Robust 3D Object Detection and Tracking on Mobile Devices

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Abstract

Detection and tracking of 3D structures is a challenging computer vision problem that has been solved for indoor and limited areas, using visual Simultaneous Localization And Mapping (SLAM) approaches, among others. These methods execute simultaneously the creation of a point cloud describing the environment, called a map, and the localization of the user inside this environment by analyzing images of the viewed scene. This work aims to improve these systems by giving them more agility and robustness to harsh conditions such as important image motion blur, unstable lighting conditions, natural image artifacts and large scale or uncontrolled scenes. These issues appear particularly sensitive when detecting and tracking 3D structures in outdoor environments. The motivation is therefore to develop a system able to track 3D structures such as buildings in urban areas, but also suited to tracking 3D objects in closed and indoor environments. The provided solution integrates edge features as part of an existing SLAM system through edge detection, matching, triangulation and tracking. Edge features are particularly convenient to get a good quality tracking in the mentioned problematic cases. They are resistant to motion blur, lighting changes, and are a good representation of 3D structures, especially buildings. Several innovations have been made to give to the system the best possible quality for detection and tracking on mobile devices. Results show good performance of the edge detector and a more continuous tracking with a handheld camera. Augmented reality is a direct use case of this work and will be its main application. Therefore, the autonomy of the system in relation to the user and its performance on mobile devices are important.