# Augmented Reality for Remote laboratories

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# INTRODUCTION

Augmented reality (AR) is **an enhanced version of the real physical world** that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology. It is a growing trend among companies involved in mobile computing and business applications. But it is also currently being introduced in new application areas such as historical heritage reconstruction, training of operators of industrial processes, system maintenance, or tourist visits to museums and other historic buildings, among others. The academic world has some connection to these initiatives and has also begun to introduce AR in some academic disciplines, although its teaching applications are still minimal. As a student, our concern is to look for AR as Remote laboratories to cope up with the COVID 19 pandemic. The required techniques and basics of AR technology are discussed in these slides. Irrespective of its large number of advantages there are certain disadvantages for which it can not be used in all areas of Laboratories.
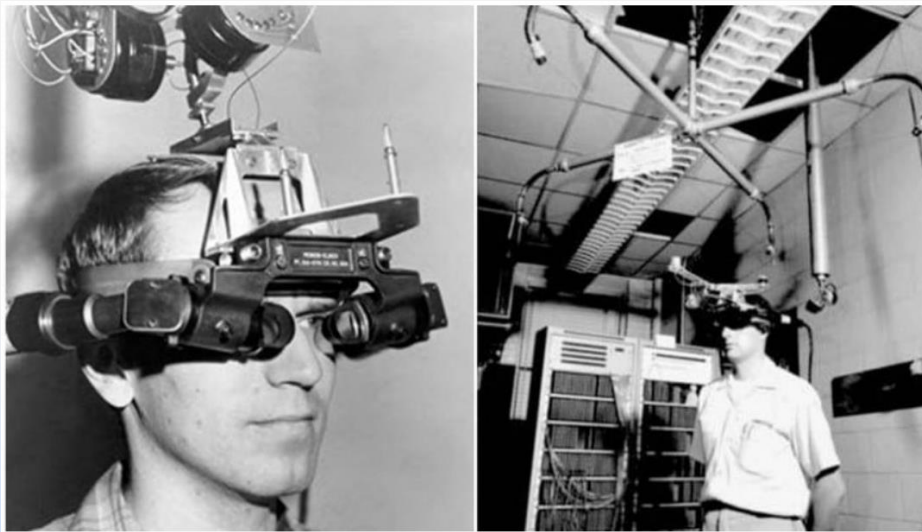
# What is Augmented Reality?

- The process of superimposing digitally rendered images onto our real-world surroundings, giving a sense of an illusion.

- AR can be defined as a system that fulfills three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects[2].

- Recent developments have made this technology accessible using a Smartphone and Head-mounted displays.

- Examples-
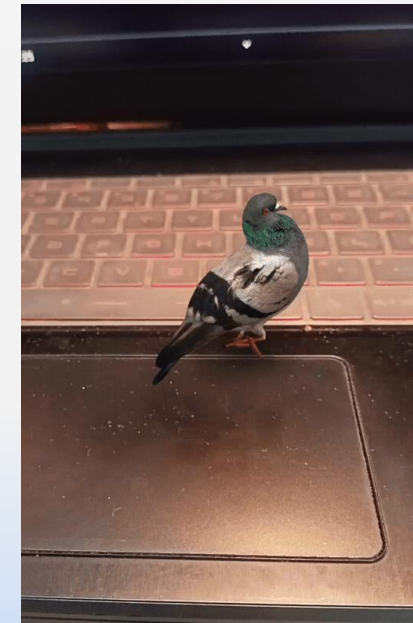
# History of Augmented Reality

- Augmented Reality tech dates back to the 60s.

- Augmented reality technology was invented in 1968, with Ivan Sutherland's development of the first head-mounted display system called 'The Sword of Damocles'.

- However, the term 'augmented reality' wasn't coined until 1990 by Boeing researcher Tim Caudell.

- In **1999,** NASA created a hybrid synthetic vision system of their X-38 spacecraft. The system leveraged AR technology to assist in providing better navigation during their test flights.



