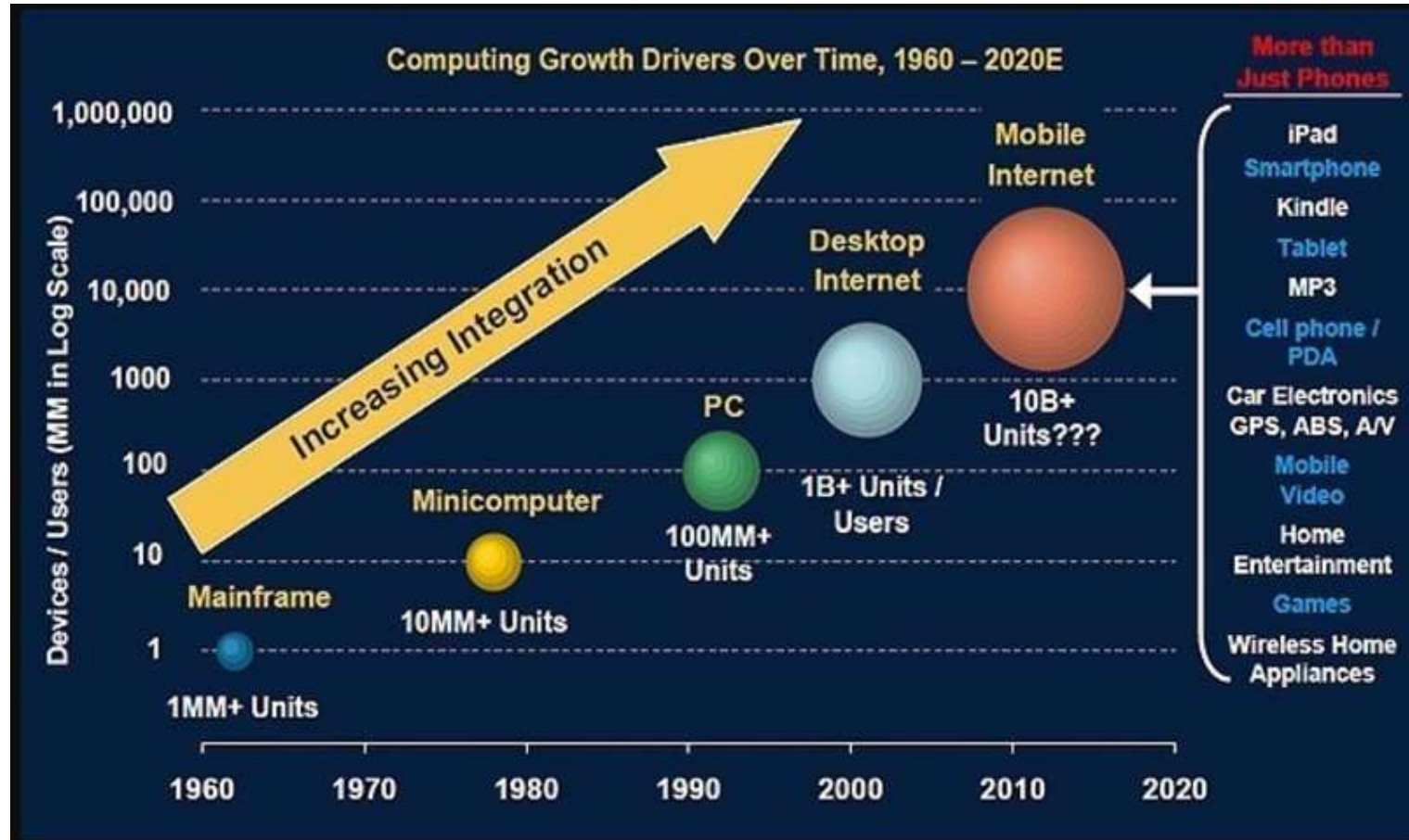


# Introduction to Augmented Reality & Virtual Reality

Dr. Kaushal Kumar Bhagat  
Advanced Technology Development Centre

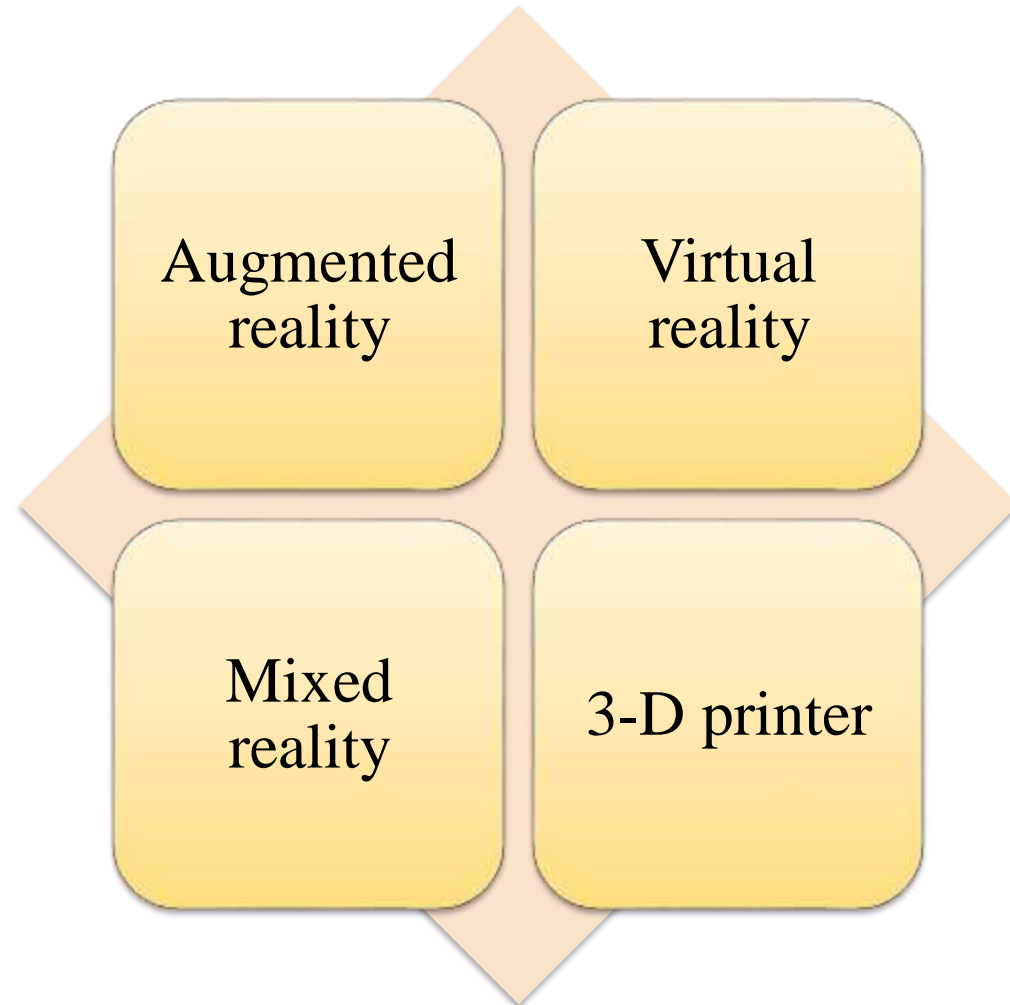


# Growth in Technology

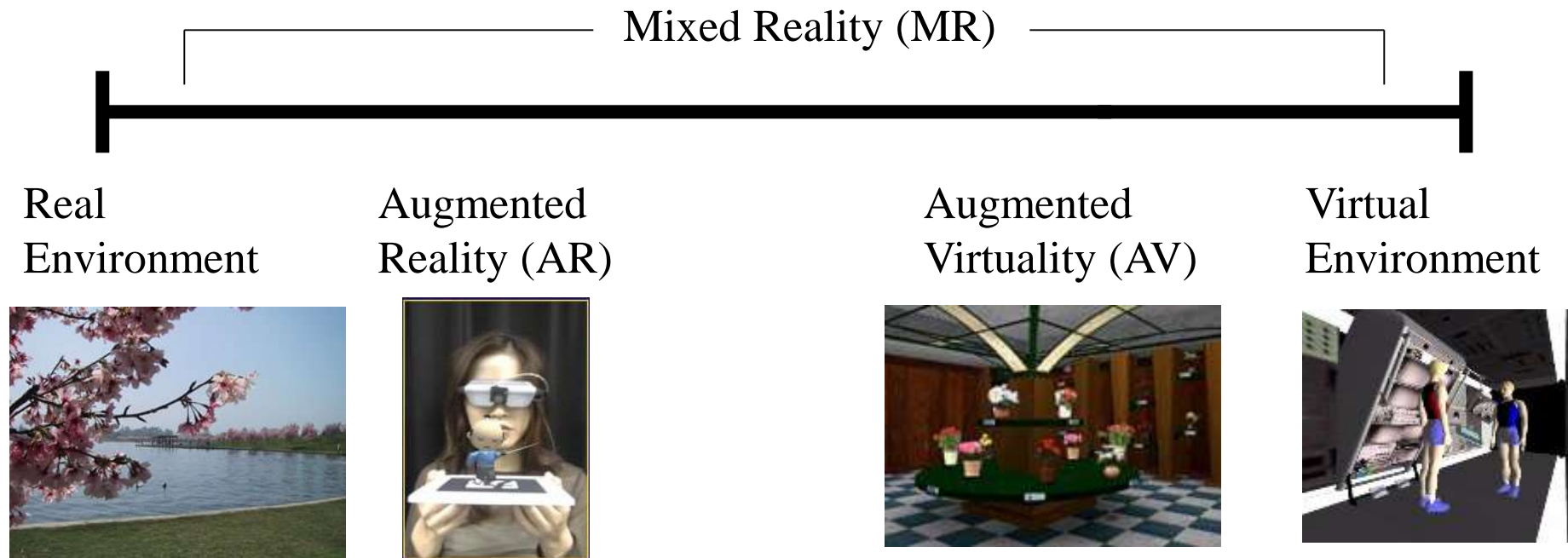


Source: <http://www.laibatechnologies.com>

