Question, Challenge
Unstructured research findings
Final Brief, How Might We . . . (HMW) Questions
Ideas
Answer, Product, Solution

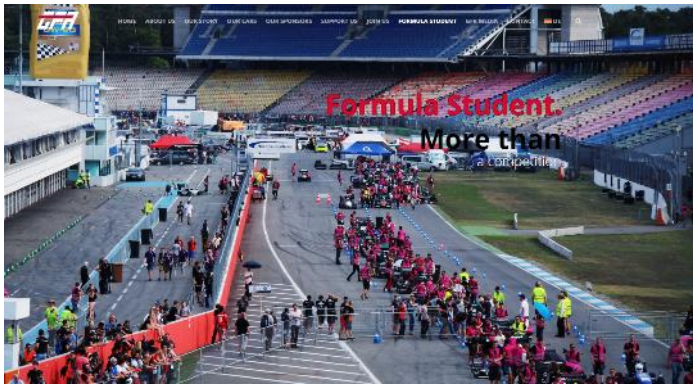
The Solution



The Tools

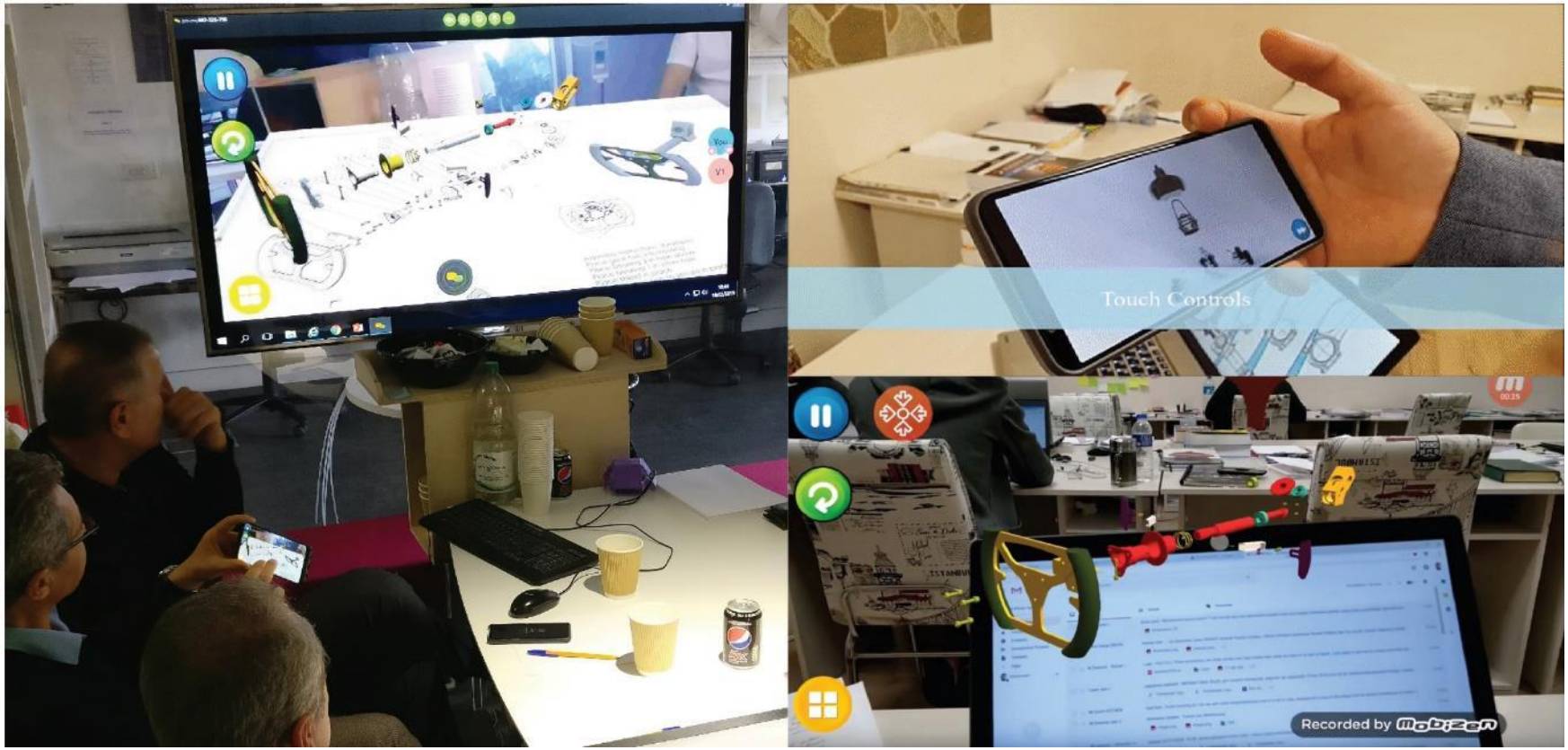
- **Software:**
  - SOLIDWORKS and 3DS Max (3D Modelling and Animation)
  - Photoshop, Illustrator and InDesign (Storyboarding and Editing)
  - Unity and Programming (C#) (VR/AR Applications)
  - Adobe Premiere and After Effects (Video and Sound Editing)
  - Keyshot (Rendering of Animations)
- **Hardware:**
  - HTC Vive
  - Android 7.0+ Smartphone
  - Samsung Gear VR

