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Implementation of Features Based Image Mosaicing Algorithm

Abstract

In some image processing applications; a single image can not provide enough information for some analysis; that is why we need to combine overlapped images to have a single image with a large field of view. This can be achieved with image mosaicing algorithm. In our work, we have proposed efficient image mosaicing algorithm based on classical features detector, which make our algorithm simple to be implemented on embedded system.

Introduction

Image mosaicing approach is to acquire several images of parts of the scene at high magnification and assemble them into a composite single image which preserves the high resolution. The basic idea of this technique is to find a suitable planar transformation which allows warping images into a single and common reference frame.
Image mosaicing is necessary in several applications such as:

- Construction of aerial maps.
- Tracking of moving objects.
- Creation of panoramas.
- Reconstruction of 3D scene.

Image Mosaicing

1. Definition

Image mosaicing is no more than, having a set of images; with a condition that should exist an overlapping between every two successive images, by applying some techniques we can get a single mosaiced image.

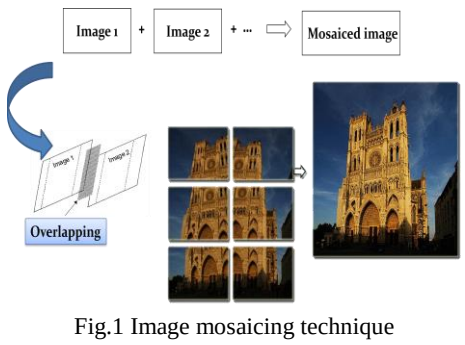

Fig.1 Image mosaicing technique

2. Image Mosaicing Algorithm

The main stages of image mosaicing algorithm are shown in figure 2:

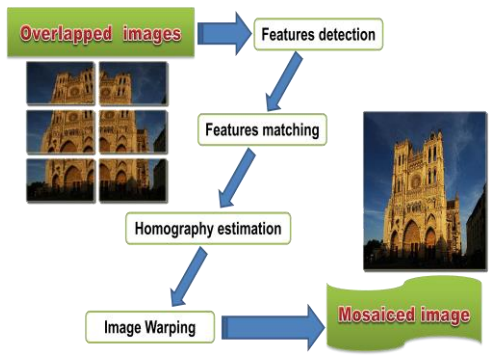

Fig.2 Image mosaicing stages

2.1. Features Detection

It is selecting distinctive objects in the two overlapped images; these objects are called features and they can be detected using:

- Classical detectors.
- Modern detectors.

2.2. Features Matching

The matching process is to find for each point of an image its correspondent in the other image. The matching can be done using:

- Correlation based methods
- Descriptors based methods.
- Tracking based methods.

2.3. Homography Estimation

Different types of transformations exist for different image processing purposes:

- Similarity transformation.
- Affine transformation.
- Homography transformation.

Homography transformation is the most general model for image mosaicing applications.

2.4. Image Warping

Image warping is the act of projecting two images on each other according to a mapping between source image I (x,y) and destination image I'(x,y). This can be done using:

- Forward warping.
- Backward warping.

Results

1. Matlab Platform

Matlab software is suitable for the development of complex image processing algorithms such as image mosaicing algorithm.

Fig.3 The used overlapped images.

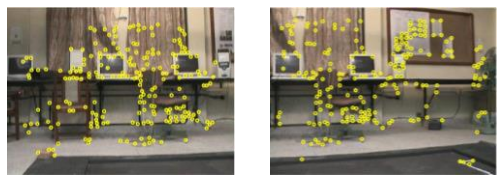

Fig.4 Features detection using Harris detector.

Harris detector provides distinctive corners features with high repeatability; the following table illustrates the effect of threshold value on the performance of the detector:

Tab.1 The performance of Harris detector

Threshold Value	Features image 1	Time (s)	Features image 2	Time (s)
1000	260	0.1021	304	0.0471
2000	167	0.0983	183	0.0468
3000	114	0.1364	134	0.0631

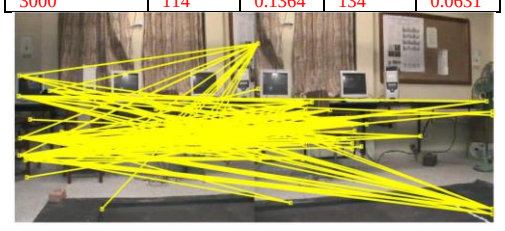

Fig.5 Features matching using correlation.

Using correlation-based matching, a lot of false associations occur in the matching stage, the correlation window is the effective parameter in this algorithm (the table bellow).

Tab.2 The effect of the window

Correlation window	Matched features	Correct matches	Time (s)
3×3	260	8	0.6028
7×7	167	18	0.9019
9×9	114	27	1.0188

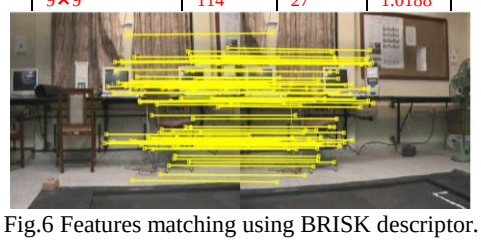

Fig.6 Features matching using BRISK descriptor.

Fig.7 Image mosaic by backward warping.

A classical Harris features detector associated with BRISK descriptors give better matching result than correlation.

2. LabVIEW Platform

LabVIEW constitutes a graphical programming environment that allows one to design and analyze a DSP system in a short time.

To build a single image with a wide view from two overlapped images (Fig.3), we design a LabVIEW VI programme which allowed us to obtain a mosaiced image.

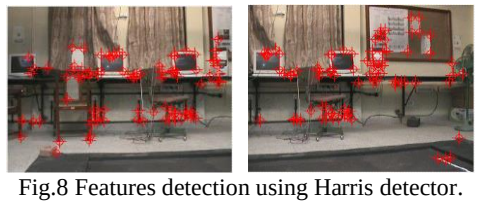

Fig.8 Features detection using Harris detector.

Detected corner points in both images using the Harris corner detection algorithms give us features with high repeatability, which make the performance of the matching higher especially if it was associated with BRISK descriptors.

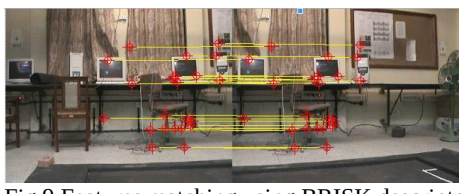

Fig.9 Features matching using BRISK descriptor.

Fig.10 Image mosaic by backward warping.

With the NI LabVIEW FPGA Module, we can take advantage of the parallel processing capabilities of FPGAs without being an expert in VHDL or Verilog.

Conclusion

The performance of an image mosaicing algorithm depends mainly on the performance features detection and matching techniques

We have used binary descriptors (BRISK) with classical features detector (Harris) and we have got efficient result.

We have tested our algorithm on Matlab, then, we have implemented it on LabVIEW and we have obtained similar results.

We recommend the implementation of our algorithm on embedded system (FPGA, DSP, … etc.)