XXVI SIBGRAPI – CONFERENCE ON GRAPHICS, PATTERNS AND IMAGES
SIBGRAPI 2013
August 5-8, Arequipa – Peru

A Markerless Augmented Reality Approach Based On Real-Time 3D Reconstruction using Kinect

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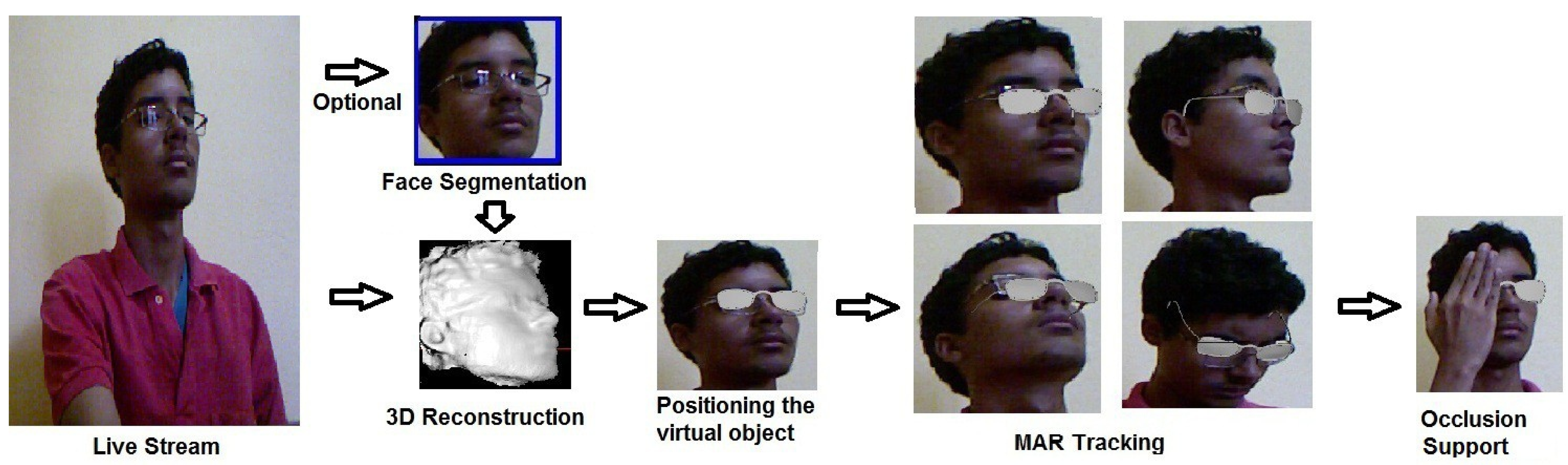

I. Introduction

Augmented Reality (AR) is a technology in which a user's view of a real scene is augmented with additional virtual information. Accurate tracking, or camera pose estimation, is required for the proper registration of virtual objects. However, tracking is one of the main technical challenges of AR.

AR can be marker-based or markerless. Marker-based AR uses artificial markers to help the system to estimate the camera pose. Markerless AR (MAR) uses a part of the real scene as the marker.

We present a general MAR approach based on real-time 3D reconstruction using a low-cost depth camera, the Kinect. We intend to use this approach to build a MAR system for 3D medical visualization, in which the patient's head will be augmented with volumetric data of his cranium.

II. MAR Approach Based on Real-Time 3D Reconstruction

Our approach can be summarized as follows:

• Segment the real object from the scene by applying a Z-axis threshold and a Viola-Jones face detector [1] (if the object of interest is a human face);
• Track and integrate each depth frame to build the real object's reference 3D model with the KinectFusion algorithm [4];
• Position the virtual object into the scene;
• Track the virtual object through the Kinect live stream by using the Iterative Closest Point (ICP) algorithm [2, 3] and the solution proposed in [5] (if the object of interest is a human face);
• Solve occlusion by using a fragment shader that check whether the virtual object is in front of real object;

III. Preliminary Results and Discussion

We tested the prototype with real data captured from a Kinect sensor using a grid with volume size of 50cmx50cmx130cm considering that the object of interest is a human face.

Our approach runs in real-time and the MAR tracking is done properly even with the noisy data provided by the Kinect. When the tracking algorithm fails, the solution proposed in [5] recovers the algorithm in most of the cases.

The drawback of our approach is that the presence of holes distributed along the real model is a problem to the occlusion test (as can be seen below) and, when there is occlusion, the real object is partially occluded and the tracking may fail.

IV. Future Work

The next steps of this work are improve its use in the 3D medical visualization, taking advantage of the KinectFusion's grid representation to implement a method for automatic position of medical volumetric data into the scene.

References

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