# Emerging Technologies in the 21st Century



# MILGRAM'S REALITY-VIRTUALITY CONTINUUM



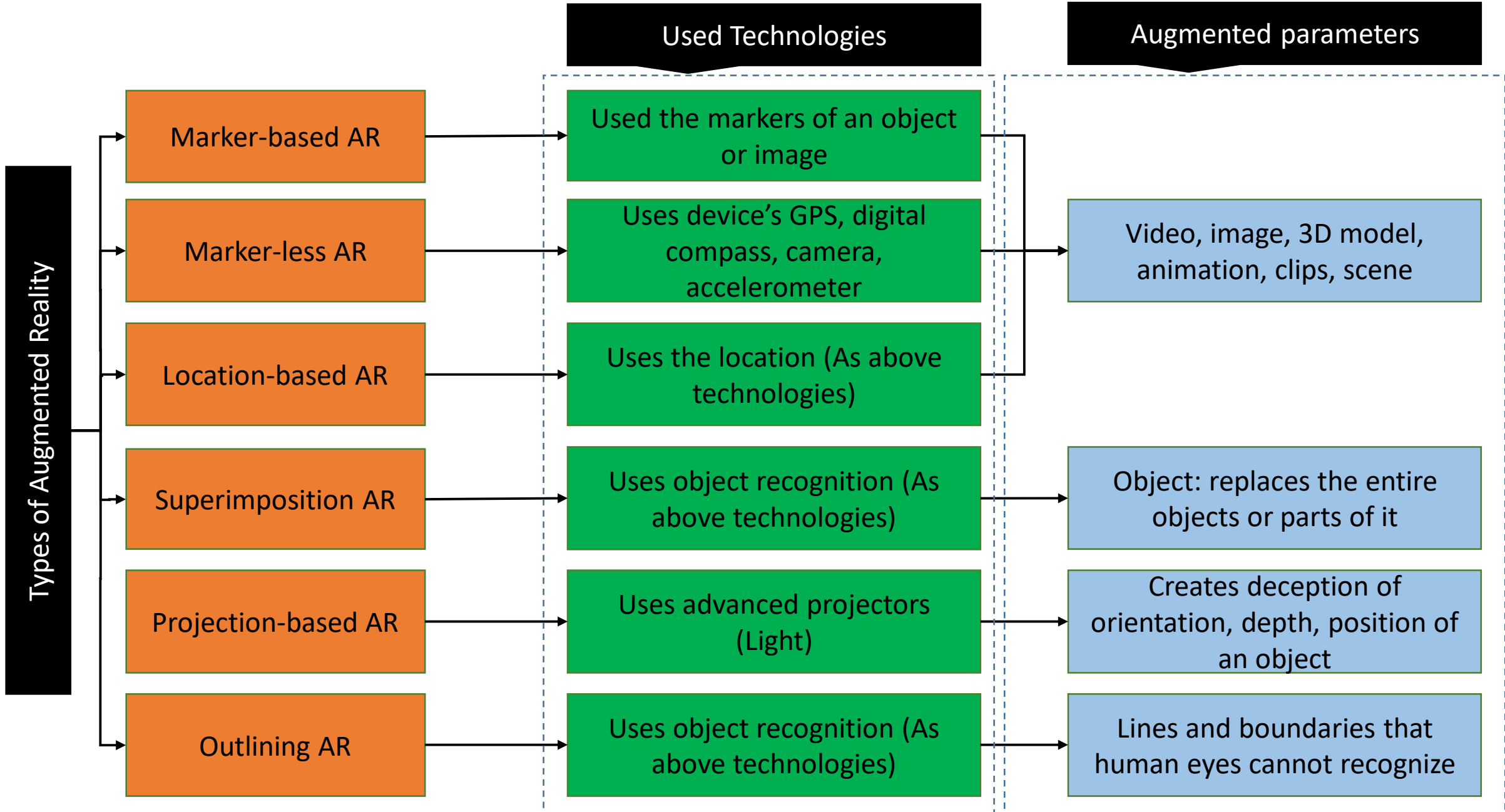
Milgram coined the term “Augmented Virtuality” to identify systems which are mostly synthetic with some real world imagery added such as texture mapping video onto virtual objects.

