

# Summer Research report

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## Abstract

A brief (one paragraph) description of the work you did.

## 1 Introduction

This section should be a general description of the basic problem you were trying to solve.

## 2 Related Work

In this section, you would describe other similar work that has been done by other researchers. For example: In [?], Berg and Belhumeur construct an image recognition system with the goal of explaining to birders the differences between similar species.

## 3 Methods

This section describes the methods used in your study. I am supplying a subsection that you can use describing how the images were collected, which you can use if you like. The rest of the section would be a high level description of convolutional neural networks, the software that you

used, and any general setup information that needs describing.

**Image collection** Images were collected using two motion-activated wildlife cameras, a Wingscapes BirdCam 2.0 and (when the original failed) a Wingscapes Birdcam Pro. The specifications and settings used are summarized in Table ???. The images were collected in Richmond,

Table 1: Camera descriptions

	<b>Birdcam 2.0</b>	<b>Birdcam Pro</b>
<b>Max resolution</b>	8.0 MP	20.0 MP
<b>Res. used</b>	medium	medium
<b>Dimensions</b>	2048 x 1536	2112 x 1188

Virginia, USA, over a period of six months from March through August of 2014. The images were collected at the camera's medium resolution setting. This level of resolution is not needed for the automatic classification of images, as the resulting number of parameters in the neural net is too large to be computationally feasible on available computing resources. However, the higher resolution was helpful in some cases for humans doing the initial labeling of the training data sets. The target was an upright suet feeder with a

tail-prop, a configuration favored by woodpeckers. An opaque shield was mounted behind the feeder to provide a uniform background for the images. The shield and feeder were painted with Krylon Neon Green paint. Neon green was chosen because none of the species that typically feed at this type of feeder have any green in their plumage, making it more difficult to confuse background pixels with pixels belonging to the bird in background removal algorithms. The feeder, shield and camera were mounted on a pole equipped with a squirrel baffle. The camera was attached to the pole by an adjustable arm, sold as an accessory by Wingscapes.

The cameras have various settings controlling focus, sensitivity to motion and how the camera responds when motion is detected. The camera does not autofocus; rather, it has a series of selectable fixed focus distances. The shortest focus distance puts the focus point at approximately the back of the feeder with the arm fully extended in our setup, which means that, especially in low light situations where depth-of-field is shallow, the bird is not in sharp focus. Experimentation revealed that the most sensitive setting for motion detection was set off even by vibrations in the shield caused by wind, resulting in hundreds of images of an empty feeder. Consequently, the camera was set at medium sensitivity, and was programmed to capture three images for each motion detected event, followed by a 30 second pause before sensing for motion again. Some species, like Carolina Chickadees and Tufted Titmice, perch, procure a beak-full of food, and are off immediately. Other species, such as Carolina Wrens and the woodpeckers, perch and stay on the feeder for extended periods of time. As a result, the size of useful training and validation sets exhibited a very wide range across categories.

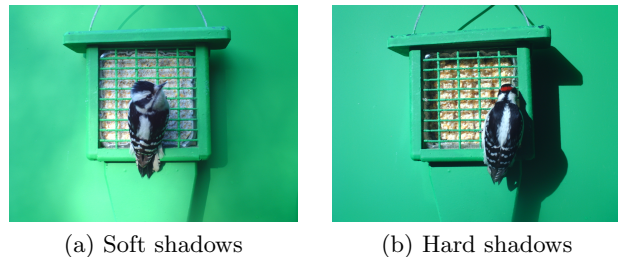


Figure 1: Some typical images.

Not all species present in the area where the images were collected visit feeders, and of those that do, not all visit the style of feeder used in this study. A total of 20 species visited the feeding station during the data collection period. Of those, nine species were present in enough images to be useful for training and validating a classifier. The set of species used in the training data is shown in Table ?? . In some cases, a

Table 2: Training set species

Blue Jay
Brown Thrasher
Carolina Chickadee
Carolina Wren
Downy Woodpecker
Northern Cardinal
Red-bellied Woodpecker
Tufted Titmouse
Yellow Rumped Warbler

tenth category of images of an empty feeder was added. Two typical images are show in figure ??.

**Convolutional neural network architecture** Describe how your CNN was set up.

## **4 Results**

Describe how things worked.

## **5 Discussion**

This section usually talks about *why* the results came out as they did.

## **6 Conclusions**

## **7 Acknowledgments**

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