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Analyzing Dog Behaviour using Image Processing

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Abstract*— To implement and analyze the behaviour of Human-Dog Relation, by using MATLAB. It is fourth generation high level programming language and provides interactive environment for computation to be done numerically, visualizing and programming. It has many build-in commands and mathematics functions which help in calculations, generating plots and performing numerical methods. It is mostly used in 2-D and 3-D plotting and graphics, linear algebra, algebraic equations, nonlinear functions, statistics, data analysis, curve fitting and various other special functions. It is used all over the world as a computational tool especially in the field of engineering. Here we have used SVM (Support Vector Machine). SVM is one of the most popular supervised learning algorithms that is used for classification as well as regression problems. The main aim of SVM is to make the best line or decision boundary which can segregate n-dimensional space into classes so that we can easily point the new data point in correct category in future. This best line boundary is known as hyperplane. SVM selects the extreme points that can help in making the hyperplane. Study involves the sample size of ten. And the work is being done on this sample size to get the authentic and effective results. To implement SVM, we have used mamdani model and the facial recognition technique is used. The face of the dogs is taken for the practical implementation. To get the results of proposed work facial area is considered.

Index Terms: Image processing, SVM, facial expression, distance evaluation.

I. INTRODUCTION

Human-Dog compatibility is the primary thing which is required if you are keeping a pet dog. Till the time we don't understand the dog it won't try to make a bond with us. The behaviour of a dog totally depends on the way that how it is being petted. There are many factors which affects the bond of an owner and a pet dog. Both owner and the pet play same role in making a bond between them. Image processing is a technique which is considered in our work. Image processing can be done 2-D or 3-D, we will be working on 2-D image processing technique. Digital image is composed of limited number of elements, in which each and every element has a particular location and value. And these are referred to as picture element, image elements and pixels. Vision is the most effective of our senses, that is why it is not a surprising thing that images play the most important role in human perception. Digital images are shown as a discrete set of intensities. Basically there exist two categories of steps involved in the process of image processing. One, methods whose outputs are inputs are images and Second, methods whose outputs are features retrieved from those images. In order to make a digital image, we have to convert continuous sensed data into digital form. For the conversion there exist 2 processes, sampling and quantization. Digitalizing the coordinate values is called sampling and digitalizing the amplitude values is known as quantization.

1.1 In the study of computational method will be used on datasets which are called manually. The best computational method is MATLAB because as per the study and proposed work accuracy plays a great role

1.2 Study is based on the normal and abnormal behaviour of dogs (pets) under which image processing in 2d will be used which clearly compares the image with normal image/ standard image of dog. While comparing the difference b/w distance based on the boundary (base line) which will be marked through SVM is calculated. Higher the difference results to more abnormality/ affected areas.

1.3 For analysis, sample size of 10 has been considered while analysing because it is the best method for distance evaluation.

Generally there are 3 types of computerized processes in the processing of image:

- **Low level process** – This involves primitive operations such as image processing to lessen the noise, contrast enhancement and image sharpening. These types of processes are characterized by the fact both input and output are images.
- **Mid level image processing** - This includes work like segmentation, detailing of those objects to reduce them to a form compatible for computer processing and classification of individual objects. The inputs to the process are generally images but outputs are attributes extracted from the images.
- **High level image processing** - It consists of "making sense" of an ensemble of recognized objects, as in image analysis and performing the cognitive functions usually associated with vision.

II. SUPPORT VECTOR MACHINE

S.V.M is one of the most constructive methods to analysis the distance evaluation by (automatically) selecting boundaries or edge on the given image. This image can either of face image, or of any object/ thing. SVM can be used in

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real time processing such that during evaluating in real time processing a complete and through analysis will be marked (e.g., During video). In the study, real time analysis is not considered because the main objective of using SVM is to analyse the distance from one point to another point. The points or landmarks which were considered for evaluation is known as fiducial points or facial points or facial landmarks. (These are the points which are marked at the edge of face region like the inner edge of the eye and outer edge of the eye).

Bosphorus Dataset: It is intended for research on 2D and 3D dog face processing tasks including expression recognition and 3D face modeling

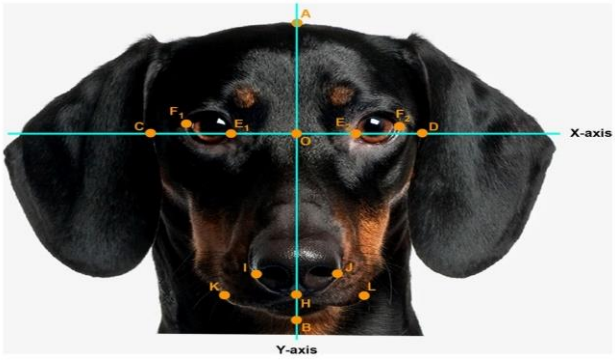

Fig.1 Face model in 2D

In human being there are basically 5 universal facial expression which are used i.e., Happy, sad, disgust, anger, surprise. Whereas in dogs for the study only normal face image has been considered. Such that complete analysis of facial regions will be more accurate.