# What is Augmented Reality?

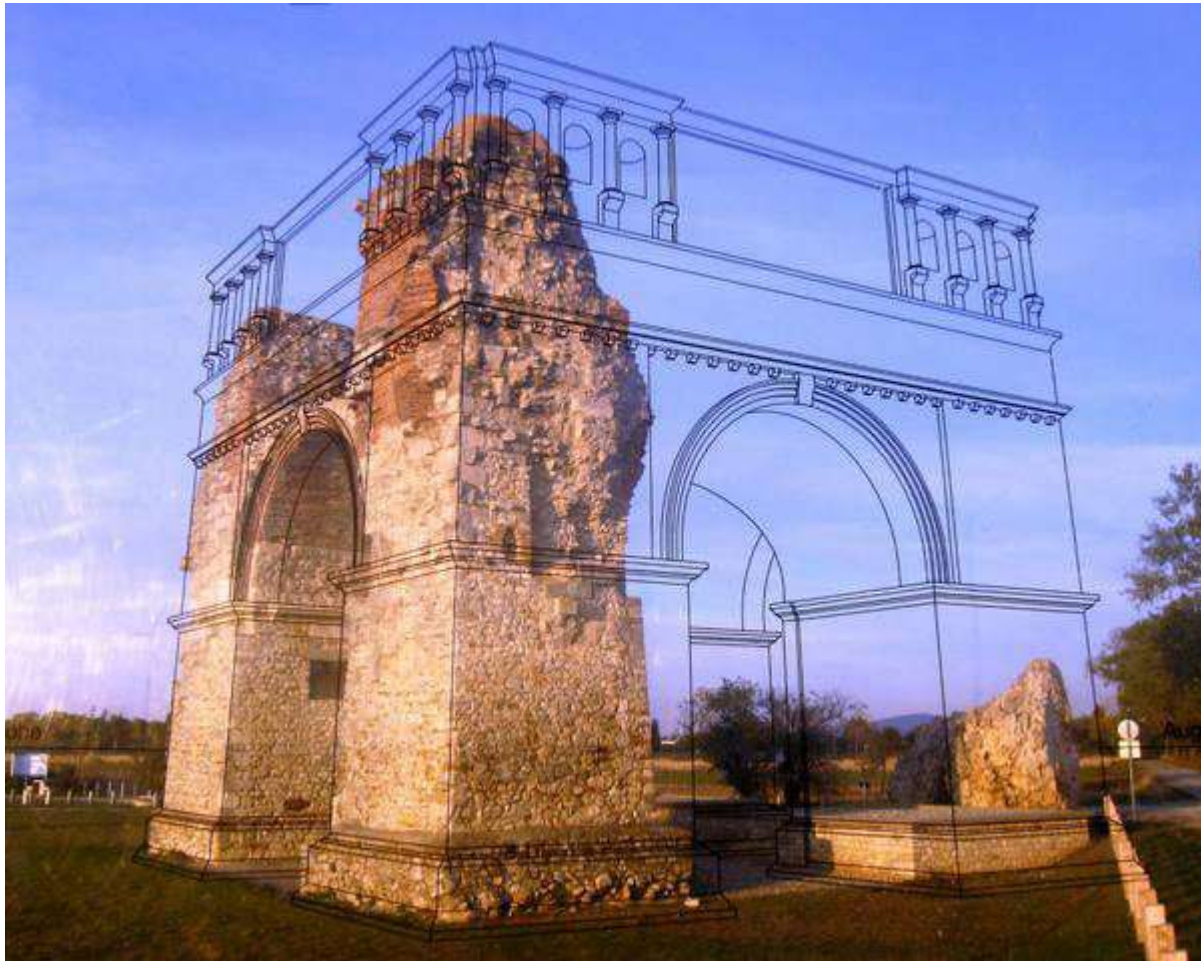
AR as a system having three basic characteristics:

- Combines reality with a virtual world
- Interactive in real time
- Supports 3-D visualization.

Azuma (1997)



