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Towards an End-to-End System for 3D Tracking of Physical Objects in Virtual Immersive Environments

Abstract

This work aims to establish an end-to-end system for tracking of physical 3D objects for virtual reality (VR) applications. We focus on training applications that require real-time tracking of the position of small physical objects and their reflection in VR space. We aim to perform object tracking in a "plug and play" manner, without using complex systems with quite large tracking devices or manually implementing object tracking. We propose a system for object tracking via fiducial markers alongside a software harness to enable fast and efficient designation of objects to be tracked and a data streaming solution for end-use applications. The system utilizes AruCo, AprilTag and an original Colored Control Points based fiducial system and allows for easy tag detection and use of object position data, which are crucial for immersive training environments based on VR and extended reality (XR). We evaluate various tag sizes and detection distances, and different camera devices against theoretical limits. In effect, we create a complete solution for easily implementing fiducial marker based object real-to-virtual position mapping for various applications.