Deep Learning Model for Identifying Snake Species Using Snake Bite Marks in Video Processing

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Abstract- **Snake bite is a neglected public health issue in many tropical and subtropical countries. One of the causes of death due to snake bite is incorrect identification of snake species. So, the proposed system is to be able to identify snake species from their bite marks in order to provide suitable treatment, and thus preventing from the subsequent deaths. The proposed system involves techniques based on video Processing, Region based convolutional neural network, image classification to achieve the mentioned purpose. Recent studies by the Centre for Global Health Research (CGHR) have found that 1.2 million deaths due to snakebites are reported in India from 2000 to 2022 i.e., an average of annual 58,000 deaths. This model should be trained with physical data of snake bite mark images so that it can get better snake predictions upon real-time. Two models have been used for pretrained architecture VGG16 and MobileNet after classifying the model VGG16 achieves accuracy of 75% and MobileNet achieves 90%. This model is created for identifying which type of snake species through video processing. This system will give the accurate result of snake species and which type of antivenom should be given to the patients with its dosage which will be helpful for doctors to save the life of patients. So, it can reduce the death caused due to snakes. Through this model it can create awareness among people in rural and hilly areas.**

Keywords- **Image Classification, Deep Learning, R-CNN and video processing.**

I. INTRODUCTION

An image is a matrix of pixel values if we consider a gray scale image, the value of each pixel in the matrix will range from 0 to 255. In case we consider an RGB picture, each pixel will have the combined values of R, G and B. Image can be transformed into the digital form for performing certain operation to get the useful information from it. This process is called image processing. The process takes the image as an input and use effective algorithms to provide outcomes that could be an image, data or features related to that image. Image processing involves some basic operations namely image rectification, image enhancement, image classification, images fusion etc. The technique of images classification includes two steps, training of the framework taken after by testing. The training process takes the characteristic properties of the images and form a general unique model for a particular class. The process is done for all classes depending on the type of classification problem, binary classification or multi-class classification. The testing step categorizes the test images under various classes using the generalized model for which system was trained. The allotting of class is done based on the partitioning between classes of the training features.

It can be difficult to identify the snake species because the most common cause of death from the snake bites is incorrect identification of snake species based on their visible features. The World Health Organization (WHO) report states that around 5.4 million people suffer from snake bites annually, causing 1.8 to 2.7 million cases of venomous (poisoning). There are between 81,400 and 1,37,880 deaths and around three times as many amputations and other permanent disabilities are occurring each year. They are more than 3400 snake species around the world which contains both venomous and non-venomous. Bites by venomous snakes can cause paralysis that may prevent breathing, bleeding disorders that may result to fatal hemorrhage, kidney failure and tissue damage that can cause permanent disability. Due to the extensive cultivation in India, there have been increased snake bites agricultural workers and children are particularly vulnerable. Identifying the species of snake bitten plays an important part for the treatment. Antivenoms can be lifesaving when correctly administered but it depends on the correct taxonomic identification of the snake bite. Despite the many efforts, automated snake species recognition is a challenging task because of the similarities in the characteristics of the species such as texture, color, head shape and body. The proposed system, using the above-mentioned techniques, aims to fulfil the desired objective of recognizing snake species within less time. It is found that the patients are taken under consideration in figuring out the snake species, however, maximum of the doctor aren't skilled to perceive the taxonomy of the snake, so accuracy of detecting the snake species may have less chances. This model will identify the correct result of snake species in one minute with the assist of R-CNN algorithm. So, it is able to reduce the death caused due to snakebites.

II. IMAGE CLASSIFICATION

Image category is the system of categorizing and labelling agencies of pixels or vectors inside an image primarily based on the particular rules. A computer will analyze an image in form of pixels that is by considering the image as an array of matrix with the size of matrix reliant on the image resolution. The purpose of image classification is to define and depict the characteristics that appear in an image as a distinct gray level in terms of the object these characteristics reflect. Image category is the maximum critical part of image evaluation or image processing. Image classification techniques are mainly divided into two categories supervised image classification and unsupervised image classification techniques. Many analysts use a mixture of supervised and unsupervised category tactics to increase very last output evaluation and categorized maps. However, object-primarily based totally category has received more reputation due to the fact its beneficial for excessive decision facts.