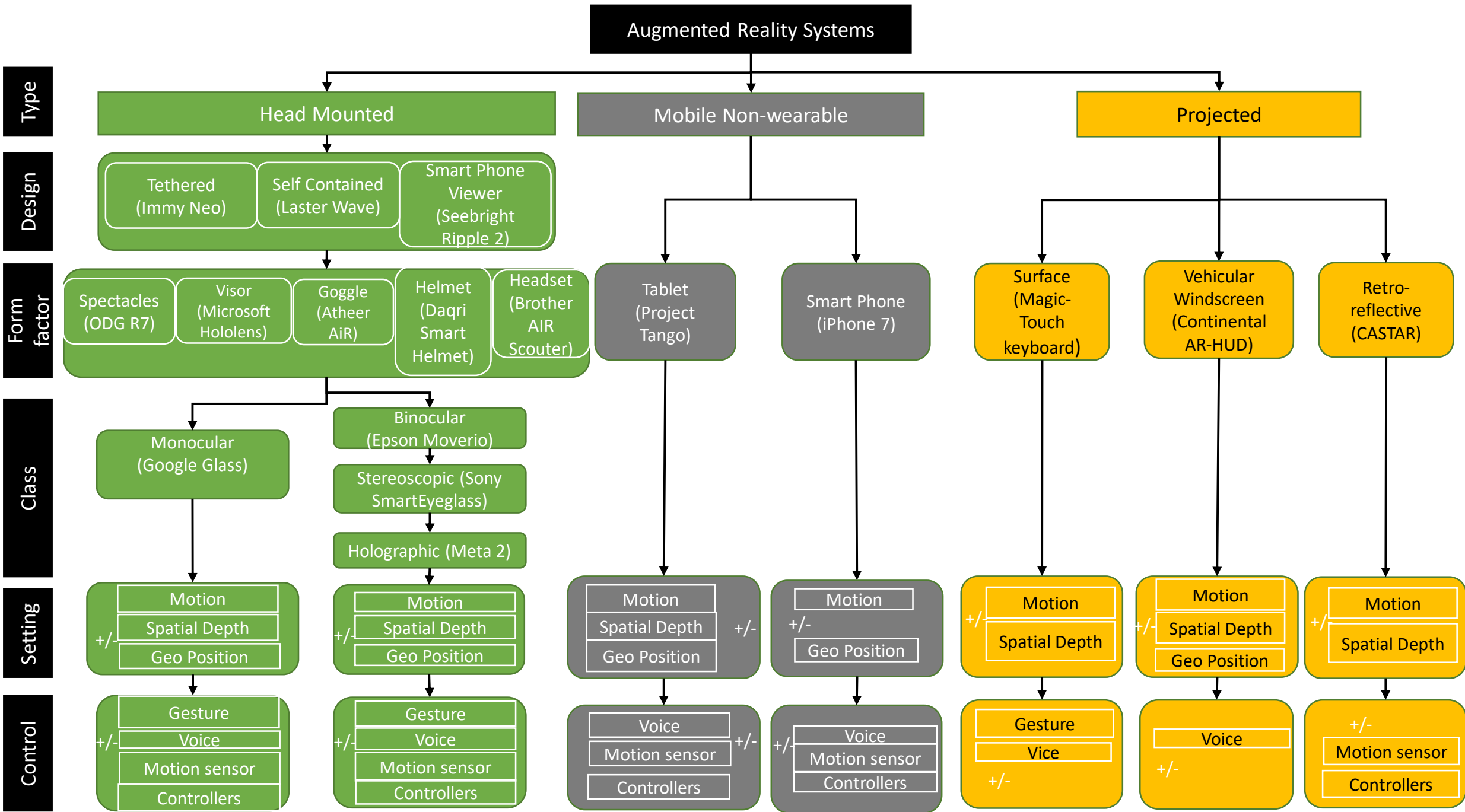




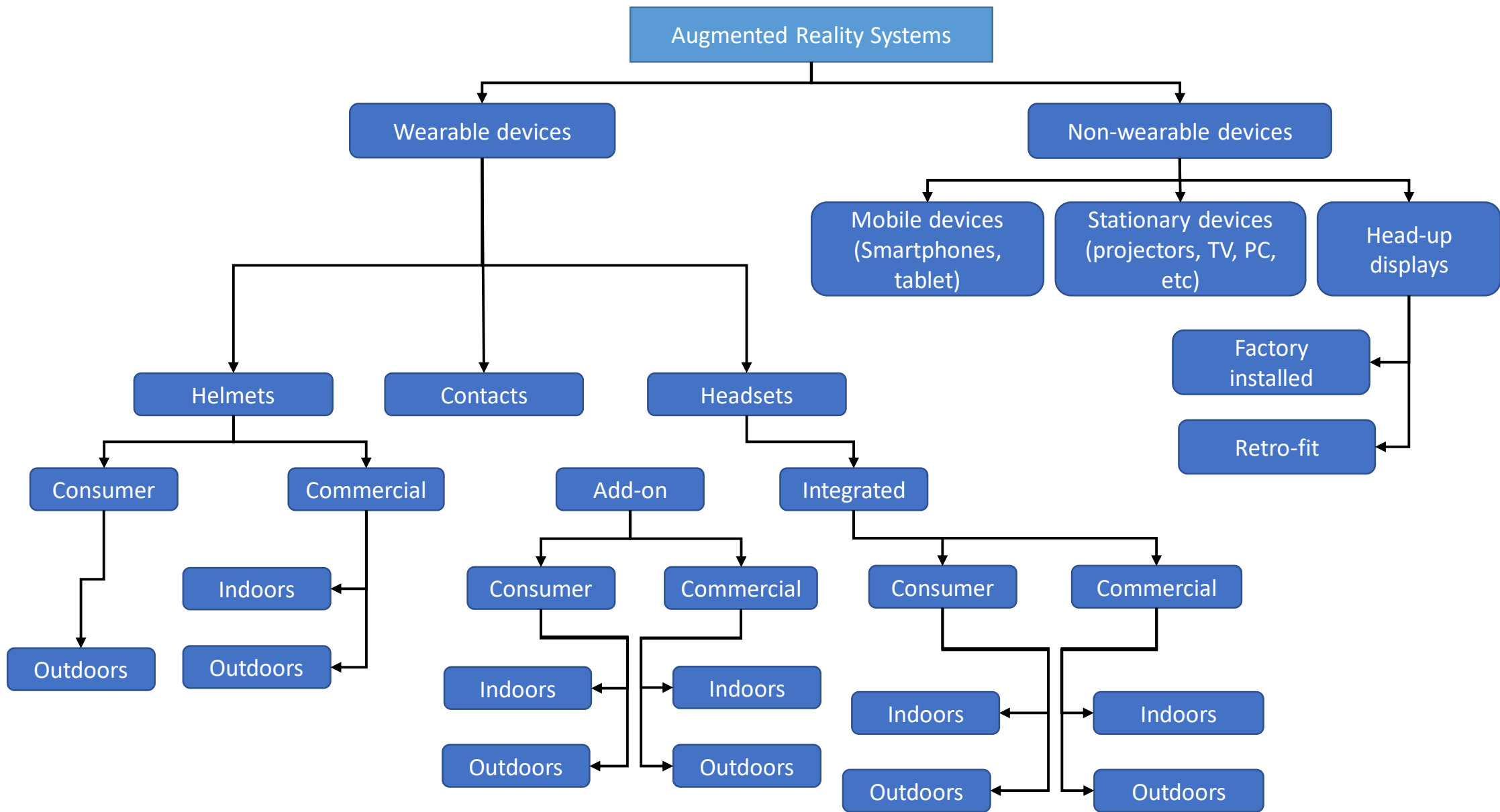
**Superimposition-based AR**



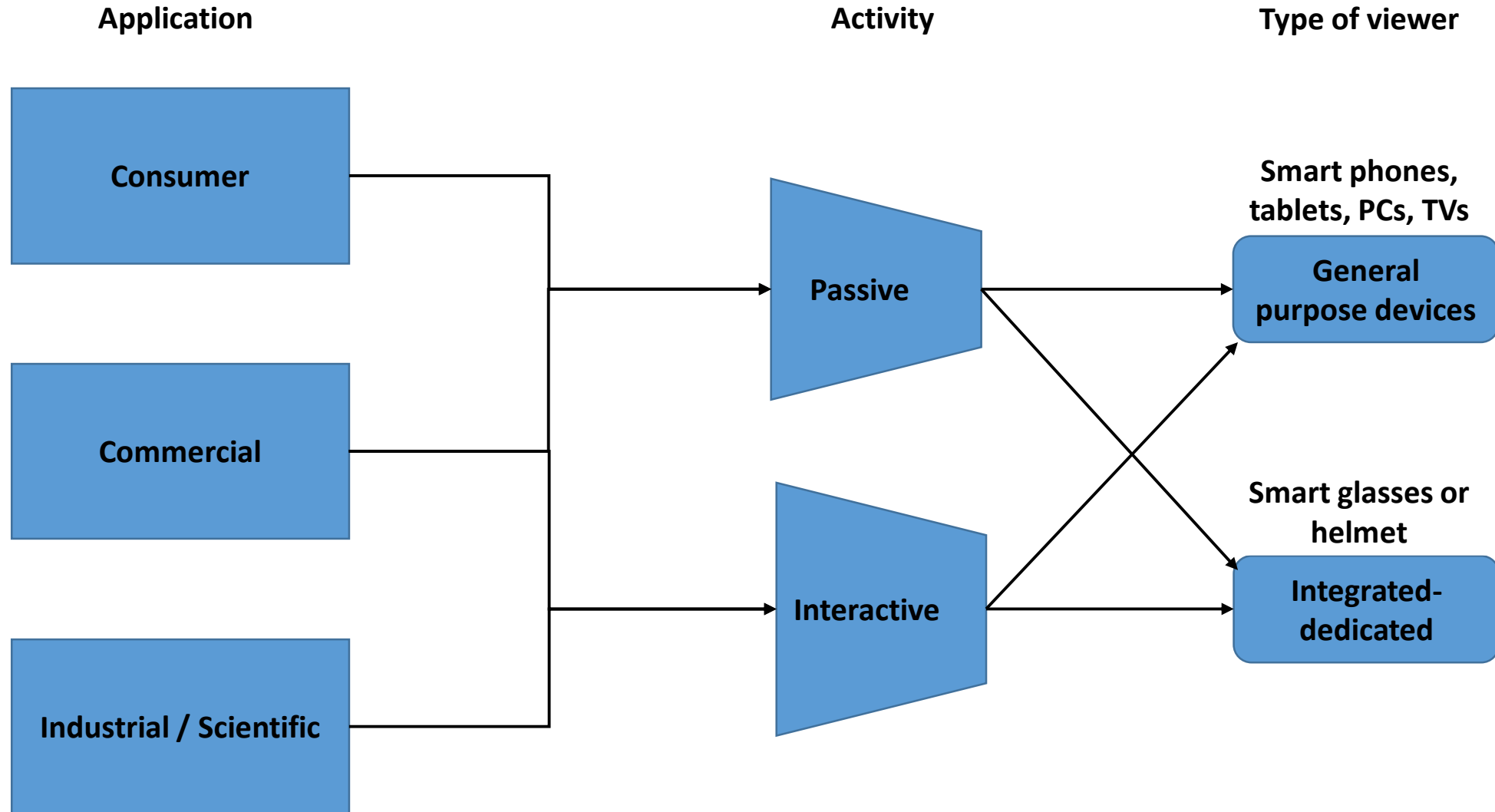
**Projection-based AR**







**Taxonomy