MACHINE LEARNING FRAMEWORK USING PSOA AND MSVM FOR MULTI-CLASS OBJECT DETECTION

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ABSTRACT

Object detection is one of the essential applications in the field of the computerized visualization that has been the major area of the research. OD is the technological aspects that identify the semantic entities of the class pictures. OD searches the object in real –time world by making the use of the object simulations that is called as the priori. Presently, one of the significant and simulating problems in computer vision seeks to locate the object features from large number of the already defined classes in natural pictures. An object detection scheme searches the objects of the real time available in digital pictures or videos , when the objects is related to any group of objects specifically cars, humans and so forth. Currently, the multi-class SVM is trained through MSRC dataset. Various papers have been studied in object detection scheme that has been found in various problems like (i) Illumination (ii) complex (size and shape) images. In existing research work, a hybrid genetic transformation algorithm was used for optimization and detection of the salient object features below different environment factors and acquired accuracy rate 86.1 Per cent. In research work, the three different types of problems are resolved using MSVM with PSO classification method, the real time images are segmented into various group of the classes or the sets. In the proposed system, SURF algorithm has applied for the extraction of the feature sets. In addition, PSO optimization algorithm has used for the instance selection of the essential characteristics based on classes from extracted feature metrics. The simulation outcome on MSRC data set defined the system performance of the improved model, mainly used for the small object detection in large size images. This proposed method has easy to detected the object of the image and improved the performance and overall performance has achieved the parameters values like accuracy score 98.4 per cent, False Acceptance Score 0.0046 %, False Rejection Score 0.0100 % and Mean Square Error Score 0.0023% as compared with existing techniques.

Keywords- Object *detection, Machine Learning method, Particle Swarm Optimization Algorithm, SURF and MSRC dataset.*

INTRODUCTION

Object detection is an essential, still challenging vision task. It plays significant role in various applications like as picture searching, picture comment and considering scene. On other hand, OD is the method of identifying the instances of the group of classes of specific class present in the picture [1]. In computerised visualization, picture segmentation is the method of segmenting a digital picture in to numerous segments (group of pixels, also called as picture objects). The major objective of the segmentation is to make things easier and alter the demonstration of the picture in to some degree that is more suitable and simple to analyse.

Object Recognition (OR) has two different types such as (i) Recognition and (ii) Detection [2]. Object Detection is dealing with characteristics the digital image object from the image contextual. And Object Recognition is dealing with various objects classification into one of the pre-defined classes. It is verifying procedure of main object in DI (Digital Images or Videos). Normally, OR methods rely on learning, matching and pattern recognition methods using appearance and feature based methods [3]. For illustration, it is used to search instances of real-life objects such as (i) Swans (iii) Giraffee Animal (iv) Things (Mug, Bottle and Apple Logos) etc.

Fig 1. Process of Recognition or Detection in Object

Fig 1 shows the OD methods use characteristics which can be removed to detect particular objects. This phase is simple to design. OD is a SR (Single Regression) issue which recognizes straight from boundary-box co- ordinates and Class Probability(CP). All objects have its individual category like all circles are round, in which are used while detecting the object category [4].

It related to the object detection is existing, and attempted to define two main confirming classes in the following phases: (i) Color-based and (ii) Shape-based method.

1.1 Color based method (CBM) : Color data is an important visual feature in farming products and it has better presentation on in-variance of extent and view point alters. CBM normally objective at image segmenting out the valuable color of awareness edge for further processing. The main disadvantage with these approaches is that they are very exposed to environment brightness modification.

1.2 Shape-base method: It separates shaped based methods into two different types such as boundary and region based methods [5]. The existing encrypts the image object boundary, with chain code [6], Fourier descriptor [7], HT (Hough Transformation), bending energy and spline-estimation. Several mathematical characteristics can be used to elaborate easy-shape-region, like Euler number, centrifugal rate, rectangular degree, Projection and area etc. It can separate the reflection into cells, each of which en-codes section of the reflection nearby. Object Shape based detection methods are normally used for the further segmentation [8].

Depending on the similar characteristics extracted from the object, very good classification methods can get better and reliable results. There are three types of classification approaches are explained as follows:

A. ***Template Matching:*** It is the approach of searching the smaller portions of the picture that matched is called as template picture. It is the direct method. In this method, template pictures for various groups of classes are placed. When the picture is provided as involvement to the method, then it is coordinated with placed pattern of the pictures to identify the object in input picture [9]. It is recurrently utilised for detection of fonts, quantity, group of classes and so forth. It is completed on single color or grey

level pictures. It may optionally be one pixel to other pixel toning or features based matching. Template pictures are comparable to characteristics of sub- pictures of the provided input pictures, to recognise if the pattern object is available in involvement picture.