Unsupervised classification method is a fully automatic technique that doesn't leverage education facts. This means that the machine learning algorithms are used to analyze and cluster unlabeled datasets by discovering hidden layers or facts agencies without the want for human intervention. With the right algorithm, the specific function of image is identified by the system through the image processing.

Supervised image classification uses reference samples that have already been classified to train the classifier and then classify new and unclassified data. The technique of visually selecting samples for training data in the image and assigning them to pre-selected categories is known as supervised classification methods. This is done to provide statistical metrics that will be used to improve the overall picture.

III. LITERATURE SURVEY

In the work of Mrugendra [1] the system is used to identify snake species from their visual traits in order to provide suitable treatment, thus preventing from the subsequent deaths. This system involves techniques based on Image Processing, Convolution Neural Networks and Deep Learning for this proposed system. The models which had been fine-tuned and optimized had been measured primarily based on the overall performance metrics and training results. An overall of 3050 images are used for training and validation that are separated into 28 species. Once the images are trained and testing is accomplished a set of random snake images are fed into the device and the possibility of the label being accurate is saved and observed. images are trained through three models DenseNet, VGG16 and MobileNet. The DenseNet model validation accuracy and test accuracy are 78% and 72%. The VGG16 model validation accuracy and test accuracy are 62.7% and 58.65%. the MobileNet model validation accuracy and test accuracy are 17.2% and 12.28%. The limitation of this work is when the large database with variety of snake species images is provided it will be not able to recognizing the species correctly.

In the work of Nur liy ana [2] it involves the collection of text-based totally description of snake's species based on the provided snake images through the use of questionnaire strategies. Then, important functions had been extracted through the use of term frequency – inverse file frequency (TF-IDF), and those capabilities had been supplied to system through transfer learning algorithms to study and predict the snake species with the help of Weka tool. The result of 180 samples text-based description collected from 60 respondents was used for training and classification. Then, features extraction techniques which includes stop phrase elimination, stemmer, and tokenizer had been done. Finally, TF-IDFT remodel was finished to calculate the weight of every phrase in each file. Four machine learning algorithms such as naive Bayes, k-Nearest Neighbor, Support Vector Machine, and Decision Trees J48 were used during training and classification. thus, J48 has the highest percentage of 71.67% followed by SVM with 68.33%. Naive Bayes obtained 61.11% and k-NN by 55.56% as the lowest percentage obtained for correctly classified instances. In this paper the overall performances show that the J48 is the best and suited for text classification task. The drawback of the work is that if the respondents are unable to describe the snake image, the snake species cannot be identified.

A parallel processed inter-feature product similarity fusion-based automatic classification of snake species, including the Spectacled Cobra, Russel's Viper, and King Cobra, was presented in Alex James and co. [3]. They utilized a dataset of 88 pictures of cobra and 48 pictures of snake for the underlying component scientific categorization investigation and perceived 31 unmistakable systematically significant elements from snake pictures for programmed snake characterization of studies. The K - nearest-neighbor classifier was utilized by the authors in this paper. The class of the unknown data sample is distinguished by this classifier from its nearest neighbor, whose class is already known. Mean-variance filtering is used to normalize the taxonomically applicable features chosen from the snake pictures for automated class. Characteristic vectors are constructed from the normalized functions' orientation and gradient histograms. A proposed minimal distance product similarity metric classifier is used to evaluate these characteristic vectors. When only 5% of the class samples were used as a gallery and the remaining 95% were used as a test on the snake image database, the proposed system was able to achieve an F-score of 0.91. The creators examined the adaptability and ongoing execution of the classifier through GPU empowered equal registering climate. The developed systems were utilized in snake population management, analysis of snake bites, and research on wild animals.

