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Artificial Neural Network Based Image Processing for Wild Animal Detection and Monitoring

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Abstract*— Animals leaving the forest area and entering the human habitat is increasing day by day. Animals entering the agricultural areas placed near the forest destroy crops or even attack on people therefore there is a need of system which detects the animal presence and gives warning about that in the view of security purpose. In this paper wild animal which enters the human habitation are recognized. The movement of animals in the input video is detected using Foreground detector algorithm. Extraction of foreground animal is done using Back ground subtraction based Gaussian mixture model. Morphological filters are used to remove the noise from binary image obtained from background subtraction. Training and recognition is done using back propagation algorithm. If trained images are matched with the test image, then the animal is recognized. The project aims to safe guard the wild life and animal life and it is a great help to forest department.

Keywords*— Foreground detector; Background subtraction; Gaussian mixture model; Morphological filters; Back propagation algorithm

I. INTRODUCTION

In India 24% of the area is covered by forest. Forestry is the source of major income for over 400 million people in India, most commonly in rural. Population in India is increasing at high rate so providing shelter to all of them is a big challenge. Hence, most of the people live around forest to fulfil their requirements. Since people live closer to forest they often come across wild animals and for safety of human being, often wild animals are killed or human beings are attacked by animals. Now safety of both human and animal life is equally important. This paper includes two ways to solve these issues: one where humans should get warning whenever wild animal comes near residential area and other is to keep wild animal away from human habitat.

The applications of computer vision include, detecting the moving object which is a major step. Human can easily notice and distinguish objects, but it is difficult for computer to identify and recognize object like humans, that is why developing an object detection and recognition system which is adaptable and not complex is important[1]. The activities of the interested object such as (humans, animals, vehicles, etc) are monitored using a video camera in a scene for Optical surveillance. Extracting the foreground object is important when grouping, tracking and examining the activities of the concerned object, which is why background subtraction is applied [2]. This paper includes Foreground detection algorithm for detection of animal from a video captured from a still camera. Background subtraction method is used in this paper as it is one of the efficient method for real-time segmentation of moving objects in image alternation of the captured video [3]. Back propagation algorithm is used to compare the training data set which is taken from Caltec-101 database and the extracted foreground test image. Back Propagation is a popular method of training Artificial Neural Networks(ANN) and used in combination with an optimization procedure such as gradient descent. The procedure of the algorithm works in two stage, propagation and weight update. When an input vector is offered to the network, it is propagated forward through the network, layer by layer, passing through all the layers until it reaches the output layer. The output of the network is then compared with the expected output, using a loss function, with this loss function the error value is determined for each of the nodes in the output layer.

II. PROPOSED METHOD

The proposed method consists of six steps which are shown in Fig. 1. In first step the input video is divided into number of frames and it then undergoes the smoothing procedure where the noise is reduced and the output is blurred image. The second step focuses on extraction of foreground animal using background subtraction which is based on Gaussian Mixture Model to detect the movement in animal. For third step, morphological filtering is useful which reduces the noise from extracted binary image. Fourth step crops the extracted foreground animal using *Bounding box*. In fifth step the extracted foreground test image is compared with the training dataset using back propagation algorithm for recognition. In sixth step the recognized output is obtained.

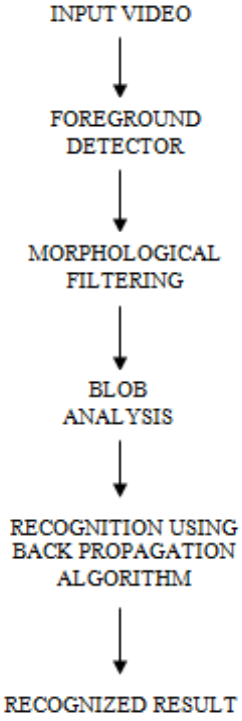

Fig 1. Flow chart of the proposed method

A. Foreground Detector using Back Subtraction

The changes in image sequences is identified using Foreground detection which is the most important tasks in the area of Computer Vision and Machine learning. Many applications do not need to know everything about the process of movement in a video sequence, but should only know the information about changes in the scene. To separate the changes in the foreground of the background Foreground detection is important. The video sequences are analysed in real time and are recorded with a stationary camera.

All detection techniques deals with modelling the background of the image which is used to set the background and detect where the changes arise. These changes play an important role in detection of the foreground. Defining the background can be very hard when it contains shadows, shapes, and moving objects. The challenges faced to identify immobile objects is that the stationary objects could vary in intensity and colour over period of time. Scenarios where these techniques are applied is likely to be very different. There can be extremely variable sequences, such as images with very different interiors, lighting, exteriors, noise and quality. In addition the processing in real time systems should adapt to various changes.

The foreground detection system should be able to do the following if it has to be considered to be an efficient method:

- Develop a background (approximation) model.
- Be vigorous to repetitive movements (leaves, waves, shadows), lighting changes, and long-term changes.

The Foreground Detection procedure compares a colour or gray scale video frame to a background model to find out whether individual pixels are part of the background or the foreground. Determining the foreground and background is a major aspect. Foreground mask is then computed. For computing Foreground mask background subtraction is used. We can then detect foreground objects in an image captured from a stationary camera.

