## **Augmented Reality**

## **INTRODUCTION -:**

**Augmented reality** (**AR**) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory [modalities](https://en.wikipedia.org/wiki/Modality_(human%E2%80%93computer_interaction)), including [visual](https://en.wikipedia.org/wiki/Visual), [auditory](https://en.wikipedia.org/wiki/Hearing), [haptic](https://en.wikipedia.org/wiki/Haptic_perception), [somatosensory](https://en.wikipedia.org/wiki/Somatosensory_system) and [olfactory](https://en.wikipedia.org/wiki/Olfactory).[[1]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-1)[[2]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-2) AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects.[[3]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-3) The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment).[[4]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-B._Rosenberg_1992-4) This experience is seamlessly interwoven with the physical world such that it is perceived as an [immersive](https://en.wikipedia.org/wiki/Immersion_(virtual_reality)) aspect of the real environment.[[4]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-B._Rosenberg_1992-4) In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas [virtual reality](https://en.wikipedia.org/wiki/Virtual_reality) completely replaces the user's real-world environment with a simulated one.[[5]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-5)[[6]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-6) Augmented reality is related to two largely synonymous terms: [mixed reality](https://en.wikipedia.org/wiki/Mixed_reality) and [computer-mediated reality](https://en.wikipedia.org/wiki/Computer-mediated_reality).

Augmented reality is used to enhance natural environments or situations and offer perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding [computer vision](https://en.wikipedia.org/wiki/Computer_vision), incorporating AR cameras into smartphone applications and [object recognition](https://en.wikipedia.org/wiki/Object_recognition)) the information about the surrounding real world of the user becomes [interactive](https://en.wikipedia.org/wiki/Interactive) and digitally manipulated. Information about the environment and its objects is overlaid on the real world. This information can be virtual. Augmented Reality is any experience which is artificial and which adds to the already existing reality.[[11]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-11)[[12]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-12)[[13]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-13)[[14]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-14)[[15]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-Azuma_survey-15) or real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space.[[16]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-16)[[17]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-17)[[18]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-18) Augmented reality also has a lot of potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real time and in semantic [contexts](https://en.wikipedia.org/wiki/Context_awareness) with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and [heads up display](https://en.wikipedia.org/wiki/Heads_up_display) technology (HUD).

**TECHNOLOGY:-**

* **Software and Algorithams-**

A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent of camera, and camera images. That process is called [image registration](https://en.wikipedia.org/wiki/Image_registration), and uses different methods of [computer vision](https://en.wikipedia.org/wiki/Computer_vision), mostly related to [video tracking](https://en.wikipedia.org/wiki/Video_tracking).[[81]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-recentadvances-81)[[82]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-82) Many computer vision methods of augmented reality are inherited from [visual odometry](https://en.wikipedia.org/wiki/Visual_odometry). An **augogram** is a computer generated image that is used to create AR. **Augography** is the science and software practice of making augograms for AR.

