Adaptative projection on a mobile planar surface

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1 INTRODUCTION AND PROJECT OBJECTIVES

The goal of the project is to adapt continuously the projection on a moving planar surface.

The project will study:

- how to automatically detect a markerless planar surface,
- how to detect a planar surface from a *uv* map generated with structured light,
- how to generate a *uv* map from the projected content using key features detection and linear interpolation.

2 Background information

A similar solution has already been proposed by [1]. The authors have developed a system able to project video content on a stationary planar surface while moving a projector. To continuously adapt the projection, they rely on the three homographies between the screen, the camera and the projector. Since these homographies are related and the one between the screen and the camera does not change over time, the only homography that needs to be updated is the one linking the projector and the camera (the one between the projector and the screen is indeed impossible to compute directly). To compute this homography, they use correspondences between feature points found on the projector and camera images. These feature points are extracted from the content thanks to the SIFT method and are used in a sequential least squares optimization to minimize the reprojection error between the camera and the projector.

Pilet et al. proposed a multi-camera calibration technique based on textured images that allows them to augment a planar surface in real-time [2]. First, the system needs to be trained to detect interest points in the textured images. These interest points are then used for a complete geometric calibration. Finally, the interest points are used to track and augment the textured image in real-time. No projector is used in the system, the augmentation is achieved through a screen.

3 Detailed technical description

3.1 Technical description

Proposed work packages in the project are:

- **WP1**: Detection and tracking of the planar surface.
- **WP2**: Planar surface detection in a *uv* map.
- **WP3**: *uv* map estimation from the projected content.

3.2 Ressources needed

The project requires cameras and projectors.

4 Work plan and implementation schedule

Week 1 Review of existing methods and installation of the experimental setup.

Week 2 Implementation.

Week 3 Implementation.

Week 4 Tests.

5 Benefits of the research and expected outcomes

The team expect to develop a software that simplify the projection on static and moving planar surfaces.

The software would automatically detect planar surfaces in the projector field of view from the *uv* map or the projected content. We will also explore the non invasive structured light projection in order to generate the *uv* map.

6 Profile of the team

6.1 Project Leaders

6.1.1 Radhwan Ben Madhkour, PhD Student, University of Mons (Belgium)

Radhwan Ben Madhkour holds an Electrical Engineering degree from the Faculty of Engineering of Mons since June 2008. He did his master's thesis in the field of Image Coders. He joined the Numediart program in May 2009. He was a visting researcher of Vision3D lab of UMontreal in 2009. His research interests focus on computer vision.

6.2 Team members

6.2.1 Ambroise Moreau, PhD Student, University of Mons (Belgium)

Ambroise Moreau holds an Electrical Engineering degree from the Faculty of Engineering of Mons since September 2014. He did his master's thesis in the field of multi-projection mapping.

References

[1] Daisuke Abe, Takayuki Okatani, and Koichiro Deguchi. Flexible online calibration for a mobile projector-camera system. In *Computer Vision–ACCV 2010*, pages 565–579. Springer, 2011.

[2] Julien Pilet, Andreas Geiger, Pascal Lagger, Vincent Lepetit, and Pascal Fua. An all-in-one solution to geometric and photometric calibration. In

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