of Augmented Reality**



# Applications of Augmented Reality

# Medical



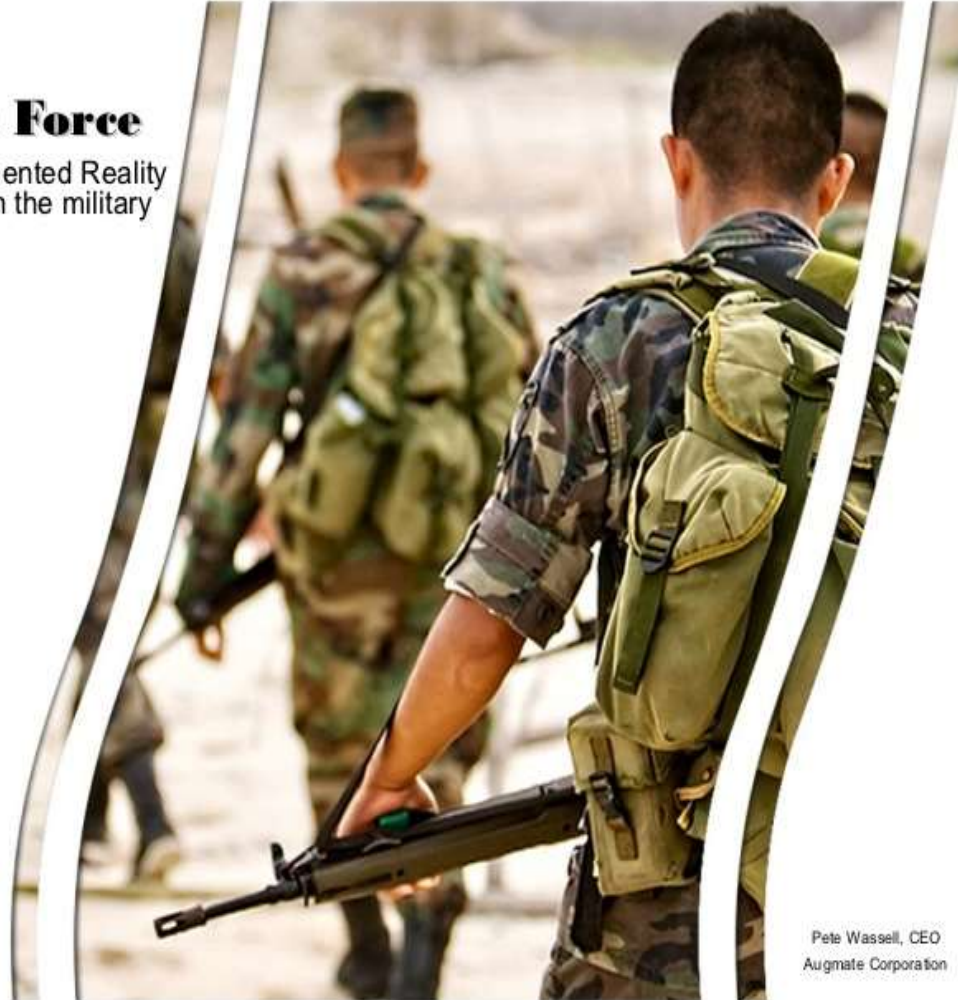
# Entertainment



# Military

## **Future Force**

Potential Augmented Reality  