Usually those methods consist of two parts. The first stage is to detect [interest points](https://en.wikipedia.org/wiki/Interest_point_detection), fiducial markers or [optical flow](https://en.wikipedia.org/wiki/Optical_flow) in the camera images. This step can use [feature detection](https://en.wikipedia.org/wiki/Feature_detection_(computer_vision)) methods like [corner detection](https://en.wikipedia.org/wiki/Corner_detection), [blob detection](https://en.wikipedia.org/wiki/Blob_detection), [edge detection](https://en.wikipedia.org/wiki/Edge_detection) or [thresholding](https://en.wikipedia.org/wiki/Thresholding_(image_processing)" \o "Thresholding (image processing)), and other [image processing](https://en.wikipedia.org/wiki/Image_processing) methods.[[83]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-83)[[84]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-84) The second stage restores a real world coordinate system from the data obtained in the first stage. Some methods assume objects with known geometry (or fiducial markers) are present in the scene. In some of those cases the scene 3D structure should be calculated beforehand. If part of the scene is unknown simultaneous localization and mapping (SLAM) can map relative positions. If no information about scene geometry is available, [structure from motion](https://en.wikipedia.org/wiki/Structure_from_motion) methods like [bundle adjustment](https://en.wikipedia.org/wiki/Bundle_adjustment) are used. Mathematical methods used in the second stage include: [projective](https://en.wikipedia.org/wiki/Projective_geometry) ([epipolar](https://en.wikipedia.org/wiki/Epipolar_geometry" \o "Epipolar geometry)) geometry, [geometric algebra](https://en.wikipedia.org/wiki/Geometric_algebra), [rotation representation](https://en.wikipedia.org/wiki/Rotation_formalisms_in_three_dimensions) with [exponential map](https://en.wikipedia.org/wiki/Rotation_matrix#Exponential_map), [kalman](https://en.wikipedia.org/wiki/Kalman_filter" \o "Kalman filter) and [particle](https://en.wikipedia.org/wiki/Particle_filter) filters, [nonlinear optimization](https://en.wikipedia.org/wiki/Nonlinear_optimization), [robust statistics](https://en.wikipedia.org/wiki/Robust_statistics).[[*citation needed*](https://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]

In augmented reality, the distinction is made between two distinct modes of tracking, known as *marker* and *[markerless](https://en.wikipedia.org/wiki/Markerless_motion_capture" \o "Markerless motion capture)*. Markers are visual cues which trigger the display of the virtual information.[[85]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-85) A piece of paper with some distinct geometries can be used. The camera recognizes the geometries by identifying specific points in the drawing. Markerless tracking, also called instant tracking, does not use markers. Instead, the user positions the object in the camera view preferably in a horizontal plane. It uses sensors in mobile devices to accurately detect the real-world environment, such as the locations of walls and points of intersection.[[86]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-86)

[Augmented Reality Markup Language](https://en.wikipedia.org/wiki/Augmented_Reality_Markup_Language) (ARML) is a data standard developed within the [Open Geospatial Consortium](https://en.wikipedia.org/wiki/Open_Geospatial_Consortium) (OGC),[[87]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-87) which consists of Extensible Markup Language ([XML](https://en.wikipedia.org/wiki/XML)) grammar to describe the location and appearance of virtual objects in the scene, as well as [ECMAScript](https://en.wikipedia.org/wiki/ECMAScript_for_XML" \o "ECMAScript for XML) bindings to allow dynamic access to properties of virtual objects.

To enable rapid development of augmented reality applications, some software development kits (SDKs) have emerges.

* **Social interaction**

AR can be used to facilitate social interaction. An augmented reality social network framework called Talk2Me enables people to disseminate information and view others' advertised information in an augmented reality way. The timely and dynamic information sharing and viewing functionalities of Talk2Me help initiate conversations and make friends for users with people in physical proximity.[[170]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-170) However, use of an AR headset can inhibit the quality of an interaction between two people if one isn't wearing one if the headset becomes a distraction.[[171]](https://en.wikipedia.org/wiki/Augmented_reality#cite_note-171)

Augmented reality also gives users the ability to practice different forms of social interactions with other people in a safe, risk-free environment. Hannes Kauffman, Associate Professor for Virtual Reality at TU [Vienna](https://en.wikipedia.org/wiki/Vienna), says: "In collaborative augmented reality multiple users may access a shared space populated by virtual objects, while remaining grounded in the real world. This technique is particularly powerful for educational purposes when users are collocated and can use natural means of communication (speech, gestures, etc.), but can also be mixed successfully with immersive VR or remote collaboration."[[*This quote needs a citation*](https://en.wikipedia.org/wiki/Wikipedia:Inline_citation#When_you_must_use_inline_citations)] Hannes cites [education](https://en.wikipedia.org/wiki/Education) as a potential use of this technology.

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