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Eliminating poaching by using machine learning algorithms and thermal imaging

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ABSTRACT

The project intends to propose a low-cost system that can be used to eradicate poachers in large, restricted areas. Poaching is a huge problem and constantly looking for different methods to eradicate it is in fact very necessary to protect the species from being extinct. The project involves creating an electric pillar-like structure that uses thermal imaging and face recognition techniques to help detect humans and faces in restricted areas. Poachers can be detected at night using thermal imaging techniques. Machine learning algorithms such as Eigenfaces, Eigenvalues, and Fisherfaces are extracted using OpenCV which can be used to detect and store the recognized faces.

Keywords— *Anti-poaching, Eigenfaces, Fisher faces, Eigenvalues, Machine learning, Thermal Imaging*

1. INTRODUCTION

Poaching is defined as the illegal taking of wildlife, in violation of local, state, federal, or international law. Activities that are considered poaching include killing an animal without a license, with a prohibited weapon, or in a prohibited manner. Killing a protected species, exceeding one's bag limit, or killing an animal while trespassing is also considered poaching. Poaching can have grave effects on the animal population, local communities, and the environment. It can also have a negative effect on the country's tourism economy. Our ecosystems are altered when there is poaching which can lead to the endangerment or even the extinction of other species.

1.1 Statistics

India: India is home to a vast array of wildlife species. India continues to suffer from conflicts related to human-wildlife and cohabitation problems. However, it has a growing poaching problem due to demand from Southeast Asia. The Wildlife Protection Society of India (WPSI) reported 23 verified deaths of tigers due to poaching in 2014. 58 died due to some other unknown causes. The deaths of 17 leopards were also reported due to poaching. 30 more died that year due to other causes. The data from 2013 shows the poaching of 38 elephants and 41 rhinos. Kenya: The data from the Kenya Wildlife Service reported the loss of 59 rhino and 302 elephants due to poaching in 2013. South Africa: The SANParks Annual Report tells that only two elephants were poached during the period. In 2013 and 2014, 1004 rhinos and 1215 rhinos were killed respectively. In those years 343 and 386 suspected poachers were arrested and killed by various authorities.

1.2 Methods of Poaching

- **Luring animals:** Cable wires of different lengths are tied on trees to lure animals. The snare is put in such a position that it traps the animal around the neck. The wire strangles the animal as it struggles to free itself. Poachers often use snares in national parks, such as in Kenya and Tanzania.
- **Spearing:** A more traditional method involves chasing and spearing animals with the assistance of dogs. The dogs disorient the animals. In some cases the dogs actually subdue it. A dog has a bell tied around its necks, which may startle the quarry from its hiding place.
- **Net:** A net is spread at one end of an area, and the poachers (sometimes of dogs) chase the animals towards it. The animals get trapped in the net, and the poachers spear them.
- **Pitfalls:** Large animals such as elephants, buffaloes, and zebras are trapped with the help of pits. The pits are dug in the path of the animals and normally covered with grass and/or trees to fool them. The animals are normally pushed towards the pit. This is done in two ways: (i) Some hunters chase the animals, (ii) While others provoke the animals into chasing them. Because the animals are heavier than the plants covering the pit, they will fall into the pit while trying to escape. Some hunters such as the Mbuti pygmies of the Congo are known for putting poison on their arrow tips.

100% effective anti-poaching methods haven't been implemented yet. About 20% of mammals, 12% of birds, 30.5% of reptiles, 30.4% of Amphibians, 36.6% of fish, 40.5% of invertebrates, and 40.5% of plants are being poached. This leads to an estimated 37.8% of over 44,838 endangered species because of poaching. Therefore, it is very crucial to determine how poaching can be curbed and reduced.

2. PROPOSED METHOD

One technique involves creating an electronic pillar-like structure that has the facilities of thermal imaging, facial recognition, and detection techniques. This can be created on a small scale and placed in National Parks and Wildlife sanctuaries in certain perimeters of the area. Helping detect poachers both in the morning and at night using the techniques can be an effective step to curbing this.