applications in the military



Pete Wassell, CEO  
Augmate Corporation

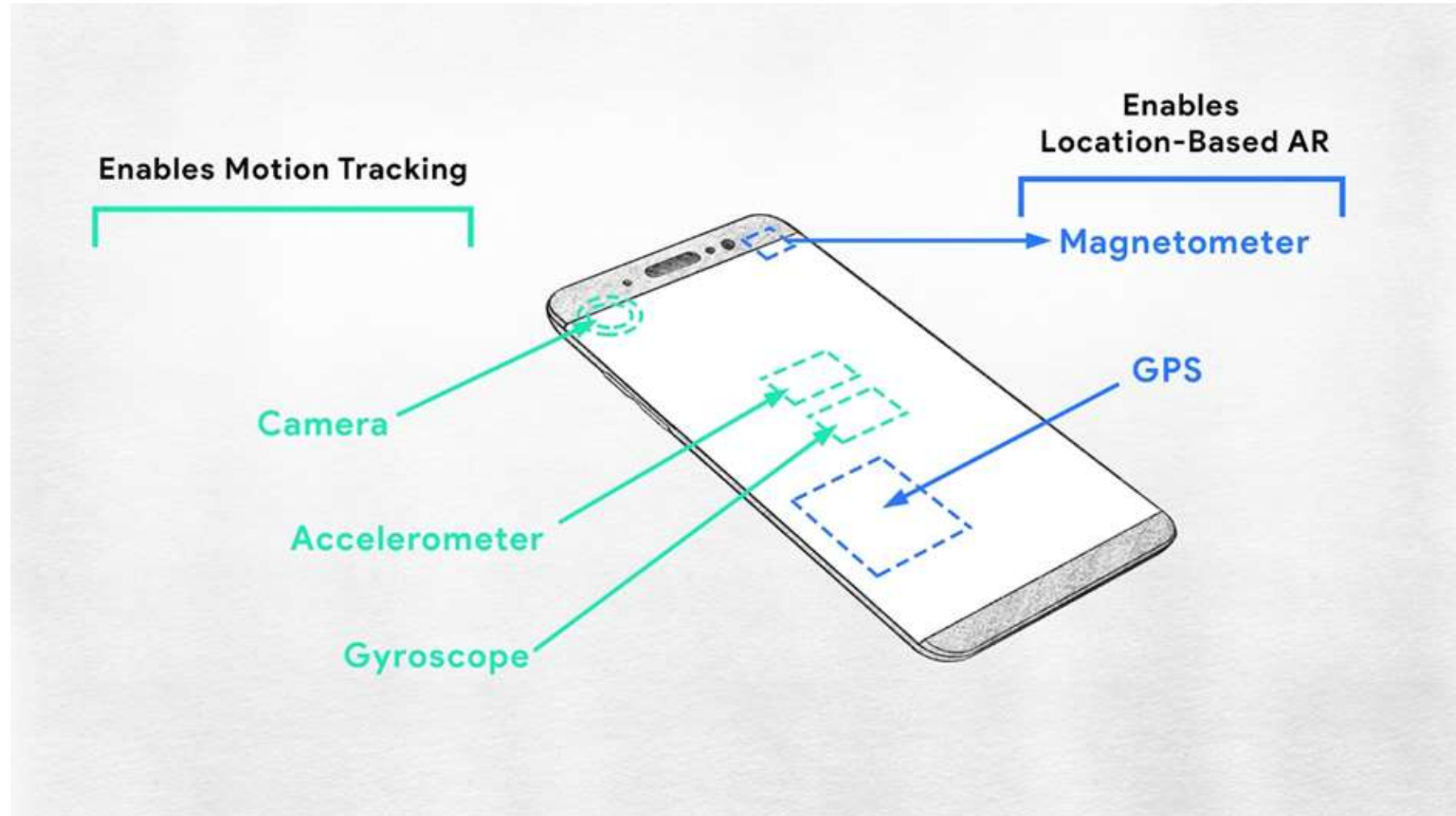


# Education



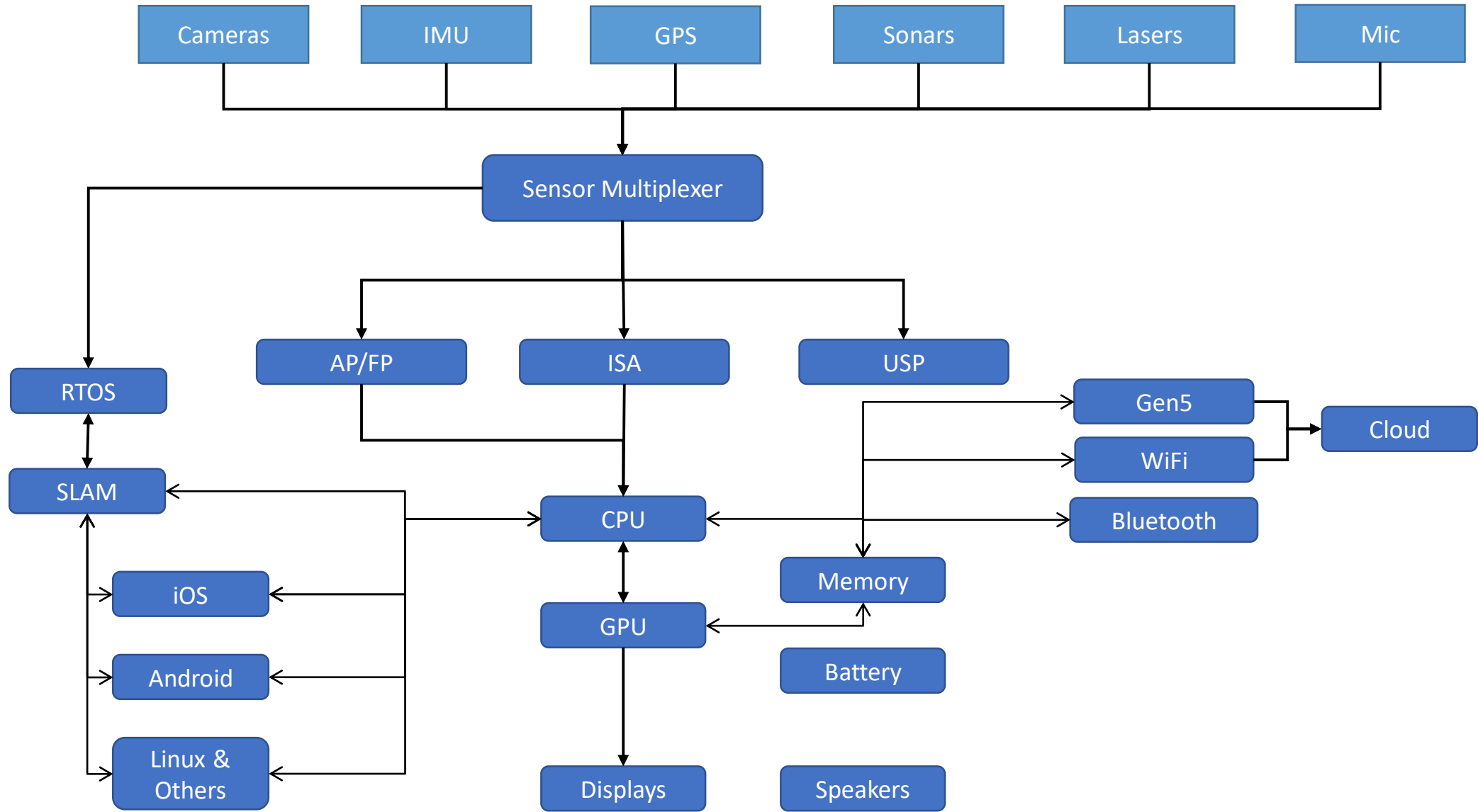
What makes AR feel real?