Car Model

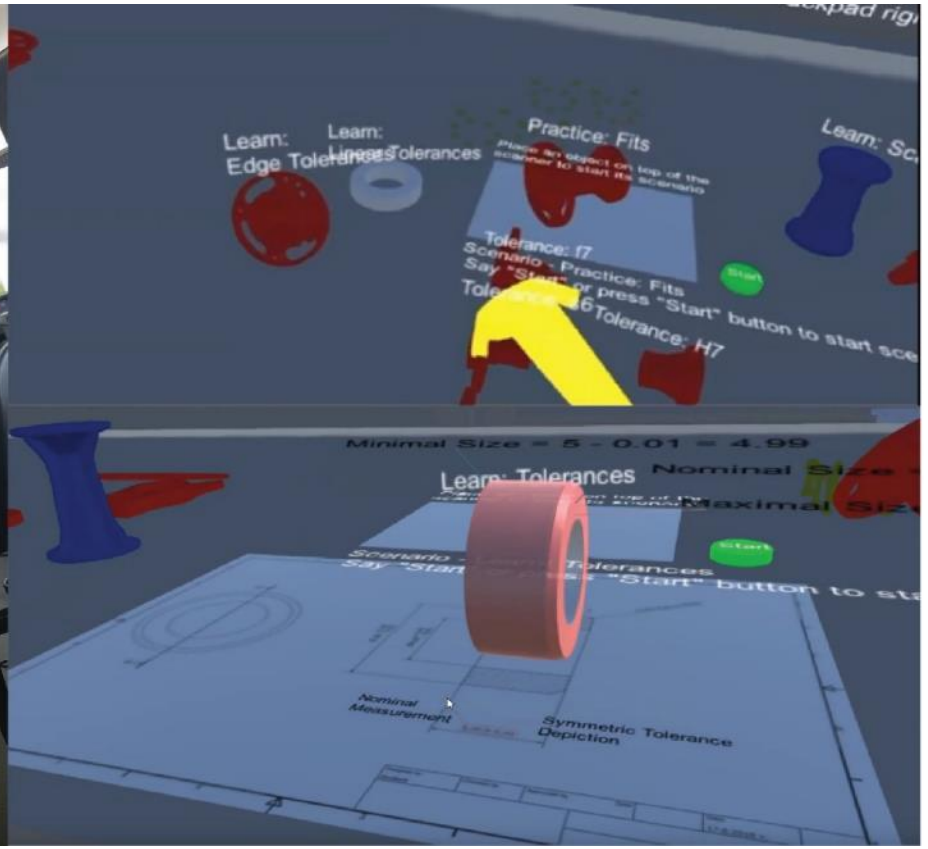


Vehicle being produced by Bulgaria for Formula student race team used as the centrepiece of the project to show real world applications.

