Smartphone 3D Reconstruction for Physical Interactions in Augmented Reality

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Over the last couple of years, Augmented Reality (AR) has reached millions of consumers with the help of Visual-Inertial Odometry systems. This key process has been developed to such extent that it can now run on handheld smartphones. Research in the field has been focused on creating usable and entertaining experiences, but there is still a need to design solutions addressed at some crucial technical obstacles of Augmented Reality systems. Nowadays, frameworks such as ARKit or ARCore are available in millions of devices and allow a basic interaction between virtual objects and real-world planes, lacking any other 3D understanding of the rest of objects present in the scene.

The project hereby presented aims to design and implement a real-time 3D reconstruction system for a richer environmental understanding of the physical world, focusing on allowing an efficient collision between real and virtual objects. Some solutions have been proposed using specific hardware. This work, however, is developed on top of monocular SLAM systems which are available in today's mobile devices, thus, the constraints that these low-end devices have must be taken into consideration. This dissertation seeks to describe how to make use of a cloud of visual features in order to build a meaningful 3D representation of the scene. The results of this research extend the alternatives currently available, and show how real-time can be achieved by taking advantage of an volumetric data structure with adaptive levels-of-detail and a multithreaded processing pipeline.