Ivan Sutherland performing his experiments with AR first Head Mounted display 'The Sword of Damocles'

| Year | Event |
|------|-------|
| 1968 | • First Head Mounted Head Display |
| 1990 | • Augmented Reality term is Created |
| 1994 | • AR in Theatre and Entertainment |
| 1999 | • NASA Hybrid Synthetic Vision System |
| 2003 | • AR added to Sports Aerial Camera |
| 2013 | • Automotive Industry leverages AR |
| 2014 | • Google Glass wearable AR Tech |
| 2016 | • Microsoft HoloLens AR Headset |
| 2017 | • AR applications in Retail |

NASA System

Sports AR

Google Glass

MS Holo Lens

Automotive Industry

AR in Retail

# How does AR Work?

- AR works with the camera to interpret the angles and distance the AR device is away from the marker.

- The software analyses the marker and creates a virtual image overlay on the screen, tied to the position of the camera.

- Along with it can pass the information through the spatially positioned speakers also.

- Advanced AR also includes the interaction with the virtual images.


Asian Paint AR Application


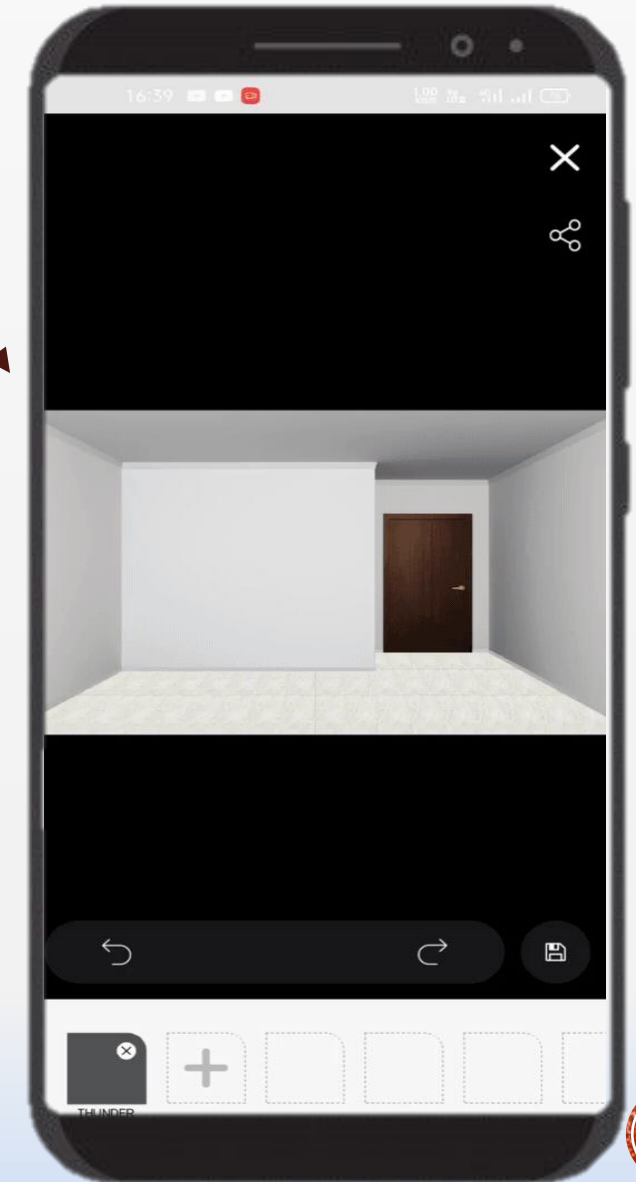Microsoft Holo Lens Applications


Lenskart AR Application

# Why do we need Augmented Reality?

- Deficiency of Proper Vision
- Unavailability of Efficient trainee
- Limited Resources
- Access to Higher Studies
- Improving practical Skills
- To have Better Foresight
- To have a Partner

