Microsoft

AI for Earth Grantee Profile

IIIT Delhi

Intelligent tool for monitoring monkey populations

Summary

Ankita Shukla's and a team at IIIT Delhi are developing an intelligent tool to monitor and control rapidly growing urban monkey populations. The tool will use Microsoft cloud and AI tools to detect and identify individual monkeys from images captured by photographers and camera traps, helping researchers identify and find monkeys needing sterilization and distribute contraceptive-laden food.

Developing an intelligent tool for monitoring monkey populations

Rapid urbanization and expansion of cultivated land in India has reduced the natural forest habitat of monkeys, but the monkeys have adapted to the new human habitats, bringing them into conflict with humans. The Wildlife Institute of India has been collecting large amounts of geotagged photos of monkeys to use in monitoring and analyzing the population. However, the Institute lacks automated tools to process the image data, requiring time-consuming manual efforts. The Institute is also developing oral contraceptives that can be distributed to the monkeys through food to help control the population and wants a means to identify untreated monkeys from those that have already been sterilized to avoid wasted effort.

> Monkeys in Himachal Pradesh have caused more than $324 million in crop damages between 2007 and 2012.

Shukla's team and Gullal Singh Cheema, a Research Assistant under Dr. Anand, are developing an intelligent tool for monitoring monkey population to meet these needs. The tool will use AI and deep machine learning techniques to detect and identify individual monkeys from images captured by photographers and camera traps. Identity for individual monkeys can be established through facial recognition as well as age and sex characteristics in the imagery. With this computer vision tool, images can be analyzed in a timely manner, aiding in monitoring the population and guiding efforts to distribute contraceptives for population control. The

team also aims to build a mobile application that citizens can use to add location-tagged images of monkeys to the database, furthering the wildlife management efforts.

Solving for increasing monkeys in urban areas

As human activity encroaches on the natural forest habitat of the monkeys, the monkeys have moved into the new human habitats, becoming more than mere nuisances. The monkeys have raided farms, causing huge losses in agriculture—for example, according to a 2015 article by the Nature Conservancy, monkeys in the state of Himachal Pradesh caused over US $324 million in crop damages between 2007 and 2012. Similarly, the monkeys have boldly moved into urban areas, stealing food everywhere from home kitchens to restaurants, damaging property, and even physically harming humans—more than 1,000 cases of monkey bites are reported daily in Indian cities. Furthermore, the monkeys are thriving in these new environments. The monkeys can easily find food in minutes rather than spending most hours of the day scrounging through the forest, increasing their life expectancy as well as giving them more time to procreate. ("Monkey-human conflicts on the rise in India." The Nature Conservancy, August 31, 2015.)

Various methods have been attempted to manage the problem, with limited success at best. Some Indian states have declared the animals a nuisance species per a provision of the national Wildlife Act, allowing culling to take place; however, the culls provide only temporary relief, as monkeys from surrounding areas eventually move in and act more aggressively. Likewise, relocation tends to simply shift the problem temporarily to other areas, while also sometimes failing to provide the monkeys with a new adequate food supply. Sterilization efforts have been hampered by a low rate of capture and treatment compared to the breeding rate, compounded by challenges in safely marking or tracking the treated monkeys so time and effort is not wasted by recapturing them.

Identifying individual monkeys with computer vision

For sterilization to be effective in population control, it's necessary to be able to identify which monkeys have already been treated. Tagging the monkeys in a permanent fashion, either with a tattooed code or a microchip, suffers from the same drawbacks as surgical sterilization, requiring the time-consuming and difficult process of capturing the monkeys and subjecting them to the procedures. Computer vision offers a non-invasive alternative for identifying and tracking that is safer and less stressful for the monkeys as well as humans.

However, for computer vision to work, it's necessary to train the machine-learning model to recognize the individual characteristics of many different monkeys. For the very large populations of monkeys involved, this training requires massive amounts of image data. The initial dataset includes about 4,000 images covering 80 individuals, and of those images, 20 to 30 percent will include faces and other identifiable characteristics. Many more images will be required for the training process, which means scalable storage and computing resources are needed, in addition to deep learning virtual machines and tools.

Collecting the additional images has its own challenges. Camera traps may be limited by low resolution, poor lighting conditions, or simply immobility—the fixed camera will not always be able to capture facial images. With handheld cameras, the images may suffer from motion blur as well as the photo problems faced by camera traps. Furthermore, getting handheld camera images means some combination of sending people out for that purpose—which is limited by availability and time—and gathering images from incidental sources (people on the street). Gathering images from the general public means either providing a means for them to submit images with location data (such as the custom app to be developed) or collecting the images from social media and photo hosting sites.

The AI for Earth grant provides Shukla's team with access to Azure data storage and cloud computing services, including the deep learning virtual machines and libraries that enable training and development of the computer vision model. The model is being developed with Microsoft Visual Studio and the Python programming language.

Currently the team has to manually sort the images available for the training dataset to find the ones that will be useful. When a good dataset is put together, they can offload the image processing to Azure and let it run on the cloud servers.

Moving forward

Once the computer vision model is trained, it will be paired with a mobile app that enables the general public to take photos of monkeys and tag their location. This app would use a visualization tool such as Esri ArcGIS Pro to show the monkey populations on a map, so they can be easily located. Researchers from the Institute and animal control officers would then be able to identify and find the monkeys needing sterilization and distribute contraceptive-laden food accordingly. Specific monkeys could also be located through the app to deal with other issues, such as attacks on humans.

About Ankita Shukla

Ankita Shukla is a PhD student at Indraprastha Institute of Information Technology Delhi (IIIT Delhi), India. Studying under Dr. Saket Anand, Shukla's PhD work focuses on geometric approaches for semi supervised learning for computer vision applications. She previously earned a Master's degree in electronics and communication also at IIIT Delhi, in 2014, in which she worked on signal processing techniques for EEG signal processing and acquisition. Shukla is also working on deep learning approaches with semi supervised learning paradigm for image clustering and classification applications. She has also explored image segmentation, object detection and localization strategies using low level computer vision features.

Resources

Websites

Ankita Shukla's personal site
Indraprastha Institute of Information Technology Delhi (IIIT Delhi)
Dr. Saket Anand's page on the IIIT Delhi website