



# Metaverse - Dive Into The New World





# Hello!

## I am Vishal Pandey

Research Scholar

Department of Computer Science and Engineering  
Indian Institute of Technology Roorkee

Co-founder & CTO, CogXR Labs Pvt. Ltd.

Research Interests – VR, ML, BCI



slido



**What do you think when  
you hear the word  
"Metaverse"?**

① Start presenting to display the poll results on this slide.

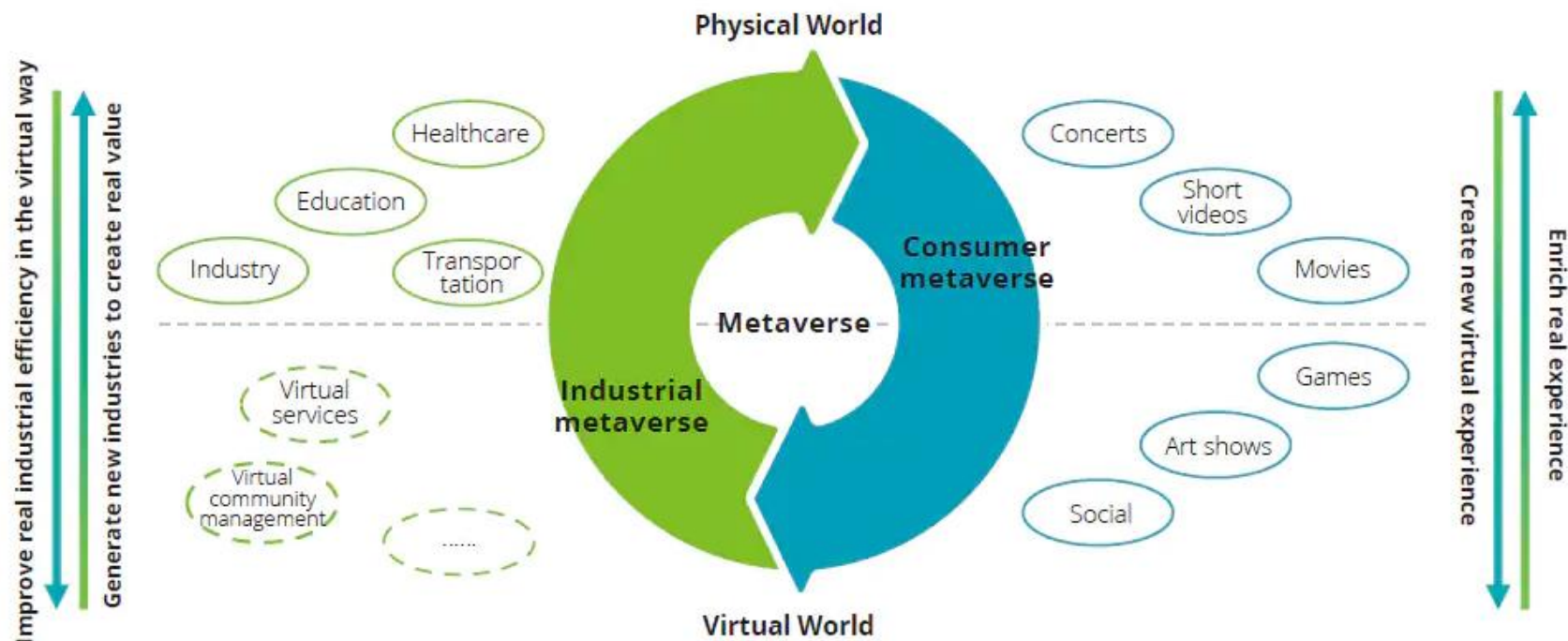
slido



**Which Industry do you  
think Metaverse will  
impact in the future?**

① Start presenting to display the poll results on this slide.

# Ecosystem of the Consumer and Industrial Metaverse



Source: Deloitte Research and analysis

## Status of Key Technologies

	Key technology	Current development status in China		Current development status overseas
End (terminal)	Near-eye display technology	BOE and other leading domestic manufacturers have planned high-performance VR LCD panels	Certain gap	Apple and Sony are the industry leaders, as they enter the market early, and there is still a certain advantage
	Perceptual interaction technology	Lack of technology leaders, insufficient R&D investment efforts and sensitivity of enterprises, development is still immature	Certain gap	Start-ups are active, investment and M&A activities of giant companies are intensive, and patent layout are implemented in advance
Channel (5G)	Network transmission technology	5G construction is at a global leading level, providing a good network transmission foundation	Equivalent	It is generally in a pursuing situation in 5G field, while head companies such as Qualcomm and Facebook have some advantages in projection coding and other technologies
Cloud (content and application)	Rendering and computing technology	In terms of artificial intelligence and point-of-view technology, it is mainly to follow the leader, mostly adopting external general solutions	Obvious gap	Facebook, Nvidia and other companies already have relatively mature solutions
	Cloud content production and distribution	In the field of three degrees of freedom, international influence of Insta360 and other local VR brands is rising, while in the field of six degrees of freedom, technical storage is insufficient	Certain gap	U.S. companies primarily lead industry standards and provide development tools and technical solutions