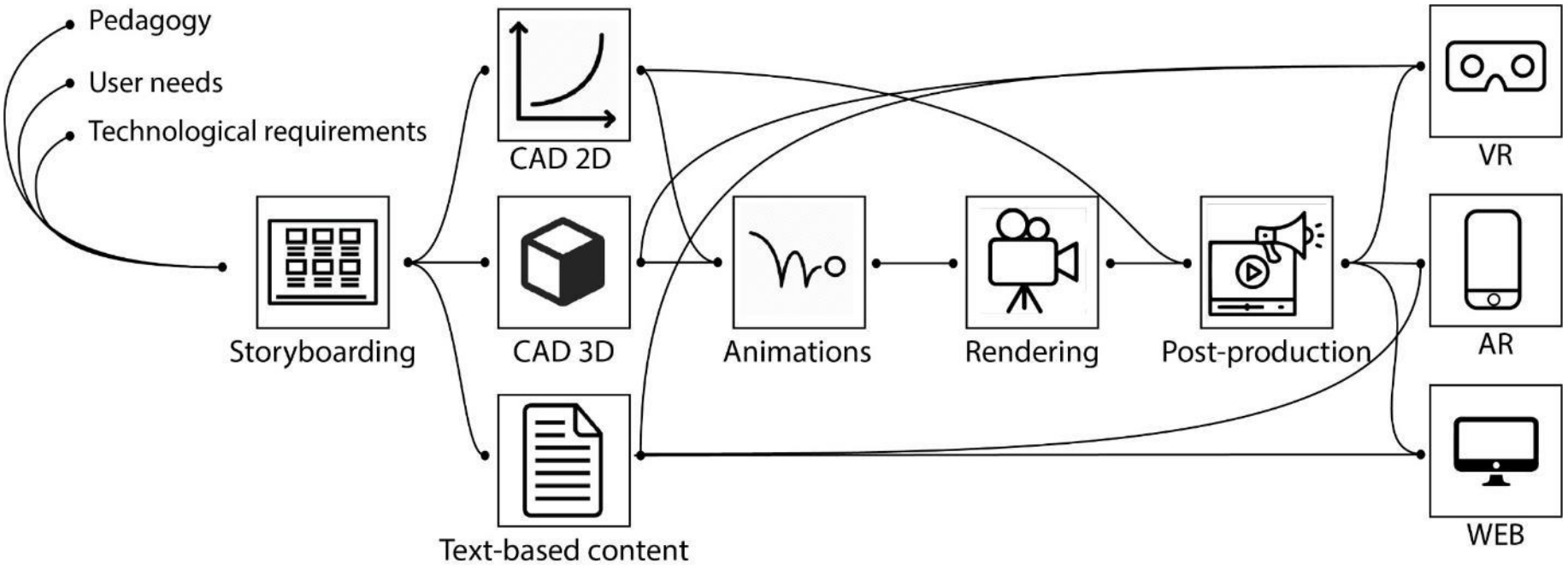
The Solution



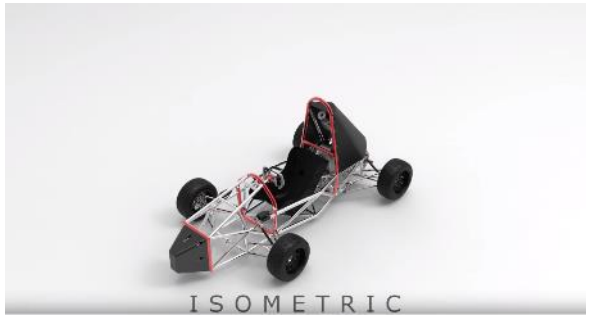
The Solution



The Process

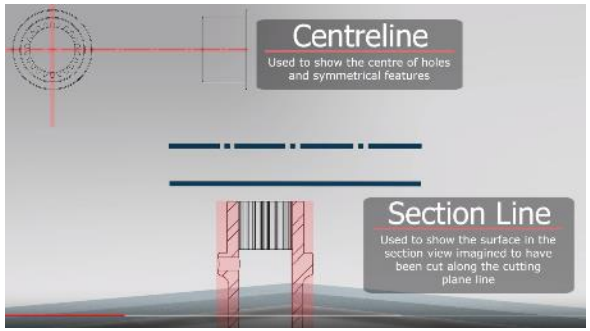

Pedagogy
User needs
Technological requirements
Storyboarding
CAD 2D
CAD 3D
Text-based content
Animations
Rendering
Post-production
VR
AR
WEB

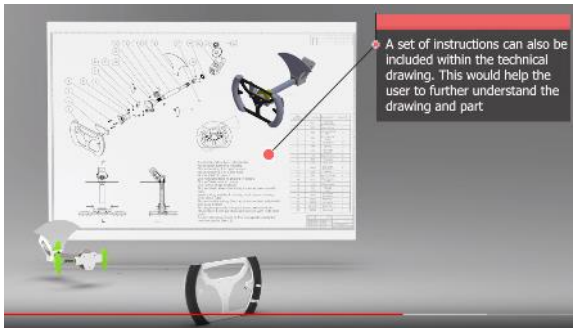
Animations

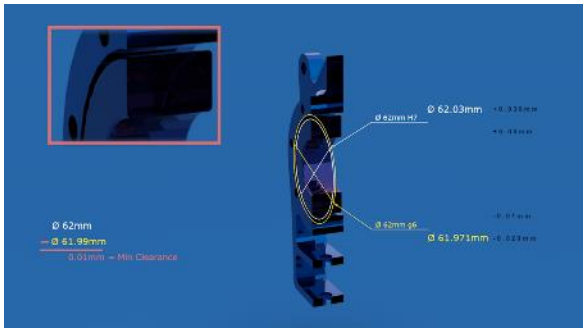

ISOMETRIC

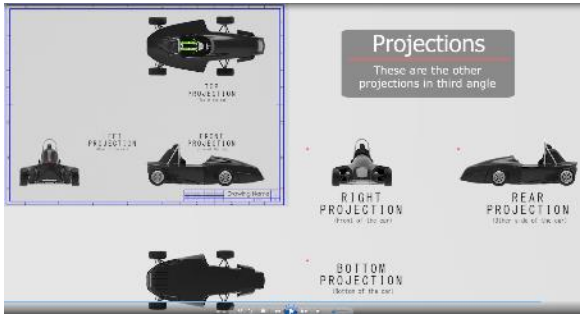

RULES FOR SECTIONING
Show contours and edges that are going to be visible behind the section plane
Remove hidden lines that are visible in section views. They can be used if they improve the clarity of the drawing
A section cut area is always shown using a visible line
Section lines in the hatched area must be parallel. Section lines going in the opposite direction is an indication of more than one part
Visible lines must never cross into a sectioned area of a drawing

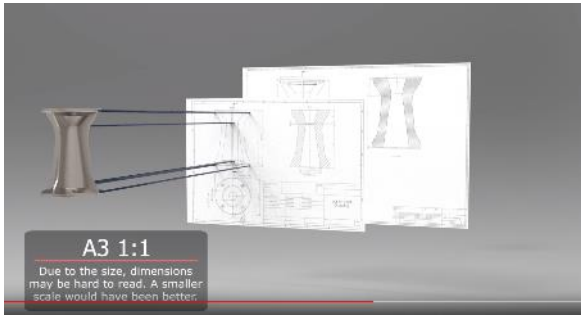

Perspective
All lines will meet at a certain point. Depth is shown in this view


Centreline
Used to show the centre of holes and symmetrical features
Section Line
Used to show the surface in the section view imagined to have been cut along the cutting plane line