# Hardware components of mobile phone



# Important Components in AR system

- IMU—Inertial measurement unit, used as a gyroscope
- AP/FP—Application processor/function processor
- ISP—Image signal processor (for camera output)
- DSP—Digital signal processor (for cameras, mic, range finders, and radio)
- GPU—Graphics processing unit (alpha blending to make the objects appear to be in the room over real objects)
- SLAM—Simultaneous localization and mapping (to track its location while simultaneously mapping its surroundings)



**Block diagram augmented reality system**

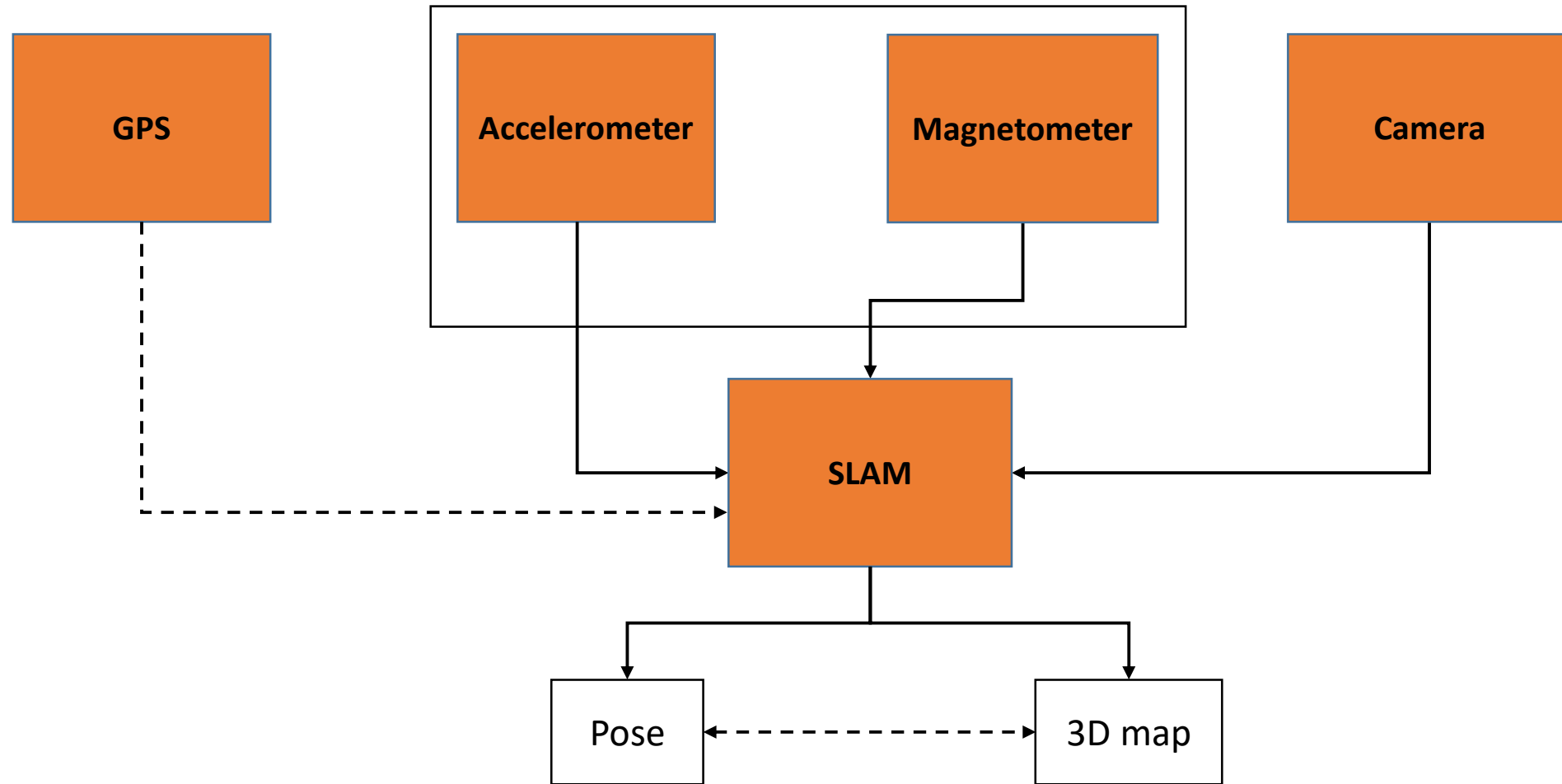
# SLAM—Simultaneous localization and mapping

- Recognizes 3D objects & scenes
- Track the world
- Overlay digital interactive augmentations
- Creates a map of its surroundings and orients itself within the map in real time
- Uses the IMU sensor data to construct a map of the unknown environment

