# Columbia Object Image Library (COIL-100)

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**Technical Report No. CUCS-006-96**

## Abstract

Columbia Object Image Library (COIL-100) is a database of color images of 100 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 color camera. Images of the objects were taken at pose intervals of 5 degrees. This corresponds to 72 poses per object. The images were size normalized. COIL-100 is available online via ftp.

# 1 Introduction

We have constructed a database of 7,200 color images of 100 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-100)*, was used in a real-time 100 object recognition system [Nayar *et al.*-1996b] [Nayar *et al.*-1996c]. Figure 1(b) shows an object (a toy cat) from the database being placed in front of the system sensor. Figure 1(c), shows the recognized object and it's pose in the upper right corner as displayed by the system. The recognition system uses 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] [Nene and Nayar-1994]. COIL-100 is available by ftp for research purposes (see Section 3).

# 2 Database Acquisition

The experimental setup used for image acquistion is shown in figure 2. A CCD color camera 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. The camera was not very sensitive, so we had to set the aperture to *f1.4* (fully open). 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. Images were digitized using a DEC J300 color frame grabber. Due to disk space limitations, it was impossible to store 7,200 color images of size 640x480. Moreover, for the 100 object recognition system mentioned above [Nayar *et al.*-1996b] [Nayar *et al.*-1996c], it was necessary to normalize the size of an input image to 128x128. Hence, for every image, we clip out the object from the black background using a rectangular bounding box and resize it to 128x128 using interpolation-decimation filters to minimize aliasing [Oppenheim and Schafer-1989]. When resizing, aspect ratio is preserved.

In addition to size normalization, every image was histogram stretched, i.e. the intensity of the brightest pixel was made 65535 and intensities of the other pixels were scaled accordingly. The images were saved as 16-bit PPM [1] (portable pixmap) color images. Note that PPM images can be viewed with xv Ver. 3.1. A sample filename of a database image is "obj7__10.ppm". The prefix obj7 identifies the object. The numeric value 10 following the double underscore separator indicates the pose in degrees. The suffix .ppm indicates the file type. The database is available as a single compressed tar file of size 250Mb. A grayscale image database COIL-20, similar to COIL-100, is also available. See [Nene *et al.*-1996].

[1] 16-bit PPM images contain data in little-endian format. When writing a program to read such PPM images, care is needed to ensure that a possible conflict with the machine endian is properly resolved.


(a)


(b)


(c)

Figure 1: The Columbia Object Image Library (COIL-100) contains 7,200 images of 100 objects. (a) The objects have a wide variety of complex geometric and reflectance characteristics. A real-time 100 object recognition system was constructed using COIL-100. (b) A toy cat 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.

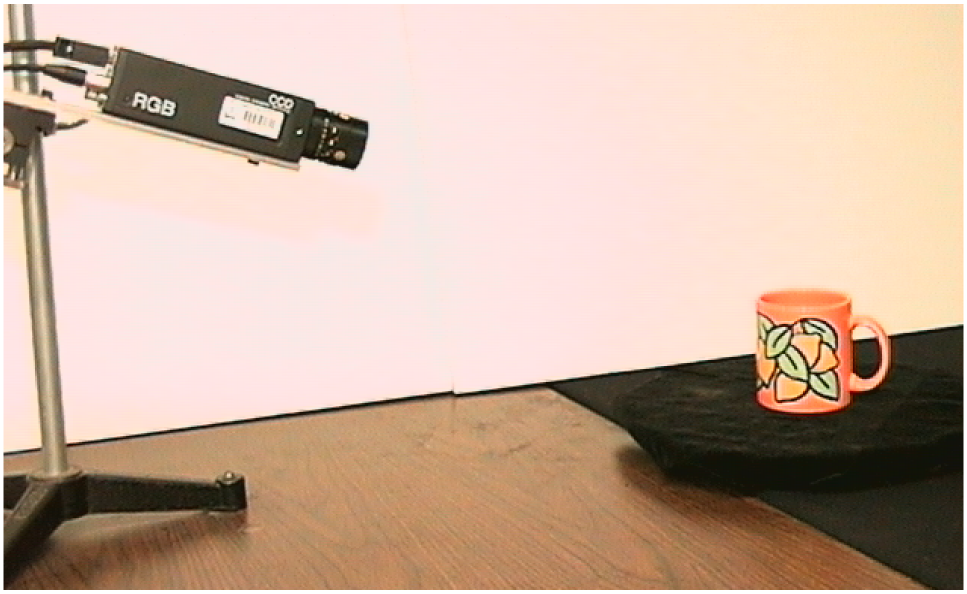


Figure 2: The objects were placed at the center of a motorized turntable. The turntable was rotated through 360 degrees. An image was acquired with a fixed color camera at every 5 degrees of rotation.

# 3 Access Instructions

COIL-100 is available by ftp over internet. All accesses are logged to help us know who is using the database. The following is a sequence of commands required to download COIL-100:

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

Name: coil-100
Password: Coil-100

ftp> cd coil-100
ftp> bin
ftp> get coil-100.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.

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