A Patel et al. [4] created a smartphone app that uses deep learning to distinguish images of nine distinct snake species that live on the Ecuadorian Galápagos Islands. Algorithms for object detection and classification have been used to accomplish this. The images included in the dataset were sourced from the Tropical Herping image collection as well as from Google and Flickr web scrapings. Various mixes of design models like Quicker R-CNN, Beginning V2, ResNet, MobileNet, and VGG16 have been tried for object discovery and picture characterization. With a classification accuracy of 75%, the Faster R-CNN with ResNet-based model performed the best.

James, Alex Pappachen [5] developed a taxonomy-based function intended for use by computer scientists and herpetologists to solve the automated snake identity problem in his paper. Each sample's 38 taxonomically applicable functions were stored in the function database. Out of those 38 capabilities, top capabilities which affect class not set in stone. To find the top capabilities from the entire information base, twelve trademark evaluators had been utilized. In addition, a collection of distinct search strategies, such as Genetic Search, Greedy Step-wise, and Linear Forward Selection, were utilized. The dataset's function-subset evaluation revealed that snake identity requires at least 15 functions. It became seen that those capabilities had been almost correspondingly dispensed from the coherent gathering of top, side and body perspectives on snake pictures. Highlights from the base perspective on snakes played minimal part in the snake personality. Thirteen classifiers were utilized for computerized snake classification. Utilizing those classifiers, the top notch F-score got was around 0.94%.

Nagifa Ilma [6] A deep convolutional neural network has been proposed in this paper to classify snakes into two categories that is venomous and non-venomous. The dataset is collected from Kaggle of 1766 snake images which contains of both venomous and non-venomous and with the help of the neural network it is able to implemented the proposed model. Fivefold cross validation model for SGD optimizer shows that the proposed model is capable of classifying the snake images with high accuracy of 90.50%. They are using transfer learning technique to boost the identification process accuracy. The proposed model is compared with other standard convolution neural network like Inception net, VGG19, Resnet50, Xception Net, Mobilenet v2, Inception-Resnet-v2, VGG16 has 82.38%, 43.75%, 81.81%, 80.94%, 82.35%, 89.62% and 62.50%. The proposed model outperformed a model with 90.50%.

In the paper of Isa Setiawan Abdurrazaq [7] snake species are identified based on the features such as head shape, body shape, texture, skin color, eye shape with the help of convolutional neural network. The classification of images has been developed manually with the help of deep learning technique and the parameters have to be changed manually. The dataset is collected manually by the trimaharani who handles emergency cases in Indonesia. It consists of 415 images for five venomous snake species they are krait 77, cobra 91, viper 72, pit viper 95, Russell’s viper 80. Three different CNN models are used in this model shallow, medium and deep architecture. After testing of three model medium architecture provides the best accuracy of 82%.

Anika patel [8] used object detection and classification for racer snakes in Galapagos islands for developing mobile application which will support the visitors in Galapagos to identify correct snake species from the uploaded images with the help of region based convolutional neural network in deep learning. The model was built using TensorFlow which is connected to API with the python technologies. Four models have been used for image classification inception v2, VGG16, ResNet, MobileNet and dataset has been collected from there different sources tropic herping, google, flickr which consists of 9 species with 247 images. MobileNet achieves the accuracy of 10%, VGG16 and Inception V2 70%, ResNet 75%.

IV. PROPOSED SYSTEM

For this model, we have collected total of 100 images of snake bite marks. These images were collected from the Kaggle website. The proposed system helps in snake species identification. The combination of a pretrained dataset model with the classifier shows good accuracy in classification of snake species. Raw images cannot be fed into the neural network, they need data pre-processing therefore we are applying the labelling software to label each of the images. After an image is labelled the txt file for each image is created and saved in the folder. Thus, for training the model we use the txt file as the input to the network. In Fig.2 The input snake bite mark images are given in live camera, the image is divided into segments where only the important segments of image are taken instead of entire image. In some instances, the snakes bite mark images where the object is blurry gaussian filter will be applied for removing the blurry regions. Converting the image from RGB to gray level which simplifies the algorithm and reduces computational requirements. The canny edge detector is used to detect the edges in the images it will find the gradient to highlight the edges of the region. Dilation and erosion are techniques used to add and remove pixels from the edges of objects in an image. And the key points in the image are located with the help of descriptor points, which are used as the foundation to later match and identify it in a new image. When the dataset is fed into the RCNN algorithm, it will compare the input and trained images to predict the output.