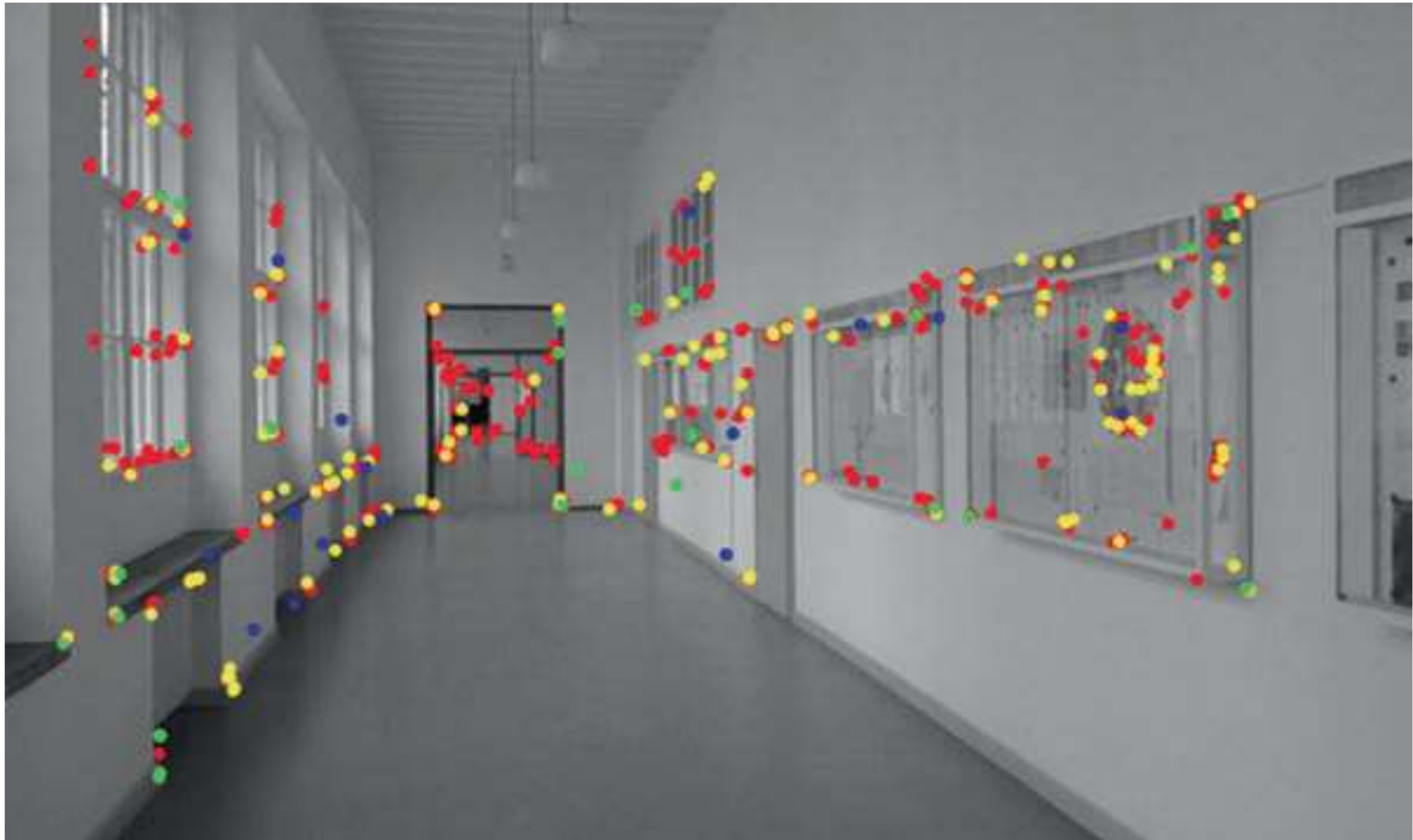


# Components of SLAM

- Sensor data: GPS, light sensor, depth sensors, etc.
- Front-End: 3D position, also called map points
- Back-End: Handling the overall geometrical reconstruction
- SLAM estimate: Tracked features, their locations & relations, as well as the camera position within the world



**Block diagram of the IMU and SLAM relationship to Pose and the 3D map**



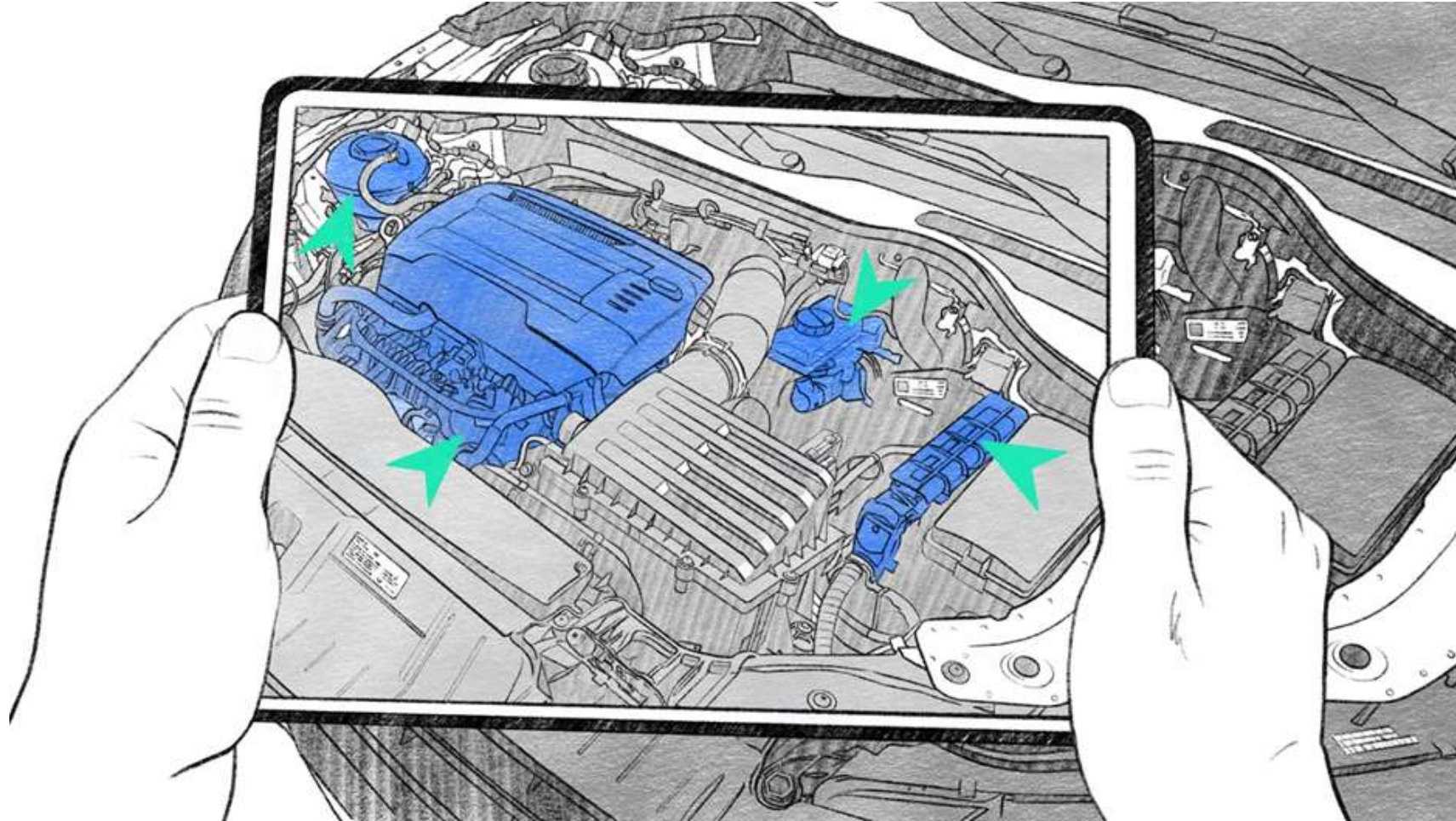
**Using SLAM technology the augmented reality device's camera in conjunction with its gyroscope and other location devices assign coordinates to objects in the FoV**

# User experience (UX) and user interface (UI)





# User experience (UX) and user interface (UI)



# Basic AR interaction options

- Drag and Drop
- Voice
- Tap
- Pinch and zoom
- Slide
- Tilt



# Challenges of current AR

- Requires high processing power, batteries generate heat, and big file size
- Language of human interaction has not been established
- A limited base of people with 3D design and interaction skills