Columbia Object Image Library (COIL-20)

Sameer A. Nene and Shree K. Nayar and Hiroshi Murase

Department of Computer Science
Columbia University
New York, N.Y. 10027

sameer@cs.columbia.edu
nayar@cs.columbia.edu

Technical Report No. CUCS-006-96

Abstract

Columbia Object Image Library (COIL-20) is a database of gray-scale images of 20 objects. The objects were placed on a motorized turntable against a black background. The turntable was rotated through 360 degrees to vary object pose with respect to a fixed camera. Images of the objects were taken at pose intervals of 5 degrees. This corresponds to 72 images per object. The database has two sets of images. The first set contains 720 unprocessed images of 10 objects. The second contains 1,440 size normalized images of 20 objects. COIL-20 is available online via ftp.

1 Introduction

We have constructed a database of 1,440 grayscale images of 20 objects (72 images per object). The objects have a wide variety of complex geometric and reflectance characteristics (see figure 1(a)). The database, called *Columbia Object Image Library (COIL-20)*, was used in a real-time 20 object recognition system [Murase and Nayar-1995]. Figure 1(b) shows an object from the database being placed in front of the system sensor. In figure 1(c), the system displays the recognized object and it's pose in the upper right corner. The recognition system used the parametric eigenspace technique [Murase and Nayar-1995] for visual learning and recognition. For related publications, see [Nayar and Poggio-1996] [Nayar *et al.*-1996a] [Nayar *et al.*-1996b] [Nayar *et al.*-1996c] [Nene and Nayar-1994]. COIL-20 is available by (logged) ftp for research purposes (see Section 3).

2 Database Acquisition

The experimental setup used for image acquistion is shown in figure 2. A CCD camera (SONY XC77) with a 25mm lens was fixed to a rigid stand about 1 feet from it's base. A motorized turntable was placed about 2 feet from the base of the stand. The camera was tilted down at about 25 degrees to point towards the turntable. This way most objects appeared at the center of the image when placed at the center of the turntable. To avoid strong shadows, only ambient (fluorescent) room lighting was used. A black background was provided by covering the turntable and visible background surfaces with black cloth.

Each object was placed in a stable configuration at approximately the center of the turntable. The turntable was then rotated through 360 degrees and 72 images were taken per object; one at every 5 degrees of rotation. The images were digitized using an Analogics grayscale frame grabber. Two sets of images were stored in the database. The first set contains a total of 720 unprocessed 640x480 grayscale images of 10 selected objects from figure 1. The second set contains 1,440 grayscale images of all the 20 objects and have been size normalized as follows. The object is clipped out from the black background using a rectangular bounding box. The bounding box is resized to 128x128 using interpolation-decimation filters to minimize aliasing [Oppenheim and Schafer-1989]. When resizing, aspect ratio is preserved. Size normalization was necessary for the 20 object recognition system mentioned above [Murase and Nayar-1995].

In addition to size normalization, every image was histogram stretched, i.e. the intensity of the brightest pixel was made 255 and intensities of the other pixels were scaled accordingly. The images were saved as 8-bit PGM (portable graymap) images. Note that PGM images can be viewed with xv. A sample filename of a database image is "obj7__10.pgm". The prefix obj7 identifies the object. The numeric value 10 following the double underscore separator identifies the pose. The suffix .pgm indicates the file type. The database is available as two compressed tar files of sizes 12Mb and 6Mb for the unprocessed and processed images respectively. A color image database COIL-100, similar to COIL-20, is also available. See [Nene *et al.*-1996].

(a)

(b) (c)

Figure 1: The Columbia Object Image Library (COIL-20) contains 1,440 images of 20 objects. (a) The objects have a wide variety of complex geometric, appearance and reflectance characteristics. A real-time 20 object recognition system was constructed using COIL-20. (b) An object from the database is shown to the system for recognition. (c) The system recognizes the object in less than one second. The recognized object and it's pose are displayed in the upper right hand corner.