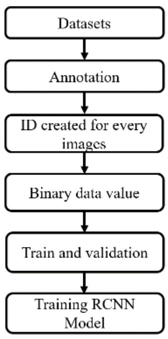


Fig. 1 Data Preprocessing

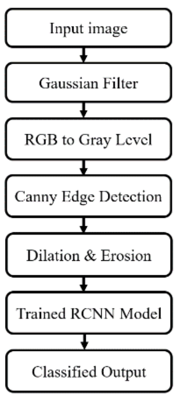


Fig. 2 Classification

V. IMPLEMENTATION OF PROPOSED WORK

A. Input image

The input image is given in live camera, Image acquisition is the action of retrieving an image from a source, usually hardware systems like cameras. The size of an image is described in its dimension, then it is given in pixels in the form of width and height. This information, can be used for resize an image according to the input.

B. Gaussian Filter

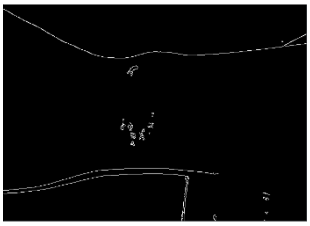
A Gaussian Filter is a low pass filter that is used to reduce noise (high frequency components) and blur image regions. Gaussian functions are used by photographers and designers for a variety of purposes. When a picture is taken in a low light and the resulting image contains a lot of noise, Gaussian blur can help to reduce that noise. If a text has to be placed over an image, a Gaussian blur will soften the image and make the text stand out clearly.

C. RBG to Gray Level

RGB stands for Red-Green-Blue, is the most well-known color model. This model, as the name implies, which represents the individual values for red, green, and blue. Almost all digital screens around the world use the RGB model. Grayscale is the most basic model because it defines colors with only one component, lightness. A value ranging from 0 to 255 is used to describe the amount of lightness that is 0 represents black and 255 represents white. It is critical to distinguish between RGB and grayscale images. An RGB image is made up of three-color channels red, green, and blue. A grayscale image, on the other hand, has only one channel. An RGB color image requires 8*3 = 24 bits to record a single-color pixel, so each color in RGB represents 8-bit component, yet when it converts an RGB image to a grayscale image, only 8 bits are needed. Instead of working directly on color photos, grayscale representations are frequently employed for extracting descriptors by doing this it simplifies the process and uses less computational power.

D. Canny edge detection

The Canny edge detector is an edge detection operator that detects a wide range of edges in images using a multi-stage algorithm. The canny edge detection first smoothens the image to remove noise using gaussian filter. The image gradient is then found by calculating the derivative of gaussian filter. The image magnitude produced results are in thick edges for converting into thin edges it uses non-maximum suppression. We have to determine the strong and weak edges to do this we have to perform the edge tracking algorithm, weak edges that are connected to strong edges are called actual edges. Canny edge detection is a technique for extracting useful structural information from various vision objects and reducing the amount of data to be processed dramatically. It has been widely used in a variety of computer vision systems. The Canny edge detection algorithm produces images that are smoother, thinner, and cleaner than the Sobel and Prewitt filters.

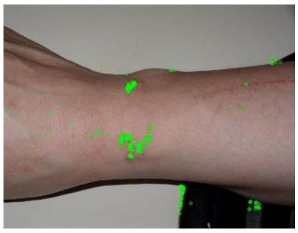


E. Dilation and Erosion

Dilation is the process of adding pixels to the edges of objects in an image. It makes the objects larger in size. It fills in the gaps and breaks. It connects the area separated by a smaller space than the structuring element also the brightness of the objects will be increased. While erosion removes pixels from the edges of objects. It makes the objects smaller in size. It gets rid of minor flaws. It eliminates objects that are smaller than the structuring element. It makes bright objects appear less bright. The number of pixels added or removed from an image's objects is determined by the size and shape of the structuring element used to process the image.