SVM is basically an acronym of Support Vector Machine which was first proposed by Vapnik. SVM attracted a lot of interest in machine learning research community. It is usually capable of resulting higher performance in terms of classification accuracy than other classification algorithms. It is a binary classifier based on supervised learning that gives better performance than other classifiers. SVM categorize between 2 classes by constructing a hyperplane in high dimensional feature space that can be used for classification. Hyperplane can be represented by following equation:

$$w.x+b=0 \quad (1)$$

w is weight vector and normal to hyperplane, b is bias or threshold.

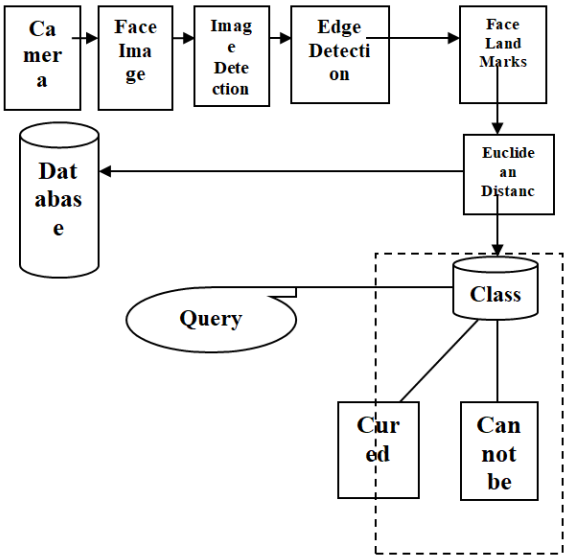

Fig.2 Proposed architecture to analyse facial image using 2D

III. COMPONENTS TO ANALYZE THE BEHAVIOUR

Following Components are used in proposed work to analyse the behaviour of Human- Dog relationship:

1. Image detection
2. Edge detection
3. Face landmarks
4. Distance evaluation
5. Classifiers

Image detection:

Image or object detection is a computer technology that detects object and process the image in it. Peoples are often confused in classification of image detection and object detection. Although the difference is very clear. If we want to classify image items, we will use classification. But if we just need to locate them, for example, find the number of trees in the picture, we will use image detection.

Let us take an example. Think of how you're looking for your friend in crowd. Even though you're trying to find your friend, you still scan all the people, and your brain quickly decide whether he/she is your friend or not. This is how Image Detection works.

Object detection:

Object detection is a computer vision technology for locating instance of object in videos or photos. To produce meaningful results object detection logarithms typically leverage machine learning or deep learning. Humans can recognize and locate objects of interest within a matter of moments when they look at image or videos. The goal of object detection is just to replicate this intelligence using a computer.

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Object detection is nothing but, just to recognize the object within the boundary in the image, whereas in image classification, we can simply categorize that is an object in the image or not in terms of the likelihood

Computer technologies like computer vision and image processing is related to object detection. It deals with the detection of similar objects of certain class (such as humans, buildings, or cars) in digital videos or images. Some well researched domains for object detection includes pedestrian detection and face detection. Object detection has applications in many areas of computer vision like video surveillance and image retrieval.

Every object class has its own special characteristic features which help in classifying the class for example all circles are round. These special features are used by object class detection. For example, when we are looking for a square, objects which are perpendicular at corners and have equal lengths of side are needed. This similar approach is used in face identification where eyes, nose and lips can be found and features like distance between eyes skin colour can be found.

Land Remarks:

To localize and represent important regions of face facial landmarks are used. Such as :

- Eyebrow
- Eyes
- Nose
- Mouth

If someone has facial landmark feature point approx. On two different faces, we can align that one face on other, and then we can clone one face onto the other flawlessly. Facial landmarks can be used to produce in between images by aligning faces that can be morphed.

The models selected for the 3D face landmarks has been employed by using transfer learning and it is trained on a network with different objectives: 3D landmarks are coordinates are predicted by the network on synthetic render data. The final network performed reasonably well on real-world data. The input taken by the 3D landmark network is cropped video frame without additional depth input. The model output the position of the 3D points, reasonably aligned in the input.

The crucial component is the geometry pipeline. Within 3D metric space it estimates the face geometry objects. The following steps are executed respectively on each frame:

- The Metric 3D space coordinates are obtained that is, face landmark screen coordinates are converted into the Metric 3D space coordinates.
- Face pose the transformation matrix is estimated as a rigid linear mapping from the canonical face metric landmark which is then sent into the runtime face a metric landmark that minimizes a difference between the two.
- Then the runtime face metric landmarks create a face mesh.

