Interactive Mobile 3D Acquisition & Calibration

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

Mobile image and video acquisition is omnipresent. However, most of the time, a smartphone camera dynamically adjusts the focus and acquires the video data without knowledge of its 3D whereabouts. The pose of the camera, however, is essential to extract 3D geometry from acquired images. This projects aims to provide a tool which keeps the camera dynamics controllable while recording the cam position and orientation such that the images can be used to create 3D models.

Background and Motivation

In order to create 3D models or democratize the acquisition of mobile medical scans with smartphones, the knowledge of position and orientation of the camera is essential. On top of that, the so called intrinsic camera parameters need to be calibrated and are typically kept static throughout the acquisition to get the best output.

In this project, we aim to provide a web-interface that helps for mobile phone camera calibration and pose estimation using marker-based tracking. The camera video stream is used to observe a calibration target with an object of interest in the middle. The target design is used to calibrate the camera and to determine the position and orientation of the camera such that the data acquisition process is optimized for consecutive 3D modelling.

Student's Tasks Description

Your task is to develop a web-interface that is accessible from a mobile phone and uses the camera feed to track a marker board. The video data is gathered and uploaded to a server.

The project can be separated into three parts:

In phase one, you read the mobile camera data using HTML5 or JS such that the mobile phone acts as a camera following e.g. the mediaDevices API [1]. Intrinsic parameters are programmatically fixed at this stage. The video feed is saved and an upload mechanism is implemented for acquired content.

In project phase two, you implement a ChArUco marker tracking [2] following OpenCV [3] and JS-ArUco [4] in JavaScript. The camera intrinsics are calculated with the help of the board and the camera pose relative to the custom target is estimated.

Phase three is an optional phase where you can show the retrieved and saved 3D camera locations in a 3D viewer to ensure full coverage of a hemisphere around the object of interest. An existing 3D viewer [5] like Three.js can be used.

After completion of the project, the student will be familiar with marker tracking using robust ChArUco targets and has gained some hands-on experience with camera calibration and OpenCV in JS. The interaction with the 3D computer vision team at CAMP offers insight in recent research trends and ways to approach problems in this domain.

Technical Prerequisites

- Previous experience with JavaScript
- Basic knowledge in Computer Vision (such as camera calibration)
- Ideally some experience with 3D viewers

Please send the completed proposal to ardit.ramadani@tum.de, lennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.

References

[1] Tutorial on mediaDevices API using JS: https://github.com/philnash/mediadevices-camera-selection

[2] OpenCV ChArUco Marker Tracking: https://docs.opencv.org/3.4/df/d4a/tutorial_charuco_detection.html

[3] OpenCV.js: https://docs.opencv.org/3.4/d5/d10/tutorial_js_root.html

[4] JS-ArUco: https://damianofalcioni.github.io/js-aruco2/

[5] Three.js. https://threejs.org/