B. ***NN (Neural Network):*** This approach is recently one of the most reliable and world-wide used knowledge classification methods [10]. Its main benefits that it is accepting to error and is influential to classify. NN algorithm finished train the classes or images with color, figure, features of region-interest can be classifying. It is normally network modes contain BPNN [10], MLPNN, HFNN, RBN etc [11].

C. ***SVM (Support Vector Machine):*** It is extended statistic LM (Learning Method) to classification, paying structure risk mitigating to enhance generalized capacity. It is able to resolve the issues w.r.t non-linear [12], HD (HighDimension), LM (LocalMinima) and also in-variable with view-point.

In this paper prepared as follows: Section II contains of related work used in proposed work. In Section III, research methodology concepts regarded to the proposal is defined. In section IV defines the experiment result analysis and comparative analysis with different number of classifiers. Lastly the conclusion is defined in section V.

RELATED WORK

Most of the researchers have analysed the various machine learning algorithms, feature extraction method used to excerpt the unique features and classify the objects. **Ahmed, A.** et al., in August 2019 proposed research on the specific technique for exact object detection. Initially, the clustering of the same colors and areas was acquired by applying the k mean clustering approach. In addition, the segmentation was performed by combining the last identified clusters that was same and interconnected. After that, the general Hough transform [13] was utilised for the identification of salient objects (SO). Lastly, the genetic approach was applied as detection engine to identifier engine to identify the salient objects below various surrounded situations. Experimental analysis was done by evaluating through the dataset MSRC data set. **Thoma, M** et al., in May 2016 [14] surveyed on various types of segmentation methods with pixel extraction in digital images. The metrics and the databases for the computation of the segmentation approaches and traditional methods like as unsupervised techniques, decision forest and SVM were explained and pointers to the related study were described. Presently, the available methods with the CNN were described and distinctive problem conditions for the segmentation methods were determined. A detailed study of the segmentation methods was also explained. This research provided a detailed study of the various types of semantic segmentation and detailed description of the compete automated, segmentation methods. **Garcia-Garcia, A** et al., in April 2017 studied the deep learning methods based on the segmentation in different application regions. Initially, they described the portray wording of this field just as compulsory foundation ideas. Next, the primary datasets and difficulties are presented to assist analysts with concluding which are the ones that best suit their requirements and their objectives. At that point, existing techniques [15] were checked on, featuring their commitments and their massiveness in the field. At long last, quantitative outcomes are given for the depicted strategies and the datasets in which they were

assessed, catching up with a conversation of the outcomes. Finally, they call attention to a lot of promising future works and determine inferences about the best in class of semantic division utilizing deep learning method **Borji, A.,** et al., in June 2014 studied the salient objects identification literature related to various regions. Identifying and portioning salient objects was extremely helpful. Articles in pictures naturally catch more consideration than foundation things, for example, grass, trees, and sky. In this manner, on the off chance that they can identify salient objects initially, they may perform definite thinking and understanding of scene in the following phase [16].Contrasted with conventional specific reason object locators, saliency models were general, regularly quick, and needn't bother with substantial comment. These assets permit preparing of countless pictures effortlessly. Investigating associations between remarkable object recognition and obsession expectation models can help improve execution for the two kinds of models. Right now, that offered both salient objects (SO) decisions of people and eye developments were exceptionally appealing. Leading social examinations to determine how people perceive and organize protests in scenes and how this idea was identified with language, scene depiction and inscribing, visual inquiry replying, properties, and so on and it can offer important understanding. **Yang, K. F** et al., in November 2015 proposed research on the object detection technique that dependent on the picture segmentation.

Salient object identification was effortlessly accomplished dependent on three basic highlights characterized for every patch, while utilizing a top notch picture division algorithm as a pre-stage preparing**.** Also, for benchmarking saliency related strategies, another various levelled object database was assembled dependent on the eye tracker noted obsessions. Exploratory outcomes showed that picture division can strikingly advance salient object recognition. Furthermore, there was other segmentation techniques which can acquire great limits can likewise be utilized as the initial phase in our structure. In any case, most existing division strategies were too complicated to as pre-stage preparing of salient object identification. Consequently, an easier yet productive picture segmentation calculation was relied upon to additionally encourage remarkable article discovery. Moreover, other than the three proportions of sectioned patches (i.e., Centricity, Fringe Proportion [17], and Limit Proportion) for saliency calculation, more measures for characterizing cover saliency may be effortlessly brought into the planned structure. Table 1 described the various types of method, advantages of object detection and recognition. It explained the various problems in object detection system and existing performance metrics.