IV. DISTANCE EVALUATION

In image analysis, the distance transform measures the distance of each object point from the nearest boundary and is an important tool in computer vision, image processing and pattern recognition. In the distance transform, binary image specifies the distance from each pixel to the nearest non-zero pixel.

The distance transform measures the distance of each object point from the nearest boundary and is an important tool in computer vision, image processing and pattern recognition in image analysis. Binary image specifies the distance from each pixel to the nearest non-zero pixel in the distance transform. The straight-line distance between two pixels and is evaluated using the Euclidean norm is called the Euclidean distance. The path between the pixels based on a four connected neighbourhood and pixels whose edges touch are one unit apart and pixels diagonally touching are two units apart, is the city block distance metric measure.

The path between the pixel based on an eight connected neighbourhood is measured by the chessboard distance metric. The total Euclidean distance along a set of horizontal, vertical, and diagonal line segments is the quasi-Euclidian metric measure. To determine the distance between images and efforts which have been made to define image distance to provide intuitively reasonable result is a central problem in image recognition and computer vision. Estimating distances in digital image is useful in different shape recognition task and shape representation.

Distance Matrix:

A metric or measure of the separation of points in the image is provided by the distance transform.

The distance between each pixel and the nearest nonzero pixel for binary images is calculated by the bwdist function.

Table 1: Distance evaluation methods

Distance Metric	Description	Illustration
Euclidean	The straight-line distance between two pixels is called Euclidian distance.	0 0 0 0 1 0 0 0 0 1.41 1.0 1.41 1.0 0.0 1.0 1.41 1.0 1.41

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Chessboard	The path between the pixels based on an 8-connected neighbourhood is measured by the chessboard distance metric. pixels whose corners or edges touch are 1 unit apart.	1 0 0 0 1 0 0 0 0 1 1 1 1 1 1 1 1 1

As mentioned in the table generally there are 3 types of distance evaluation techniques but in the study only Euclidean distance evaluation has been used because of mathematical computation used in the study.

Classifier:

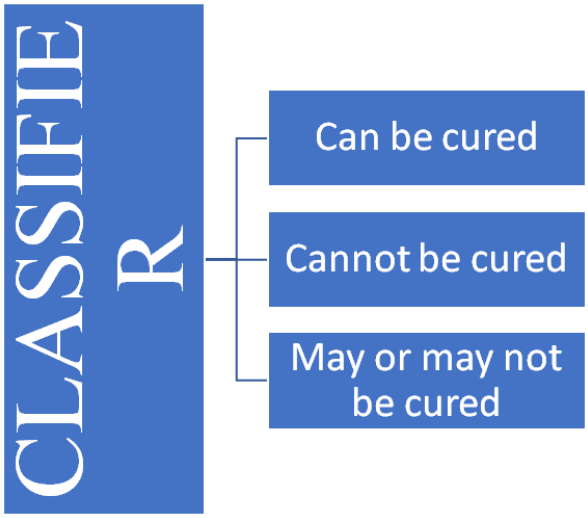

Fig.3. Classifier

Study includes 2 cases in case of classifier, first is when the pet is cured by its owner and the other one is when the pet was not cured by the men.

V. PROPOSED WORK

1. Image (face image) of a dog (pet) with the consent of the owner is taken for the studies.
2. Edge detection with the use of SVM.
3. Facial landmarks. We have taken 4 landmarks, i.e., ears, eye outer edge, nose outer edge and Lips.
4. We have divided the face image into 2 parts (left side and right side)
5. Euclidean Distance evaluation.
6. Difference in the distance (from left side and right side).
7. Affected portion: how we have calculated the affected portions in such a way that the more the difference the more the affected portion.
8. Classifier is used to detect whether the affected part can be cured or not. (Difference of Euclidean distance is added with difference of distance between points).

S.V.M is one of the most constructive methods to analysis the distance evaluation by (automatically) selecting boundaries or edge on the given image. This image can either of face image, or of any object/ thing. SVM can be used in real time processing such that during evaluating in real time processing a complete and through analysis will be marked (e.g., During video). In the study, real time analysis is not considered because the main objective of using SVM is to analyse the distance from one point to another point. The points or landmarks which were considered for evaluation is known as fiducial points or facial points or facial landmarks. (These are the points which are marked at the edge of face region like the inner edge of the eye and outer edge of the eye).

VI. CONCLUSION

From the study, it has been concluded that with the help of evaluation, one can easily detect whether the dog(pet) will be cured or not cured, which limit the surgical portion because if it cannot be cured then surgery is of no use or depend on the opinion of owner only.

For distance evaluation “Euclidean distance” is the best approach as concluded in the study. Further the study will focus on the accuracy part because in the current study on 10 sample size has been taken which is not the appropriate dataset to calculate accuracy.

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