Stereo Depth Map Construction

By:
Emmanuel Fuentes
Pawel Mikolajczyk
Naji Barnes-McFarlane

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CONNEXIONS

Rice University, Houston, Texas

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Chapter 1

Introduction to Computer Vision[1]

1.1 Stereo Imaging

The human eyes both take independent "photos" at different angles and positons. The remarkable thing about the human brain is that it is able to use both images to recreate the 3D world. It does this very quickly and remarkably accuratly.

To replicate this in computers is a crucial part of image processing and robotics. A computer's ability to understand its own position compared to its surroundings is a crucial step forward. This would allow the ability for robots to go where humans could not and "learn" useful information about their surroundings.

In the scope of this project we try to replicate basic Stereo Imaging given two photos taken at different horiztonal positions from eachother. We are going to rebuild the 3D space possible with two images, with depths from the camera plane.

[1] This content is available online at <http://cnx.org/content/m36393/1.1/>.

Chapter 2

Correspondence Problem[1]

2.1 Correspondance Problem

2.1.1 Stereo Image Matching

Given any two images of the same scene one may want to understand where given parts of the picture exist in the other. Most often is it virtually impossible to take identical picutres with the same scene in exactly the same positions for two or more images.

There are two methods of corresponding two images. The classical method is to analyze a location on an image and see where is it most like on the other image. This is called the **Correlation-Based Method**. The more robust and practical method is the **Feature-Based Method** that indentifies unqiue features in one image and finds the same features in the other image.

A **Feature** is best desribed as a unique piece of the image that is not repeated anywhere else in the picture. There are many methods to indentifing features in a given image, however the method that lent itself well to our partcular problem of replicating stereo imaging is the SIFT Alogrithm.

[1]This content is available online at <http://cnx.org/content/m36386/1.1/>.

Chapter 3

SIFT Alogrithm[1]

3.1 SIFT Alogrithm

3.1.1 Scale Invariant Feature Transform Alogrithm

This algorithm was developed by David Lowe in 1999 at the Univeristy of British Columbia. Through it methodology the **SIFT Alogrithm** is invariant to scale, light,noise and other commons changes that can effect an object's representation in an image. The alogrithm best identifies objects with clear edges, points of high contrast, and stable fundamental geometry that will not change from picture to picture. The features the method displays, not only have their respective x,y corrdinates in the photo, but also have an oriention in radians, and a scale factor to describe the size of the feature. This allows for accurate description of the uniquness of the feature. All of this lends itself well to solving the correspondance problem presented with two or more images.

Regardless of scale or orientation or position the SIFT alogrith will be able to tell where a particular feature is based on the geometry of the photo and the features neariest to the feature being matched, as well as its descriptors.

[1] This content is available online at <http://cnx.org/content/m36387/1.1/>.

Chapter 4

SIFT Alogrithm Feature Extraction Example[1]

4.1 Feature Extraction

4.1.1 Application of Feature Extraction

Two images of the same bear on a desk taken at different horitzonal positions relative to the subject were taken and anaylzeed using the SIFT algorithm implemented in Matlab with the aid of a toolbox by VLFeat.

[1] This content is available online at <http://cnx.org/content/m36388/1.1/>.

Picture A

Figure 4.1: Taken on a DSLR Nikon D3000

Picture B

Figure 4.2: A horizontal shift from camera position in Picture A

After the SIFT algorithm has been applied corresponding features are very clear and intuitive.

Zoomed In Feature Extraction Picutre A

Figure 4.3: Features(Green) with scale and orientation

Zoomed In Feature Extraction Picutre B

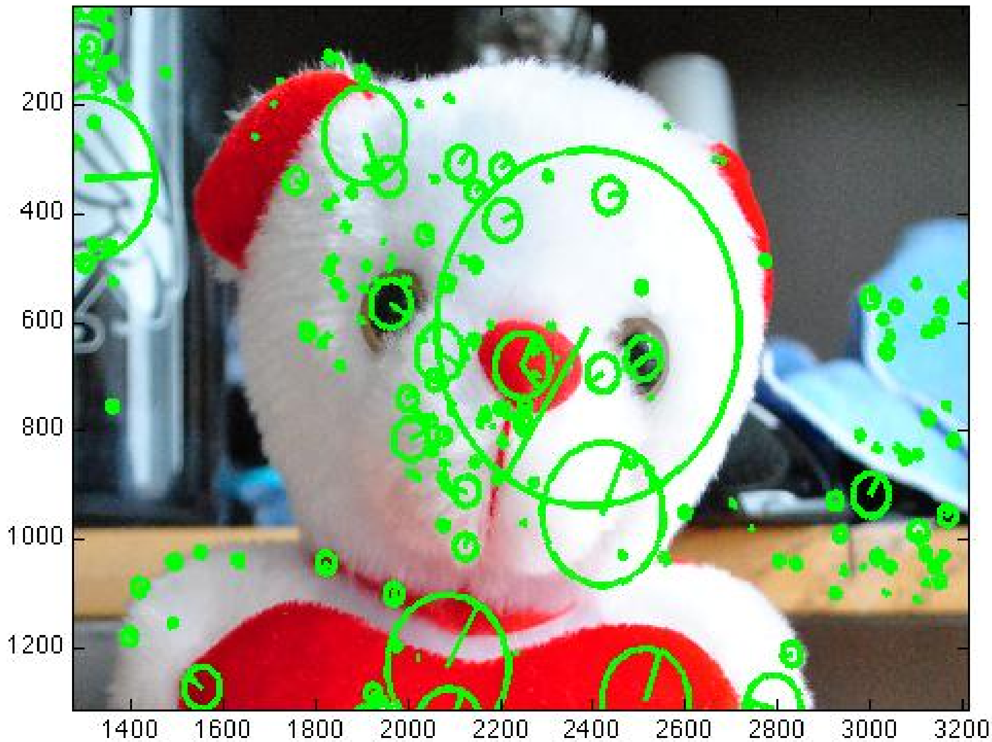

Figure 4.4: Features(Green) with scale and orientation

It is clear that the SIFT program chooses the same features of the same scale and orientation in each image, and there is a clear match between the two images.

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