



Bachelor's Thesis

Designing and Implementing a Rephotography Application for iOS

Rasmus Diederichsen

First Supervisor: Prof. Dr. Oliver Vornberger

Second Supervisor: Dr. Thomas Wiemann

Department of Computer Science
Department of Cognitive Science

This page intentionally left blank

CONTENTS

1	INTRODUCTION	3
1.1	Overview	3
1.2	Previous Approaches	3

INTRODUCTION

1.1 OVERVIEW

Rephotography or repeat photography denotes the retrieval of the precise viewpoint used for taking a — possibly historic — photograph and capturing another image from the same spot, ideally with the same camera parameters. This allows for documentation and visualisation of changes which the scene has undergone between the two or more captures. For instance when documenting urban development, one can present progress of construction, restoration efforts or changes in the surroundings in a visually striking manner, e.g. by blending the photographs together. Figures [Figure 1](#) and [Figure 2](#) show examples.

When done manually, the photographer must attempt to find the original viewpoint usually by visual inspection of the original image and trying to match the current camera parameters — camera position, camera rotation, focal length, possibly principal point — to the original. The procedure is often carried out by placing the camera on a tripod and comparing a printout of the original image with what can be seen through the viewfinder or the camera screen. The number of parameters to match as well as the difficulty to estimate them purely from comparing two-dimensional images makes the process error-prone and tedious. Visual acuity and experience of the photographer thus place limits on the accuracy with which the camera pose of the reference image can be reconstructed.

The advancement of mobile phones and tablet computers with integrated cameras and larger screens presents the opportunity to develop applications which can assist in this endeavour, moving away from the traditional trial-and-error approach. On current digital cameras¹ this is impossible due to their closed infrastructure not permitting running user programs.

1.2 PREVIOUS APPROACHES

Several applications have been developed to assist a photographer in taking rephotographs. For smartphone operating systems, *rePhoto*² and *Timera*³ exist, both available for Android and iOS devices. These applications support the user by placing a transparent version of the original image over the current camera image, allowing for eas-

¹ At the time of writing, no commercial manufacturer produces a camera with user-modifiable firm- or software. A project at Stanford ([Adams et al., 2010](#)) was discontinued [Levoy \(2009\)](#)

² <http://projectrephoto.com/>

³ <http://www.timera.com/Explore>



Figure 1: Residenzschloss in Dresden, destroyed during World War II, © Sergey Larenkov, printed with permission



Figure 2: Frauenkirche in Dresden, destroyed during World War II, © Sergey Larenkov, printed with permission

ier alignment. The captured rephotograph is then presented together with the original image in a blend (c.f. ??).

What is characteristical about both applications is that the user must still determine on their own how to actually move the camera. An overlay simplifies the procedure, eliminating some of the inaccuracy introduced into the manual approach by the necessity to move the eyes from printout to camera, but it is still the user's responsibility to determine the necessary motion between the current camera position and the goal position (that of the original image). A more sophisticated approach was presented in (Bae et al., 2010).

BIBLIOGRAPHY

- Adams, A., Talvala, E.-V., Park, S. H., Jacobs, D. E., Ajdin, B., Gelfand, N., Dolson, J., Vaquero, D., Baek, J., Tico, M., Lensch, H. P. A., Matusik, W., Pulli, K., Horowitz, M., and Levoy, M. (2010). The frankencamera: An experimental platform for computational photography. *ACM Transaction on Graphics*, 29(4):29:1–29:12.
- Bae, S., Durand, F., and Agarwala, A. (2010). *ACM Transactions on Graphics*, 29(3).
- Levoy, M. (2009). Camera 2.0: New computing platforms for computational photography. <http://graphics.stanford.edu/projects/camera-2.0/>. accessed 2015-07-28.