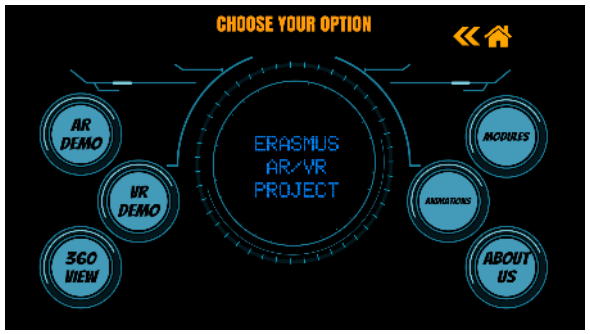

A set of instructions can also be included within the technical drawing. This would help the user to further understand the drawing and part

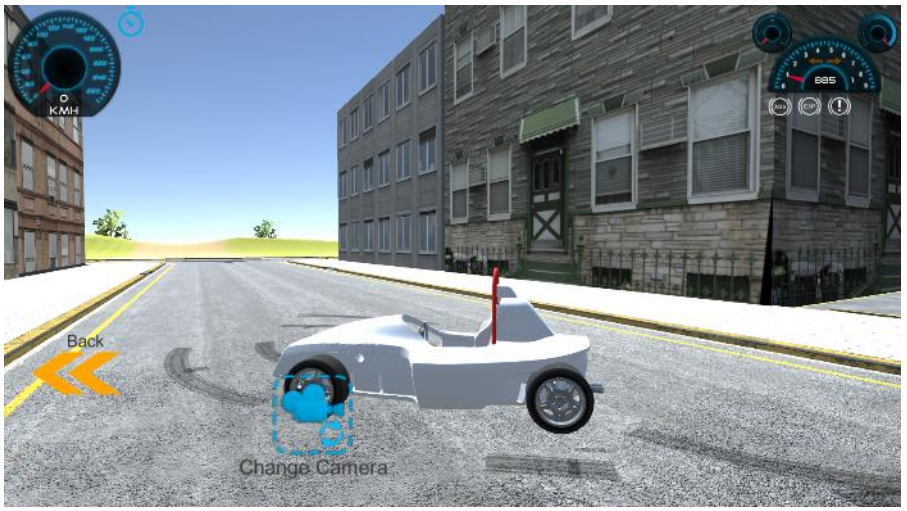

Ø 62.03mm
Ø 62mm
Ø 61.99mm
Ø 61.971mm


Projections
These are the other projections in third angle
RIGHT PROJECTION
REAR PROJECTION
BOTTOM PROJECTION


A3 1:1
Due to the size, dimensions may be hard to read. A smaller scale would have been better.