F. Descriptor Point

Key points are used to identify key regions of an object that can later be matched and identified in a new image. The same object can be photographed under different conditions such as lighting, angle, scale, and background. To detect high-contrast corners and edges, key points are identified by analyzing the magnitude and direction of intensity changes in local image neighborhoods. This analysis extends across multiple reduced-resolution versions of the image that are constructed dynamically according to the rules of the specific key point detection algorithm to ensure that the key points can be detected at different image resolutions.



G. Datasets

The dataset is collected from the Kaggle.com for 3 snake species cobra, python and viper. A total of 100 images of snake bite marks were collected. The dataset is trained using R-CNN algorithm and with the help of trained model classification is done which achieve the accuracy of 90% using MobileNet model.

H. R-CNN Algorithm

RCNN is a Region based Convolutional Neural Network used for object detection within image. The concept behind the R-CNN algorithm is region proposals. The input image is generated to sub segmentation to obtain the multiple regions. The region proposals are the smaller regions which is used to localize objects within an input image. For reducing the region proposal in RCNN uses a selective search method. Selective search is used for combining the multiple regions based on color, texture, size, shape. Finally, these regions then produce the final object locations this is called region of interest. All these regions reshaped as per input to CNN and each region is passed through the CNN layer. CNN will extract features for each region and divide the regions into different classes of each region proposal are used for predicting the class and bounding box of this region proposal. And finally, we can obtain output by plotting these bounding boxes on input image and labelling object that is present in the bounding boxes.

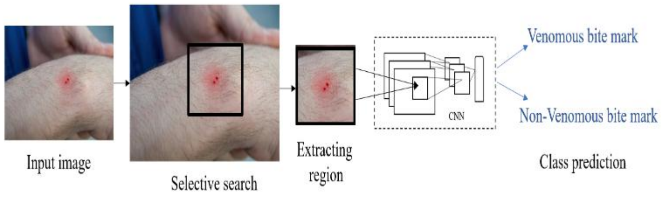


Fig. 3 R-CNN Algorithm

I. Euclidean Distance

The distance Euclidean distance is used in machine learning algorithm for measuring the similarity between two recorded observations. The algorithm needs to understand the similarities between content so it has to maintain certain distance from the object. These distance metrics calculate the mathematics driven between various data points available in the dataset. If the distance between two data points is less that means they are more likely to be similar and vice-versa. The length of a segment connecting the two points is measured to find the two points on a plane. The Pythagorean theorem is used to derive the Euclidean distance formula which is used for measuring the shortest distance. As the name implies, the Euclidean distance formula calculates the distance between two points. The Euclidean distance formula is shown below. Let us consider two points A (x1, y1) and B (x2, y2) and assume that d is the distance between them to derive the Euclidean distance formula. A line segment connects A and B. To derive the formula, a right-angled triangle is constructed whose hypotenuse is AB. For this, we draw horizontal and vertical lines from A and B which meet at C as shown in Fig.3.

Pythagorean Theorem

$$AB^2 = AC^2 + BC^2$$

Euclidean Distance

$$D = \sqrt{[(x2 - x1)^2 + (y2 - y1)^2]}$$

The Euclidean distance is calculated, the value between 2mm to 8mm belongs to category A, the value of distance between 8mm to 12mm it belongs to category B, the value between 15mm to 20mm belongs to category C.

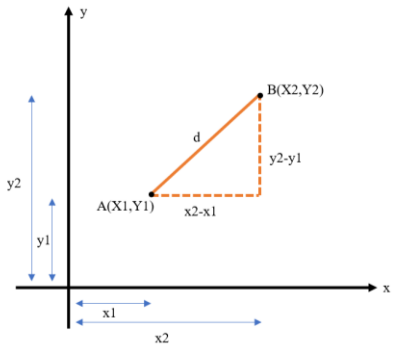


Fig. 4 Euclidean Distance

VI. RESULTS

The following images are the output of the proposed system. Fig. 5 shows the venomous snake bite mark image Fig. 6 shows the non-venomous snake bite mark image Fig. 7 measures the distance between the snake bite mark Fig. 8 displays the output screen which will provide information about snake species, toxic or non-toxic and which type of antivenom with its dosage should be provided. Fig. 9 shows the losses from training the image dataset using MobileNet. Fig. 10 shows the losses from training the image dataset using VGG16 Fig. 11 confusion matrix it is used for determine the performance of the classification models for a given set of test data. Fig. 12 comparison of MobileNet VGG16.