# Topics

- ◇ Introduction to XR
- ◇ Project Demo
- ◇ Development Tools
- ◇ Queries



A decorative graphic on the left side of the slide. It features a large central hexagon with a blue-to-cyan gradient, containing the white number '1'. Surrounding this central hexagon are several smaller hexagons of varying shades of blue and cyan. Some of these smaller hexagons contain white icons: a lightbulb, a thumbs-up, a smartphone, a magnifying glass, and a gear. There is also a network-like icon with a central node and several smaller nodes connected by lines.

# 1

# Introduction

Defining VR, AR, MR





# Virtual Reality

- ◇ a three-dimensional, computer-generated environment
- ◇ can be explored and interacted with by a person
- ◇ ability to manipulate objects or perform a series of actions

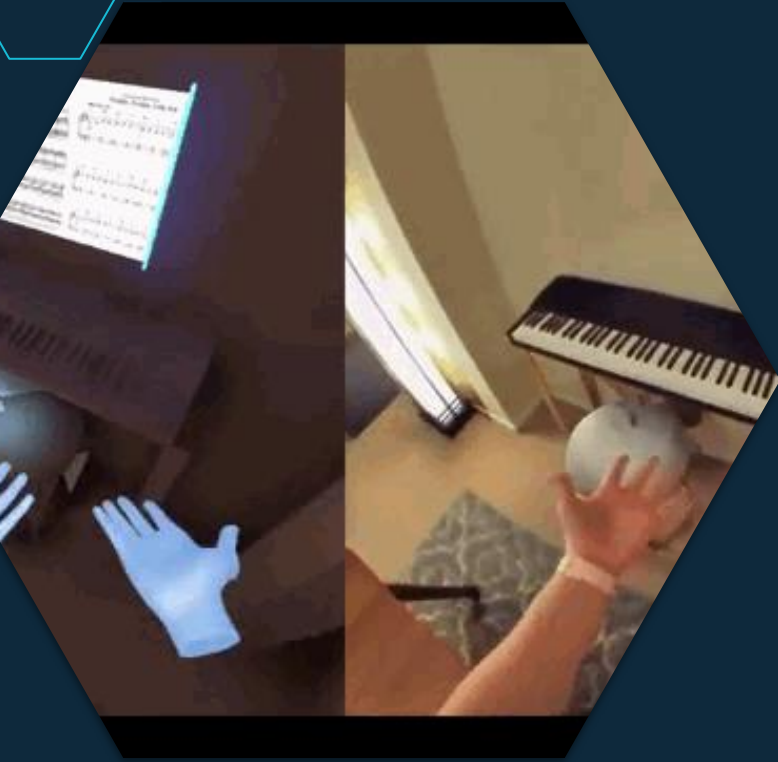




# Augmented Reality

- ◇ superimposes a computer-generated image on a user's view of the real world
- ◇ enhances natural environments or situations and offer perceptually enriched experiences

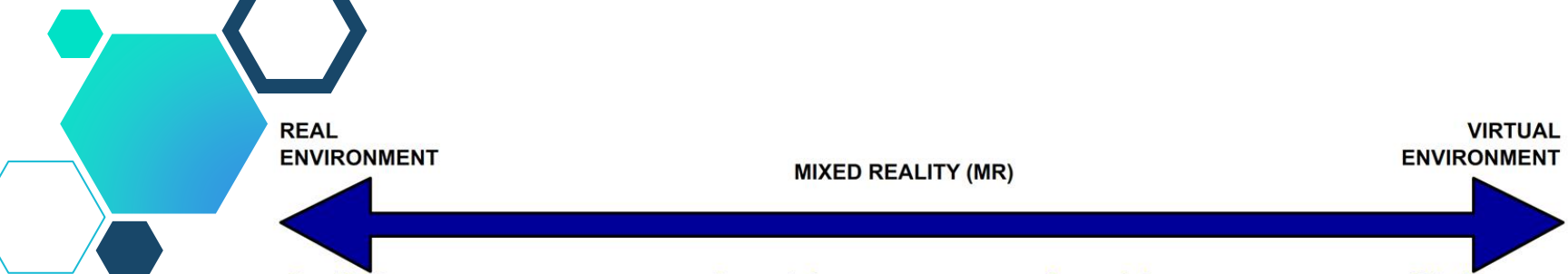




## Mixed Reality

- ◇ merging of real and virtual worlds to produce new environments and visualizations
- ◇ physical and digital objects co-exist and interact in real-time





**Tangible User Interfaces (TUI)**

A TUI uses real physical objects to both represent and interact with computer-generated information (Ishii & Ullmer, 2001).



