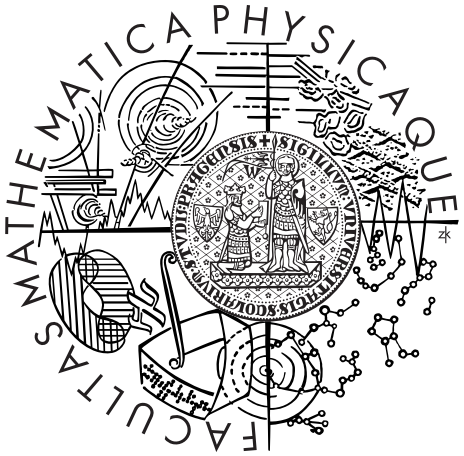
Charles University in Prague
Faculty of Mathematics and Physics

BACHELOR THESIS



Viktorie Vášová

3D Computer Vision on the Android Platform

Name of the department or institute

Supervisor of the bachelor thesis: Mgr. Lukáš Mach

Study programme: General Computer Science

Prague 2013

Dedication.

I declare that I carried out this bachelor thesis independently, and only with the cited sources, literature and other professional sources.

I understand that my work relates to the rights and obligations under the Act No. 121/2000 Coll., the Copyright Act, as amended, in particular the fact that the Charles University in Prague has the right to conclude a license agreement on the use of this work as a school work pursuant to Section 60 paragraph 1 of the Copyright Act.

In ..... date ..... signature of the author

Název práce: 3D počítačové vidění pro platformu Android

Autor: Viktorie Vášová

Katedra: Informatický ústav Univerzity Karlovy

Vedoucí bakalářské práce: Mgr. Lukáš Mach

Abstrakt:

Klíčová slova: 3d počítačové vidění, problém korespondence, platforma Android

Title: 3D Computer Vision on the Android Platform

Author: Viktorie Vášová

Department: Computer Science Institute of Charles University

Supervisor: Mgr. Lukáš Mach

Abstract:

Keywords: 3D computer vision, image correspondence, Android platform

Contents

Introduction

Last years, many researchers have been attracted by the task of Computer Vision. Particularly the problem of 3D reconstruction is being investigated a lot since it has received attention from the public. At this moment there is a great number of algorithms to solve problems in this area. Most of the approaches depends on the kind of input that is available (a set of pictures – determining is also how many pictures are taken, a video stream, etc.) and also on the output that we expect.

The work of many researches resulted in several online applications such as PhotoSync by Microsoft or Google StreetView that is used by millions of people nowadays.

Meanwhile we could observe a large progress of telecommunication devices. In last years, for an ordinary person it became very common to own a mobile phone that is denoted as smartphone. Especially mobile phones with Android platform are very popular. A built–in camera and large amount of applications is an obviosity for such kind of telephone.

The goal of this work is to explore conceivable ways how to connect these two phenomenons and to create an Android application which takes a set of pictures and visualises the result of the reconstruction of the depth information. Due to the ambiguity of solving the task, we have to be aware of the fact that it is possible, and to a certain extent even probable, that our application will be limited to only a particular type of scenes.

The first part of this work analyses the problem, describes available software and gives an overview of programming libraries and languages that were used. Secondly we focus on the theoretical basics and introduced approaches connected to this topic. The next section is denoted to implementation of our application and finally we evaluate and benchmark our work.

1. Overview

As we have already mentioned, with tasks of 3D Computer Vision have been dealing many researchers last years. In the Czech Republic there are several successful institutes specialised in image processing such as Center for Machine Perception or Institute of Information Theory and Automation with Department of Image Processing or Pattern Recognition Department for example where the latest issues are discussed. Their cooperation with governmental institutions and higher authorities indicates the importance of this area of computer science beside the popularity of creating 3D models in the general public.

However, many years of researches resulted in several applications. In this part we will give an overview of available software dealing with analysing depth information and 3D reconstruction. In the second part of this chapter, available programming languages and libraries considered for our work, are discussed.

1.1 Existing Software

One of the first applications that were used to create a 3D model from a set of pictures of an object was Photosynth designed by Microsoft company in cooperation with University of Washington. The algorithm is based on pattern recognition and generates a 3D model of a photographed object including the point cloud. After releasing the application there were available only projects generated by Microsoft or BBC and later a cooperation with NASA was started. Until two years later the version for public was released so users could upload own images to create a 3D model.

In 2007, a year after releasing Photosynth, Google introduced Street View to extend Google Maps and Google Earth. At first, this additional application provided a panoramic views of cities in the USA, but soon it expanded to other places in the world.

Autodesk, an American corporation focused on 3D design software, released modelling application Autodesk 123D recently. There are several additional tools available. One of them is 123D Catch that creates 3D model from a set of pictures taken from different view angles. This software is compatible with Autodesk 123D application, so it is advisable idea for designers who want to work with real–world objects in the virtual scene. The program is available for these operating systems: Windows XP, Windows Vista, Windows 7, Mac OSX and iOS. It seems that for creating such a 3D model it is necessary to follow detailed instructions how to shot the pictures. In most cases the process of building model fails because of wrong set of images. An error can occur when pictures are blurred, the background is not solid or the amount of photos is not sufficient.

If we evaluate accessibility of the software for mobile phones, Google Street View is running on every type of mobile platform without any larger errors. There is a version of Photosynth for Windows phones and iOS operating system. As we already mentioned, Autodesk developed a version for iOS as well. But apparently, we miss applications developed for Android platform.

1.2 Existing Libraries

In this work, the main assignment is getting an image information from a set of pictures and its processing afterwards. To be able to program a software dealing with a task from the area of computer vision, it is necessary to be familiar with a library that supports work with images. That kind of functions offers OpenCV library.

OpenCV is a cross–platform library developed by Intel. It provides large scale of functions supporting image processing; classes for segmentation and recognition, blob detection and other 2D and 3D feature toolkits are available.

For our work is important that support for C, C++, Python and the Android platform is included in the library. OpenCV4Android offers us great equipment for image processing.

2.

2.1

2.2

3.

3.1

3.2

Conclusion

Bibliography

List of Tables

List of Abbreviations

Attachments