AR

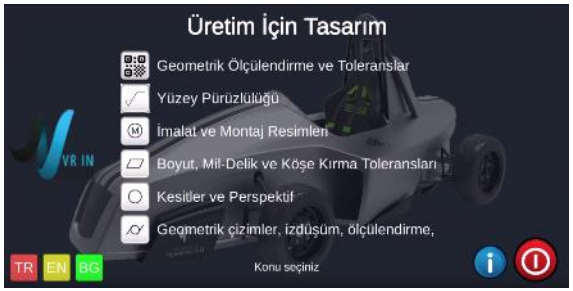


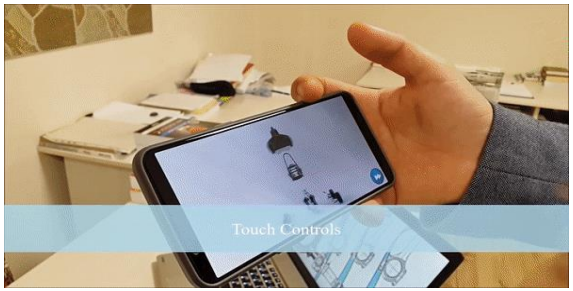


- Gamification exploration done in Unity to understand the impact on T&L

AR

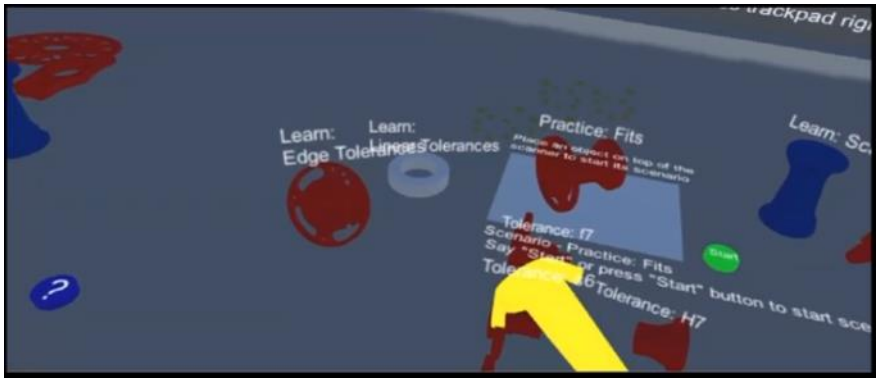
- Car in AR – Virtual car in a real environment with the use of a camera phone