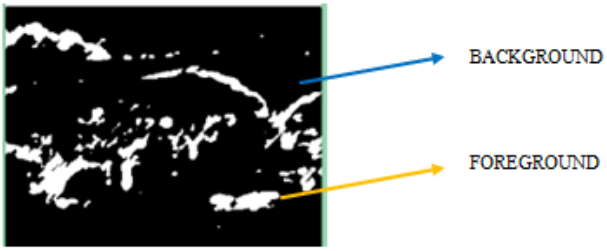

Fig. 2. Foreground objects and detected background

B. Morphological Filter

Morphological image processing deals with collection of non-linear operations related to the morphology of shape or features in an image. Morphological operations are suitable for processing of binary images since, it depends only on the relative ordering of pixel values and do not depend on the numerical values or numbers. Morphological techniques takes

into account the smaller details of an image such as a small shape or pattern called a structuring element. The structuring element is located at every possible location in an image and it is compared with the corresponding neighbouring pixels to determine the difference in values. Some operations are used to test whether the element "fits" within the neighbourhood, while others test whether it "hits" or intersects the neighbourhood. The fundamental operations of Morphological Filters are *Erosion* and *Dilation.* In this paper *Opening filter* is used to remove noise.

C. Blob Analysis

The extraction of foreground object is adapted with blob area. The object corresponding with blob area is detected as the animal object and marked by a bounding box. The Vision Blob analysis is used to find the movement in the frame and applying Bbox by connecting the pixel values.

Fig. 3. Image extracted using bounding box

D. Recognition using Back Propagation Algorithm

For training artificial neural networks Back Propagation is a pervasive and efficient method and used in conjunction with an optimization procedure such as gradient descent. The procedure works in two stage, they are forward propagation stage and weight update stage. When an input vector is presented to the network, it is propagated in a forward direction through the network, layer by layer, passing all the layers until it reaches the output layer. This is a forward procedure to train the network. The output of the Back propagation neural network is then compared with the predetermined expected output, error value, and a loss function is calculated for each of the nodes in the output layer which is utilized in further steps. Starting from the output, the error values are propagated backwards until each node has a related error value which roughly/barely represents its contribution to the original expected output. These error values are used by back propagation to determine the gradient of the loss function with respect to the weights in the neural network. In the second stage, the gradient determined in previous steps is applied to the optimization method, which in turn uses this gradient to update the weights/bias of the neural network, which is an attempt to minimize the loss function.

E. Recognition Result

Foreground extracted test image and training dataset are taken for comparison.

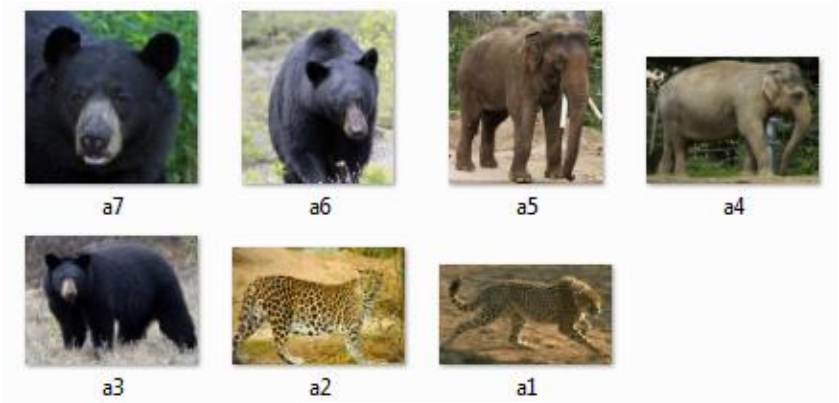

Fig.4. Trained images

Fig. 5. Test image

After comparing, the desired animal is recognized.

Fig.6. Recognized result

III. RESULTS AND DISCUSSION

In this section, experimental results of the proposed animal detection and recognition method is discussed. The suggested Back Propagation algorithm was implemented in MATLAB 2013a, and displays the recognized animal name in the command window.

Fig.7. Shows the pre-processing of input video. The input video is captured from a stationary camera which is in the form of .mp4 with the frame rate of 25frames per second.

Fig 7. Input Video

The input video is now set for foreground extraction. If the binary pixel value is '0' then it is a background image which appears in black colour and if the binary pixel value is '1' then it is a foreground image which appears white as shown in Fig.8.

Fig 8. Foreground Extraction

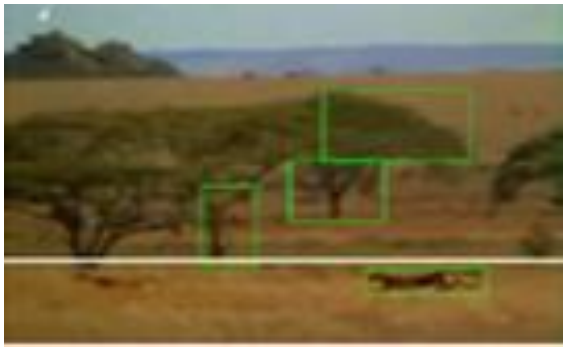

Fig.9. Blob Extraction

In a video static objects are considered as background and moving objects are considered as foreground. Blobs are applied to extract this moving objects and the extracted image is considered as a test image for comparison.

Table 1 Performance Analysis of Proposed Method

Input Video	Total Number of Frames	Frames in which Animals are Detected	Correct Recognition of Animal	Recognized Result
Cheetah	98	44	32	72.72%
Bear	81	22	16	72.72%
Elephant	112	51	39	76.47%

IV. CONCLUSIONS

From all these results and discussions we can conclude that, background subtraction procedure gives us better and accurate result for moving animal detection. The proposed method uses Back subtraction based Gaussian mixture model because it is well suited for various lighting intensities and also in deletion of repeated frames. Back propagation ANN is used here because it is computationally less complex and is very effective. Performance analysis shows the recognition result of the proposed method.

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