Using physical objects to create a virtual model (Ichida, Itoh, & Kitamura, 2004). As a user adds a physical 'ActiveCube' to the construction, the equivalent virtual model is automatically updated.

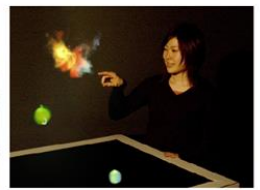
Projection Augmented models (PA model) are a type of Spatial AR display, and are closely related to TUIs

**Augmented Reality (AR)**

AR 'adds' computer-generated information to the real world (Azuma, et al. 2001).

**Spatial AR**

Spatial AR displays project computer-generated information directly into a user's environment (Bimber & Raskar, 2005).



The 'Bubble Cosmos' – 'Emerging Technology' at SIGGRAPH'06. The paths of the smoke-filled bubbles are tracked, and an image is projected into them as they rise.

**'See-through' AR (either optical or video)**

A user wears a head-mounted display, through which they can see the real world with computer-generated information superimposed on top (Cakmakci, Ha & Rolland, 2005; Billinghamurst, Grasset & Looser, 2005).



See-through AR: the butterfly is computer-generated, and everything else is real (Fischer, Bartz & Straßer, 2006; Kölsch, Bane, Höllerer, & Turk, 2006).

**Augmented Virtuality (AV)**

AV 'adds' real information to a computer-generated environment (Regenbrecht, et al. 2004).

**Semi-immersive VR**

A semi-immersive VR display fills a limited area of a user's field-of-view.



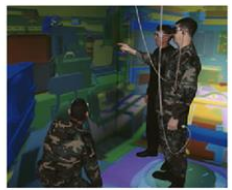
Semi-immersive VR using the Barco Baron workbench (Drettakis, Roussou, Tsingos, Reche & Gallo, 2004).

**Virtual Reality (VR)**

VR refers to completely computer-generated environments (Ni, Schmidt, Staadt, Livingston, Ball, & May, 2006; Burdea & Coffet 2003)

**Immersive VR**

Immersive VR, which uses either a head-mounted-display or a projection-based system, completely fills the user's field-of-view.



Projection-based immersive VR. The users are fully immersed in the 'CAVE' (FakeSpace, 2006; Cruz-Neira, Sandin & DeFanti, 1993).





# Key Advantages of XR



- Immersive
- Engaging
- Risk Free Experience
- Low Cost
- Enhanced Interactivity
- Entertaining



# Opportunities in the Field

## Industry

Entertainment

Training

Customer  
Support

Manufacturing

## Research

Advancing the  
field of XR

Psychological  
Research

Driving  
Artificial  
Intelligence

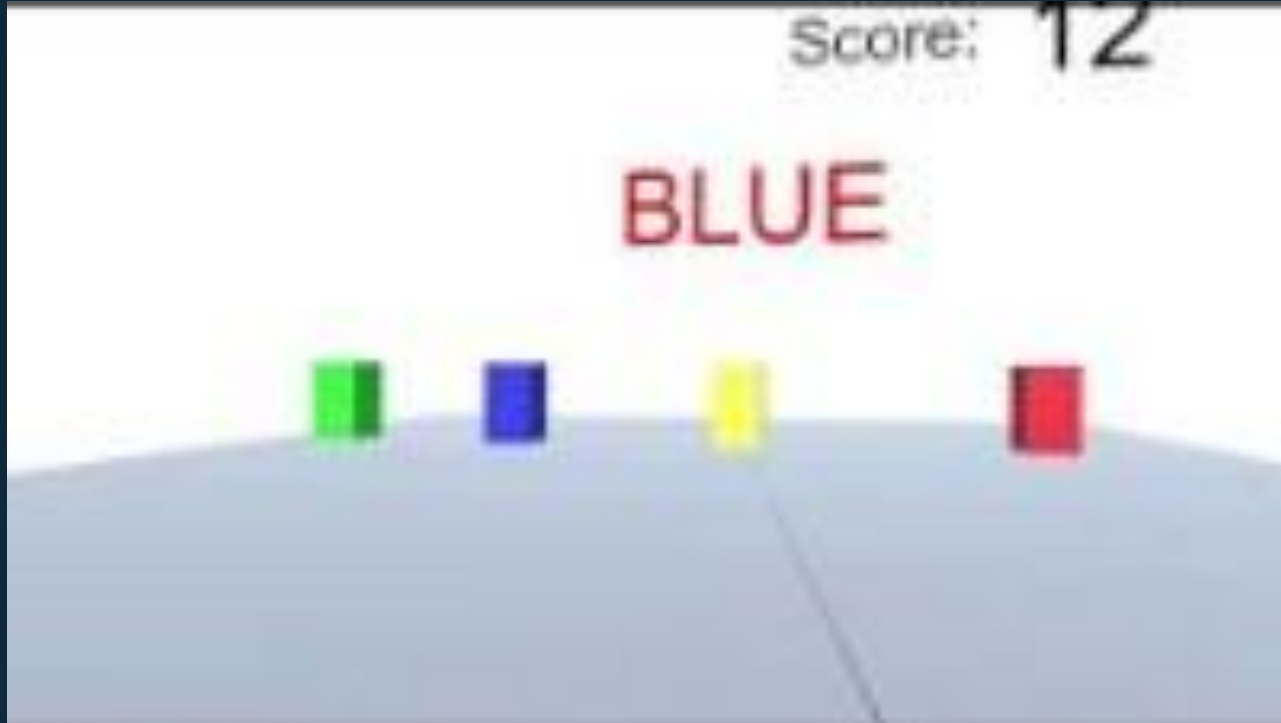
A decorative graphic on the left side of the slide. It features a large cyan hexagon with a white number '2' inside. Surrounding this central hexagon are several smaller hexagons in various shades of blue and cyan. Some of these smaller hexagons contain white icons: a lightbulb, a thumbs-up, a smartphone, a magnifying glass, and a gear. There is also a network-like icon with a central node and radiating lines.