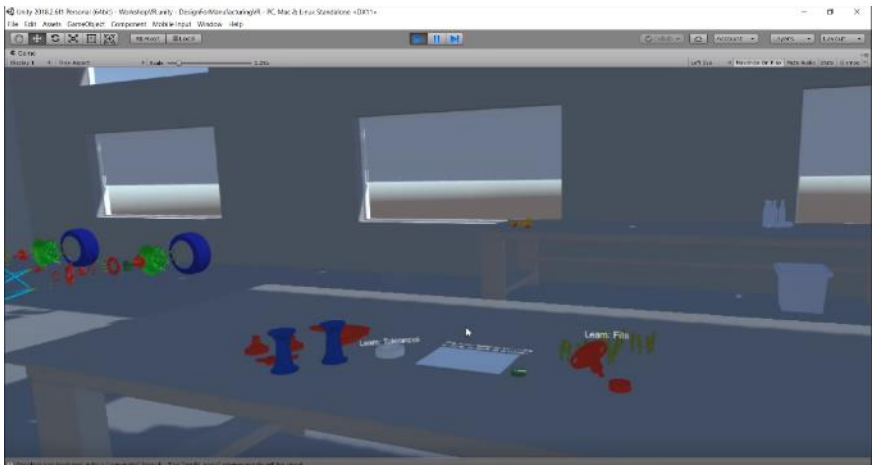


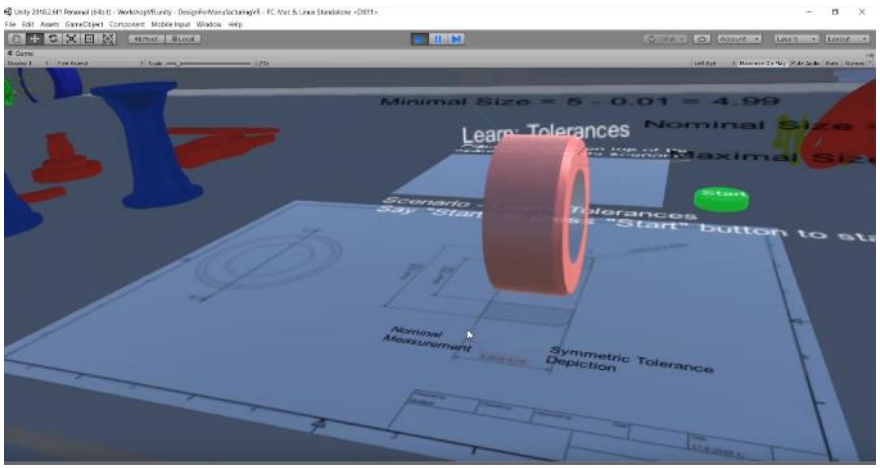


- AR application

VR

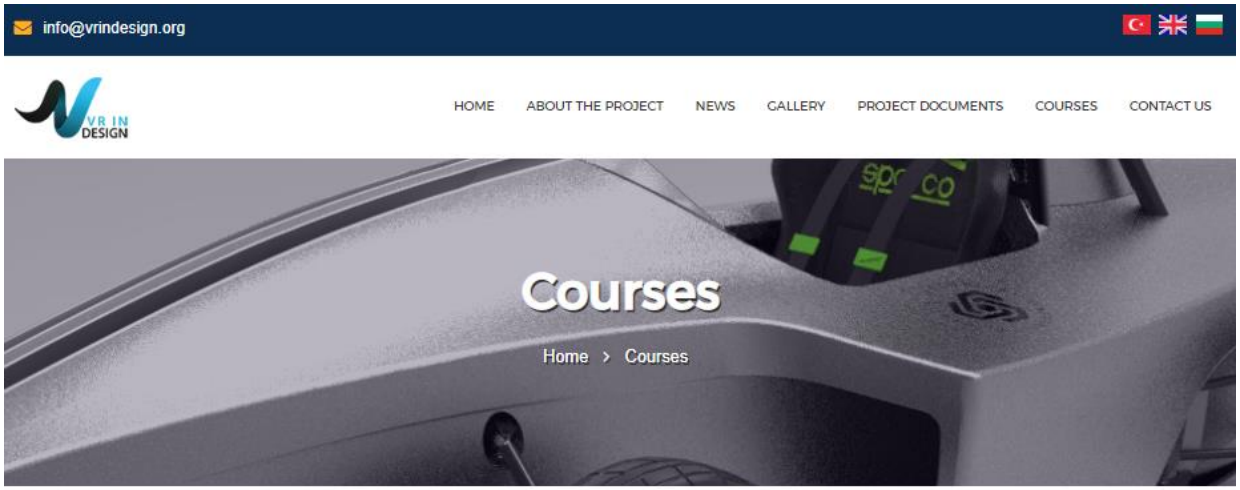


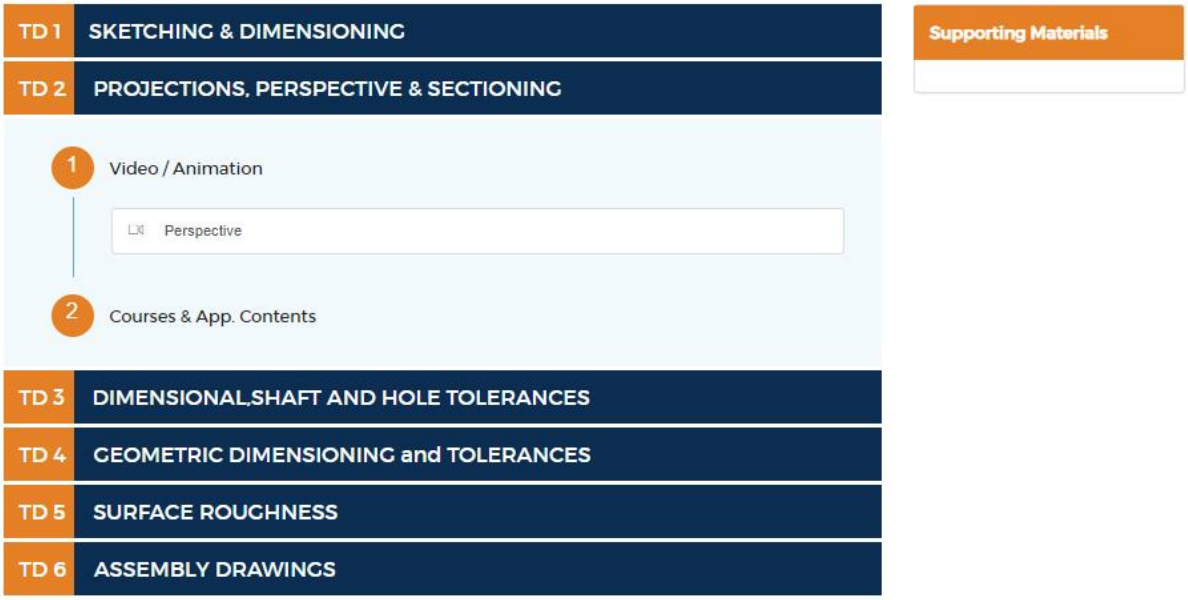




- VR Development done by Bulgaria for use with the HTC Vive (Unity and C# Programming)

Website


info@vrindesign.org
VR IN DESIGN
HOME
ABOUT THE PROJECT
NEWS
GALLERY
PROJECT DOCUMENTS
COURSES
CONTACT US
Courses
Home › Courses


TD 1 SKETCHING & DIMENSIONING
TD 2 PROJECTIONS, PERSPECTIVE & SECTIONING
1 Video / Animation
Perspective
2 Courses & App. Contents
TD 3 DIMENSIONAL,SHAFT AND HOLE TOLERANCES
TD 4 GEOMETRIC DIMENSIONING and TOLERANCES
TD 5 SURFACE ROUGHNESS
TD 6 ASSEMBLY DRAWINGS
Supporting Materials

The Results

TD Topic	*Feedback*
Sketching and Dimensioning	Participants reported satisfaction and appropriateness of content. Participants discussed the importance of graphic & editorial design for better reading and assimilation of contents, and there where instances where the animations worked better for this topic. Some suggestions made included the timing for text-based information and colour changes.
Projections and Sectioning	Participants discussed the appropriate choice of a wheel for the sectioning topic, as it is a well recognisable part with different simple and complex parts and materials that offered a variety of options for the selected topic. A combination of AR and animations was preferred across the participant for these topics. There were instances where participants were more open to sharing among the group their thoughts as a collaborative learning experience when using AR and animations. Turn-taking was smooth and participants help each other using the App.
Shaft and Hole Tolerances	Participants discussed a variety of factors related to these topics. The selection of the wheel as central part for these topics was well perceived as it included all type of tolerances within the same part making the move from one topic to other seamless. It was discussed the possible improvement of the T&L experience by using mixed VR to get tactile or haptic feedback.