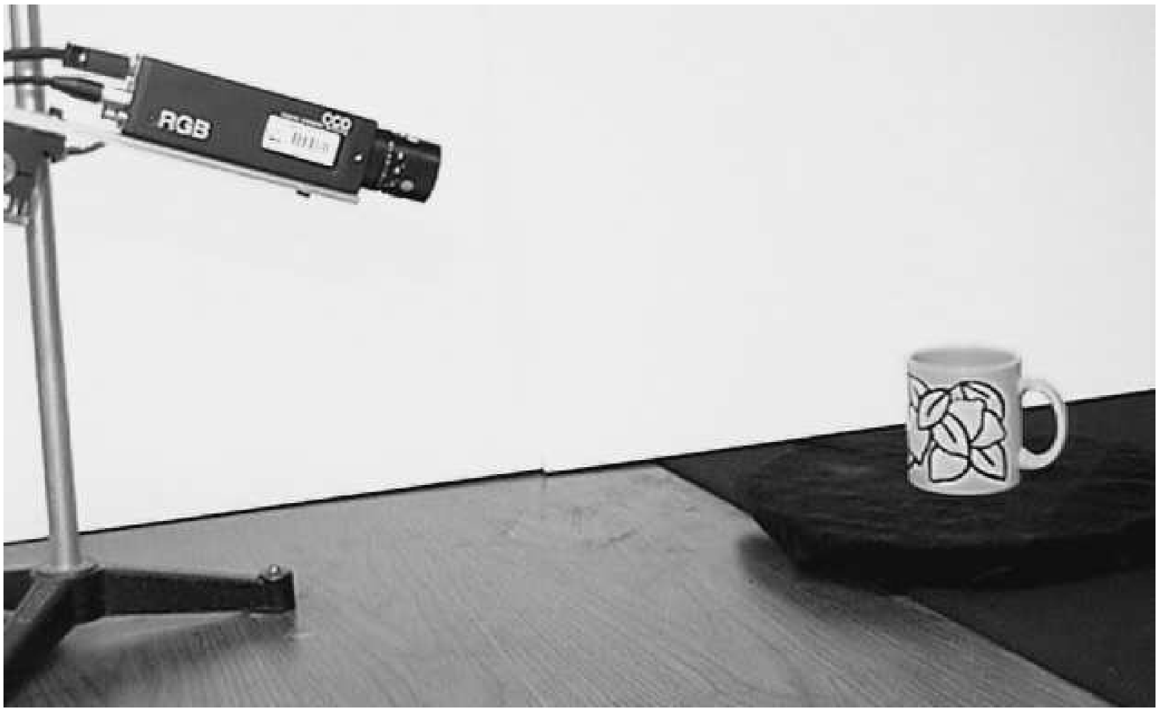

Figure 2: The objects were placed at the center of a motorized turntable. The turntable was rotated through 360 degrees. An image was acquired with a fixed camera at every 5 degrees of rotation.

3 Access Instructions

COIL-20 is available over the Internet by ftp. All accesses are logged to help us know who is using the database. The following is a sequence of commands required to download COIL-20:

```
$ ftp zen.cs.columbia.edu

Name: coil-20
Password: Coil-20

ftp> cd coil-20
ftp> bin
ftp> get coil-20-unproc.tar.gz
ftp> get coil-20-proc.tar.gz
ftp> quit
```

In case of any problem or questions, the reader is advised to send mail to *sameer@cs.columbia.edu* or *nayar@cs.columbia.edu*.

Acknowledgements

This database was collected at the Center for Research on Intelligent Systems at the Department of Computer Science, Columbia University. It was supported by DOD/ONR MURI

Grant N00014-95-1-0601 and a NSF National Young Investigator Award.

References

[Murase and Nayar, 1995] H. Murase and S. K. Nayar. Visual Learning and Recognition of 3D Objects from Appearance. *International Journal of Computer Vision*, 14(1):5–24, January 1995.

[Nayar and Poggio, 1996] S. K. Nayar and T. Poggio. Early Visual Learning. In S. K. Nayar and T. Poggio, editors, *Early Visual Learning*. Oxford University Press, March 1996.

[Nayar *et al.*, 1996a] S. K. Nayar, H. Murase and S. A. Nene. Parametric Appearance Representation. In S. K. Nayar and T. Poggio, editors, *Early Visual Learning*. Oxford University Press, March 1996.

[Nayar *et al.*, 1996b] S. K. Nayar, S. A. Nene and H. Murase. Real-Time 100 Object Recognition System. In *Proceedings of ARPA Image Understanding Workshop*, Palm Springs, February 1996.

[Nayar *et al.*, 1996c] S. K. Nayar, S. A. Nene and H. Murase. Real-Time 100 Object Recognition System. In *Proceedings of IEEE International Conference on Robotics and Automation*, Minneapolis, April 1996.

[Nene and Nayar, 1994] S. A. Nene and S. K. Nayar. SLAM: A Software Library for Appearance Matching. In *Proceedings of ARPA Image Understanding Workshop*, Monterey, November 1994. Also Technical Report CUCS-019-94.

[Nene *et al.*, 1996] S. A. Nene, S. K. Nayar and H. Murase. Columbia Object Image Library: COIL-100. Technical Report CUCS-006-96, Department of Computer Science, Columbia University, February 1996.

[Oppenheim and Schafer, 1989] A. V. Oppenheim and R. W. Schafer. *Discrete-Time Signal Processing*, chapter 3, pages 111–130. Prentice Hall, 1989.