# 2

## Project Demonstrations

Implemented as part of research projects at DRDO and IIT Roorkee

# VR Cognitive Test Battery





# Multi Tasking Drone Simulator



Developed By – Mumbai University Students

# Driving Simulator for Workload Estimation



# Real Time Cognitive State Monitoring



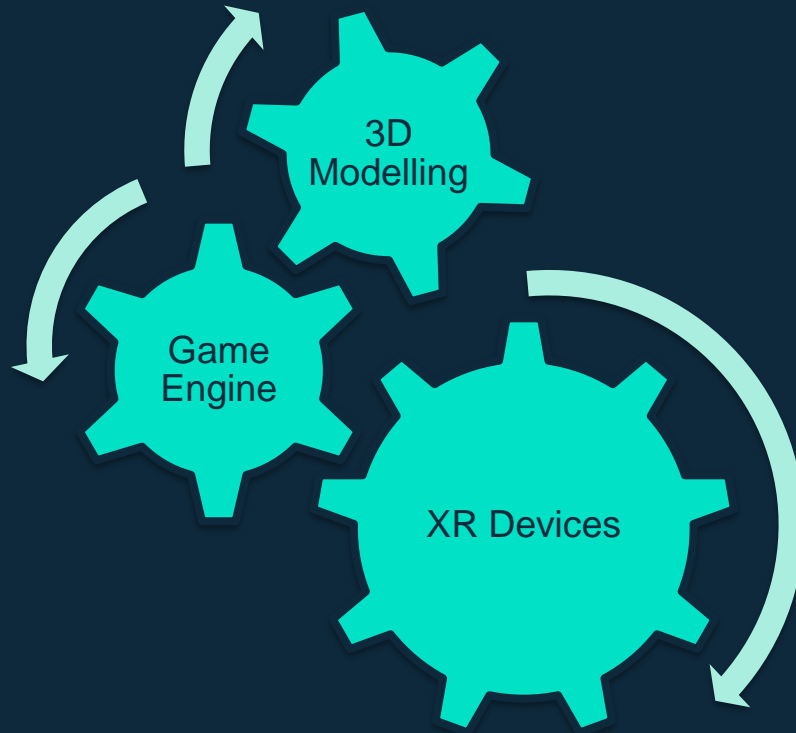
A decorative graphic on the left side of the slide consists of a cluster of hexagons in various shades of blue and cyan. Some hexagons contain white icons: a lightbulb, a thumbs-up, a smartphone, a magnifying glass, and a gear. A network of dots and lines is also visible. The central hexagon is the largest and contains the number '3'.

# 3

## Development Tools and Technology

Base of all XR Development

# Key Components





# 3D Modelling Tools

- ◇ Modelling
- ◇ Texturing
- ◇ Rigging
- ◇ Animation



**BLENDER**



AUTODESK  
**3DS MAX**



AUTODESK  
**MAYA®**



# Game Engines

- ◇ Physics
- ◇ Scripting
- ◇ User Interaction
- ◇ Gameplay



**Godot**  
GAME ENGINE



# Devices

## Virtual Reality



## Augmented Reality







# Thanks!

## Any questions?

You can find me at:

- ◇ [v\\_pandey@cs.iitr.ac.in](mailto:v_pandey@cs.iitr.ac.in)
- ◇ 9971510759
- ◇ LinkedIn