Asian Paints
AR Home
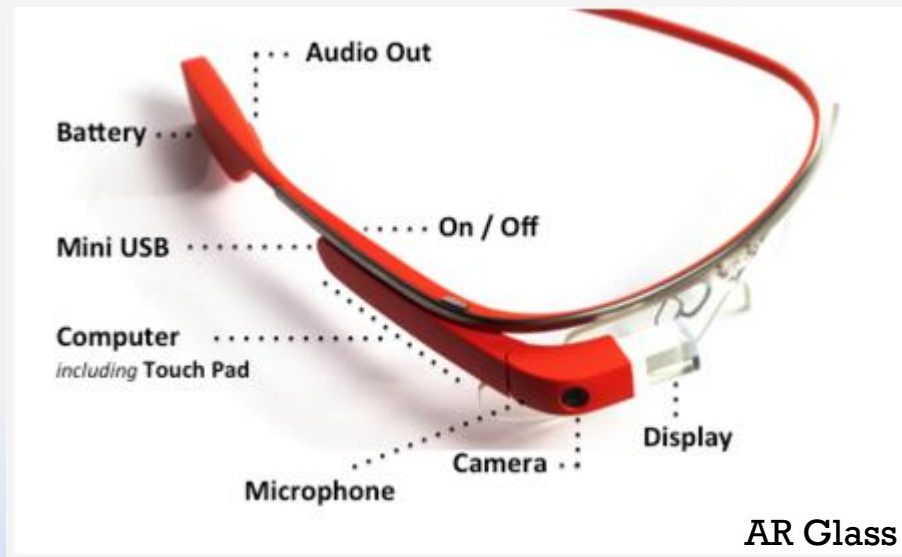Coloring App

Biology Lab
AR
Human Bone

# Augmented Reality in Laboratories

## Why?

- Remote Accessing
- Time Management
- Resource Management
- Expertise Learning
- Interactive Learning
- Safe and Experimental

## How?

- Augmented Reality Laboratories(ARL)
- ARRL Application
- Mobile/Desktop & Keyboard
- Head Mounted Display & Speakers
- Gloves for AR Environment
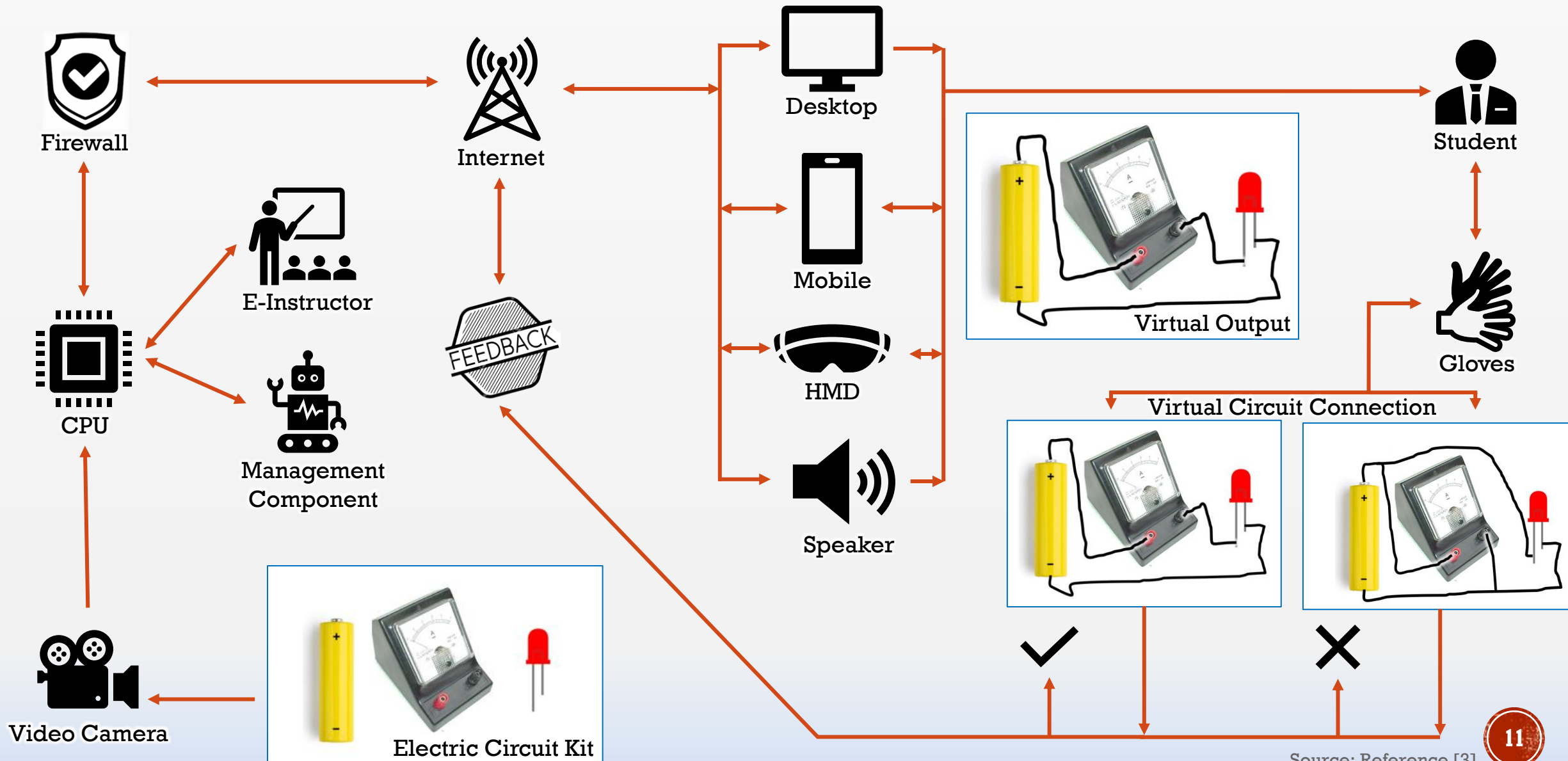


