Tracking & Sensors - Tracking, Calibration, and Registration

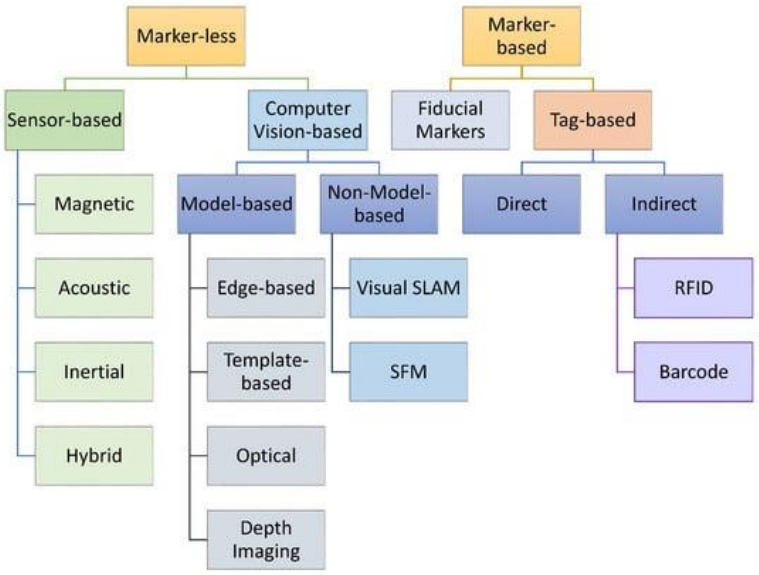
Tracking:

Tracking technologies introduce the sensation of motion in the virtual and augmented reality world and perform a variety of tasks. Once a tracking system is rightly chosen and correctly installed, it allows a person to move within a virtual and augmented environment. It further allows us to interact with people and objects within augmented environments. The selection of tracking technology depends on the sort of environment, the sort of data, and the availability of required budgets. For AR technology to meet Azuma's definition of an augmented reality system, it must adhere to three main components:

- it combines virtual and the real content;
- it is interactive in real time;
- is is registered in three dimensions.

The third condition of being "registered in three dimensions" alludes to the capability of an AR system to project the virtual content on physical surroundings in such a way that it seems to be part of the real world. The position and orientation (pose) of the viewer concerning some anchor in the real world must be identified and determined for registering the virtual content in the real environment. This anchor of the real world may be the dead-reckoning from inertial tracking, a defined location in space determined using GPS, or a physical object such as a paper image marker or magnetic tracker source. In short, the real-world anchor depends upon the applications and the technologies used. With respect to the type of technology used, there are two ways of registering the AR system in 3D:

- Determination of the position and orientation of the viewer relative to the real-world anchor: registration phase;
- Upgrading of viewer's pose with respect to previously known pose: tracking phase.



Sensor-Based Tracking

Magnetic Tracking Technology: This technology includes a tracking source and two sensors, one sensor for the head and another one for the hand. The tracking source creates an electromagnetic field in which the sensors are placed. The computer then calculates the orientation and position of the sensors based on the signal attenuation of the field. This gives the effect of allowing a full 360 range of motion. i.e., allowing us to look all the way around the 3D environment. It also allows us to move around all three degrees of freedom. The hand tracker has some control buttons that allow the user to navigate along the environment.
Calibration = offline adjustment of measurements

- Spatial calibration yields static registration
- Offline: once in lifetime or once at startup
- Alternative: autocalibration

• Tracking = dynamic sensing and measuring of spatial properties

- Tracking yields dynamic registration
- Tracking in AR/VR always means “in 3D”!

Calibration:

Depending on the app’s goals and functionality, AR calibration may involve one or more of the following user actions:

Scanning: The user must scan a rough or textured surface such as a floor or wall (or a certain indicator in the environment such as edge between a wall and the ceiling).

Absolute positioning: The user has to position the device in a certain location, such as leaning it to a wall or go to a specific landmark in a city.

Relative positioning: The user must have the device in a fixed position on the ground or at waist level, then get to a certain distance from the camera/device and be fully or partially visible in the camera view. This is typical for AR fitness apps or games.

No calibration: The AR feature can be used right away and requires only appropriate lighting. This is usually the case with live try-on apps (e.g., Ulta, Warby Parker) or AR filters (e.g., Instagram, TikTok).

Registration:

Registration is a process which blends virtual objects generated by computer with real world image caught by camera. First of all it confirms the position between virtual objects and observer, and then projects the virtual objects into the visual field of the observer through projection transformation.