Fig. 5 Venomous snake bite

Fig. 6 Non-Venomous snake bite

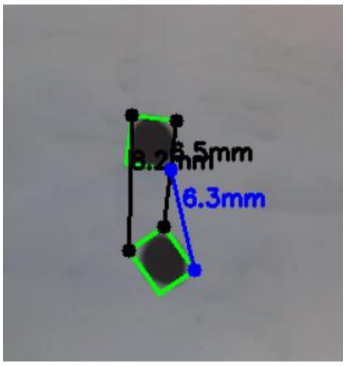


Fig. 7 Measuring the distance of snake bite mark

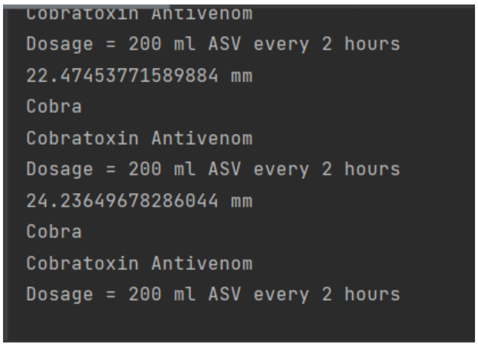


Fig. 8 Displays snake species and antivenom

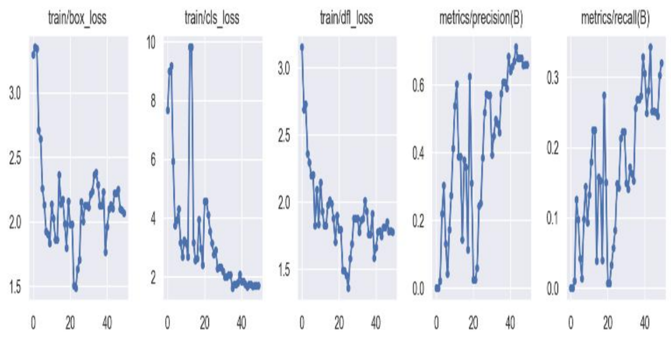


Fig. 9 Training of VGG16

Fig. 10 Training of MobileNet

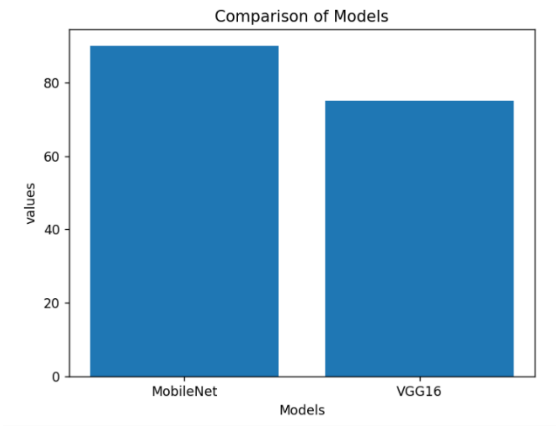


Fig. 11 comparison of models

VII. CONCLUSION

This model helps in identifying the snake species more accurately by using MobileNet model in deep learning when compare to VGG16. The R-CNN model with the training set achieves the highest accuracy of 90% while VGG16 achieves the accuracy of 75%. It can save time and computation resources by R-CNN algorithm. The model will be able to identify which type of snake species, toxic or non-toxic and which type of antivenom with its dosage should be given to patients through video processing. As there are millions of snake species around the world, this system can be trained with a great number of snake bite mark images to recognize them. The further research can be developed has mobile application with its first aid measurement. In this way it can be help for people who can't reach the hospital at the correct time. It can be implemented with different algorithm to get better accuracy.

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