AR Glass

Desktop & Mobile

Glove

# Framework of ARRL

- Video Capture of Live Video Streams

- Real Object Identification

- Object Tracking

- Image Overlays

- Control & Management System

- Interactive Output
  - Natural User Interface
  - Suitable Gesture
  - Gesture Control
  - Types of Displays
  - Timings and Delays

- Security

- Error Handling



Microsoft Holo Lens Application in Industries

# Distributed System Architecture of ARL



Firewall

Internet

Desktop

Student

E-Instructor

Mobile

Virtual Output

CPU

FEEDBACK

HMD

Gloves

Management Component

Speaker

Virtual Circuit Connection

Video Camera

Electric Circuit Kit

# Implementation Example of ARRL

- QR codes (markers) of specific Experiment is Provided.

- Scanning the QR code downloads a 3D model to the screen along with instructions.

- Not only we can see them but we can perform experiments using those 3D models.

- Feedback to the experiment is also loaded with QR code to get result after performing experiment.

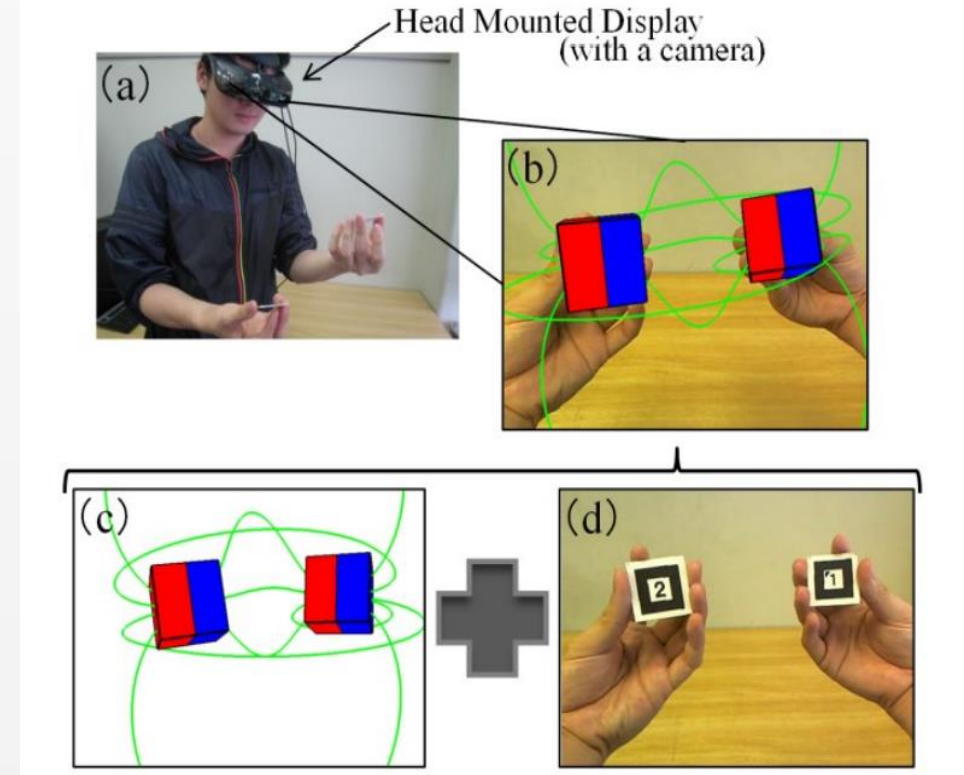- Fig.1 is a simple experiment that is performed using ARRL Application.