Thermal imaging techniques can be used at night and dark times to detect humans. Thermal imaging is the technique of using the heat given off by an object to produce an image that helps locate it. It is a method used to improve visibility of object in a dark environment by detecting the object's infrared radiation and creating an image based on the extracted information. The radiator connects radiation from objects and creates electronic images based on the temperature differences. The temperature difference can be set based on the temperature of the environment and just above it.

The next step is to create a face detection and recognition device which will help identify any faces and recognize them when it sees again. This will help recognize any humans in the restricted area and detect them when they come back. The existing face detection techniques are ineffective in real surroundings and act poorly when there is an external influence such as light, shadows, orientation of the face, positions, etc. There are four main steps involved: face detection, face preprocessing, collecting and face recognition.
To execute the first step, Harr based cascade classifiers and Local Binary pattern detector methods are used. These together are effective for determining both side-view faces and frontal faces. LBP Detectors use histograms of pixel comparisons of different intensity, which enables them to locate corners and edges. It is computationally simple which makes it possible to analyze the data in real settings. Harr based classifiers use convolution kernels to detect edges and corners. They use ada-boost algorithm which detects important features from a big set and uses cascading methods to detect a face. These two are trained to detect faces, which can take a lot of time to code. Instead OpenCV has preprogrammed Harr and LBP based detectors stored as XML files which can be easily loaded. Both features when together combines is a powerful combination that increases the accuracy.

The first step includes loading the detectors. The load () method is used along with a try/catch the message. Histogram equalization is performed to improve contrast and brightness during light conditions using equalizeHist (). The face is detected using CascadeClassifier: detect-MultiScale () function. Face preprocessing can be done by applying the same histogram function. For reliability in real conditions, we need complex techniques to identify facial features detection such as detecting mouth, eyes, eyebrows, etc. These detectors are available in OpenCV v2.4. In real-world conditions, it is common to have strong lighting on one half of the face and weak lighting on the other. This has a big effect on the face recognition algorithm. So it is important to perform equalizations separately for both sides.

The face recognition algorithm will learn how to distinguish between the faces of different people. This is the training phase and the collected faces are referred to as the training set. After the face recognition algorithm has finished training, you could then save the generated knowledge to a file, or program the detector. After the faces have been collected, the machine needs to be trained to learn the inputted data. Eigenfaces and Artificial Neural Networks are effective machine learning algorithms that can be used. The basic principle of Eigenfaces is that it will calculate a set of special images (eigenfaces) and blending ratios (eigenvalues). When combined in different ways, since each of the values is unique it can generate and differentiate between faces. In FisherFaces, only one value of Eigenfaces and Eigenvalues are calculated for every face. OpenCV contains all the necessary algorithms for us to implement without much difficulty. The three algorithms available are FaceRecognizer.Eigenfaces, FaceRecognizer.Fisher faces, FaceRecognizer.LBPH which can be put into use for this project.

The next step involves recognizing faces from the existing set of faces. The FaceRecognizer class from OpenCV can be used for this function. Eigenfaces and Eigenvalues can be used to reconstruct the image and compare it with the inputted image. FaceRecognizer class makes it quite easy to generate a reconstructed face from any input image, by using the subspaceProject() function to project onto the eigenspace and the subspaceReconstruct() function to go back from eigenspace to image space.

3. CONCLUSION

This system can be used to effectively determine faces and humans in the area and store information of the poachers which can be used to alert in case the poacher comes back. Poaching is not going to be eradicated soon, but certain steps can be taken in order to protect endangered species. Securing large forested areas against intruders proves to be a daunting challenge. There is a need for new approaches that take up the challenges and provide better protection against poachers. Setting up the electric system where these endangered species reside can potentially eradicate poachers to a large extent.

4. REFERENCES

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