Geometric Dimensioning and Tolerancing	Participants raised concerns about the complexity of these topics. The division of topics in basic, mid and advanced level was seen as more appropriate. Among other concerns raised, the level of previous knowledge and transferability of knowledge acquired to other applications or components was discussed. AR and animations were perceived as more appropriate for the topic that VR.
Surface Roughness	The use of AR animations to explain the principle by showing the machining and surface measuring process was well perceived and participants were deeply engaged with the activity. Some suggestions were made regarding the text-based information in order to improve the T&L experience.
Assembly Drawings	Participants struggled at first to get around the VR instructions and extra support from the group was needed. Long turn taking or perceived difficult tasks put participants off from trying the App or continue using it.

The Conclusions

- Use of AR/VR for engineering education still has some technology, pedagogic, and design and user experience limitations.
- Applications and animations developed had an overall positive impact as participants during focus groups reported a positive user experience, as they felt Immersed and engaged with the activities.
- Design Centric Hybrid (DeCH) method brought in a holistic approach where technology, pedagogy and user experience where at the core of the development.
- The use of design elements (i.e. aesthetic considerations) improved the user experience as these were perceived as usefulness, ease of use, and enjoyment.
- Storyboarding provided a development path that was easy to follow among a multidisciplinary team as it was used as well as a communication tool.

Q&A

Try the app

http://vrindesign.org

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