Fig. 1. Real-time visualization system for 3D magnetic field distribution. (a) Overview of proposed system and the HMD with a camera. (b) The composite image displayed on the user's HMD. (c) The simulated magnetic flux lines in 3D space. (d) The markers which indicate the positions and the type of the objects (e.g., magnet, coil, iron).

# Statistics of its Acceptance
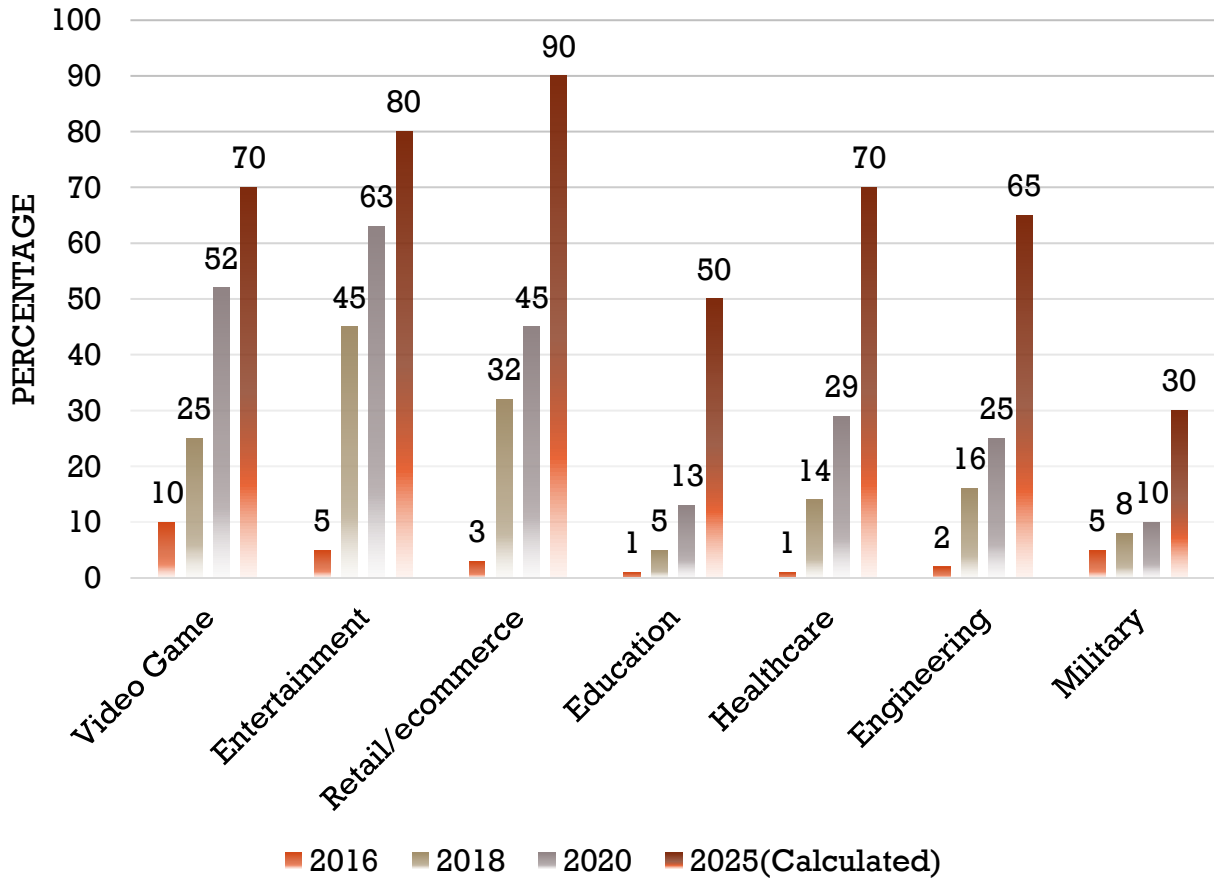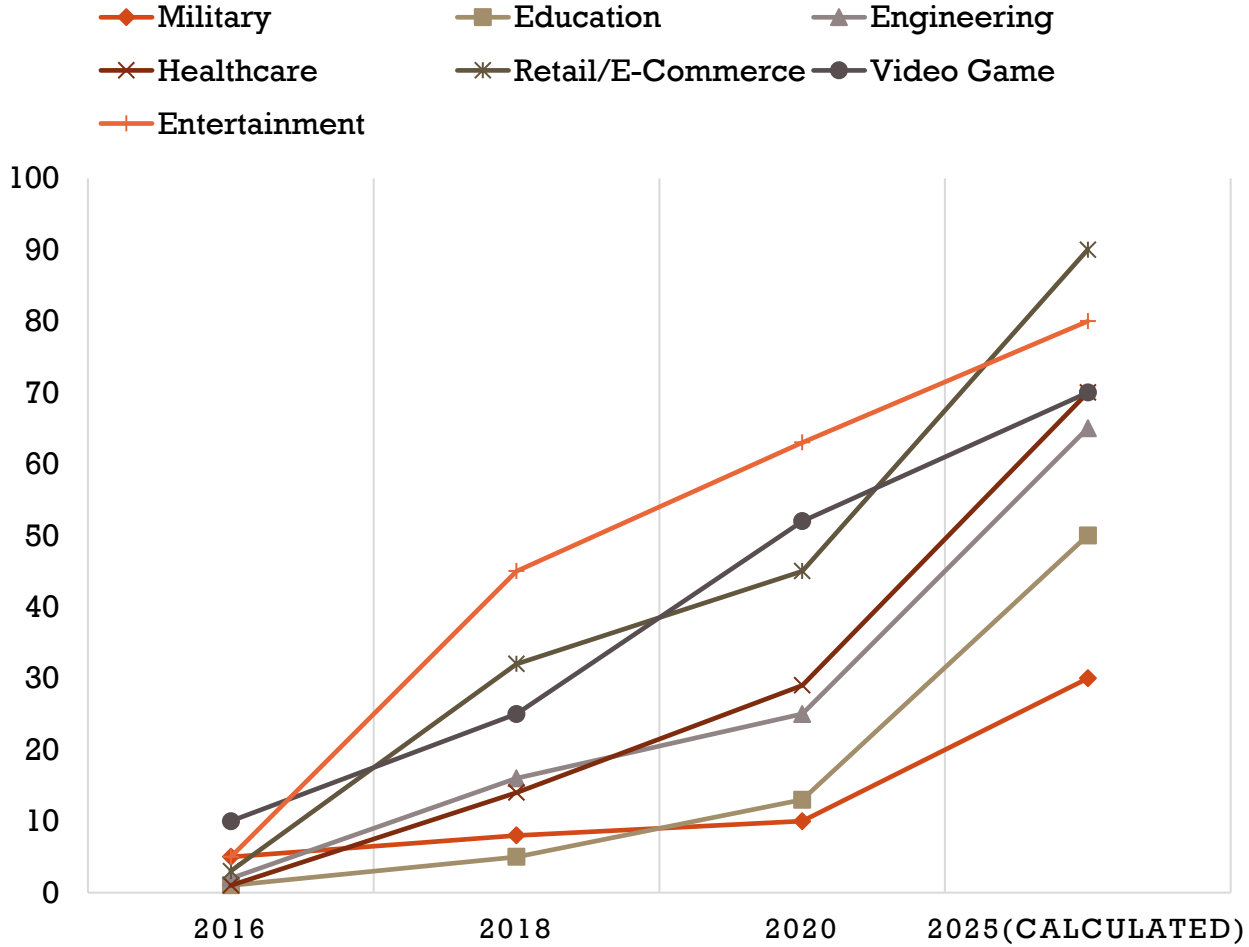
# Disadvantages of Augmented Reality & ARRL

- Lack of Privacy and Security

- Costly & Time taking for Program Development

- Lack of Physical Contact in Remote Laboratories

- Laboratories like Chemical Labs are unsuitable for Remote Testing

- Wrong use may bring Accidental Scenarios

- Addiction & Psychological Effects

# CONCLUSION

- Augmented reality (AR) is similar to the mobile technology, we are not using it much, but once we start using it, then it will be a part of our day to day life.

- Augment Reality Technology going to replace mobile phones in some 5 to 10 years. The Head mounted Displays going to a part of our daily wear.

- It has some disadvantages but looking at its advantage side, disadvantages can be neglected or corrected.

- In this Pandemic most of the activities are digitalized. Therefore, the calculated data for the year 2025 reaches a high margin. Along with all other areas AR is also going to reach heights in education section.

# References

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