TABLE I. COMPARISON ANALYSIS

Author and Year	**Techniques**	**Advantages**	**Issues/Gaps**	**Parameters**
Ahmed, A. et al., 2019 [13]	Salient object detection and hybrid genetic algorithm	Video surveillance and self- driving	Identify pictures	Accuracy
Thoma, M et al., 2016 [14]	Semantic segmentation	In medicine	Unassigned pixels	-
Garcia-Garcia, A et	Deep learning	Automated	Undefined	Accuracy

al., 2017[15]	method	driving	structure	
Borji, A.,et al., 2014 [16]	Salient object detection and segmentation	Simplification and efficiency	Larger blocks	Precision rate
Yang, K. F et al., 2015[17]	Salient object detection	Image detection and compression	Contour detection issue	Precision , Recall

RESEARCH METHODOLOGY

This phase is elaborated the research proposed with machine learning technique, PSOA is used select the feature sets and extract the features using SURF algorithm. The object detection is the production in binary map, and the methods aimed to assign the marker from different classes like as sky, road, and building to every pixel. Object detection is an efficient and major method utilised to trace the objects in correct way during the complicated scenes. Generally, the analysis of the objects has received the consideration of the investigators to discover and protect the facts of object detection (OD) associated issues in technologies like;

(i) Robots
(ii) Surveillance
(iii) Medical Field, and
(iv) Advertising.

The proposed steps are described in detailed as follows:

Step 1: Data Collection: First of all download the MRCN dataset from the online site (Kaggle.com). In this dataset various category object detection images such as Bottle, Mug, swarm and Flower etc. To upload the image from the dataset train folder.

Step 2: Image Pre-processing: In this phase, uploading image size 245*345*3 pixels. Resize the input image and convert into 256*256 image pixel size. To convert the red, green, blue color channel into gray scale image and reduce the image in 2D. After that, Image pre-processing has identified the noise level in the gray scale image. In case noise is presented input image implement a filtration method to calculate the smooth image.

Step 3: Segmentation using K-Means Clustering: In this process, develop a KMC method to evaluate the region of interest in the form of clusters or groups. In KMC algorithm is used to divide the input data into different clusters with the help of centroid.

Step 4: Feature Extraction and Selection: In this process has implemented a SURF algorithm to extract the valuable properties in the key-point's setup. After that feature extraction, implement a PSOA procedure to select the valuable features in the original extracted database.

Step 5: Classification using MSVM: In this research work, MSVM classification algorithm to detect the objects. MSVM algorithm is divided into two phases such as;

(i) Training

(ii) Testing

In training process defined the train multiple images from the train dataset folder. In test process, to test the single image and simulate with train feature set. If train and test feature set comparison is true then detects the object and then false detection rate fail. After that, it evaluated the performance metrics such as accuracy rate, false acceptance rate, false rejection rate and Image Quality (PSNR).

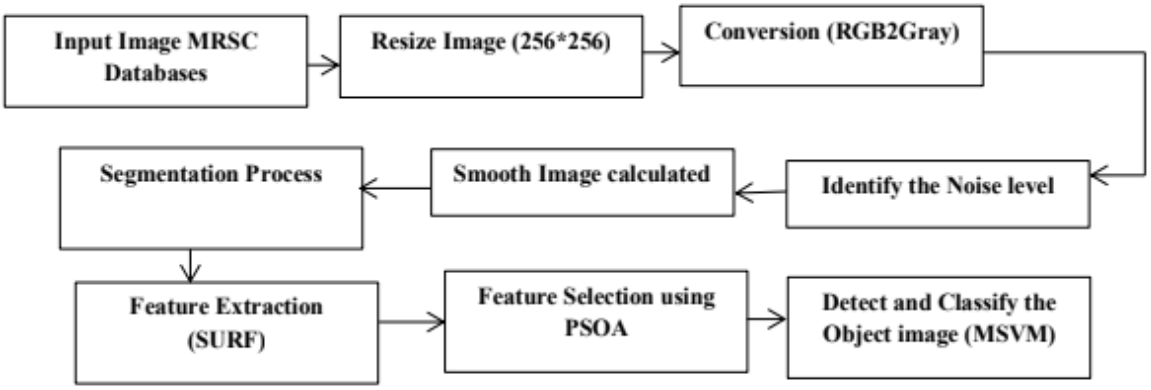


Figure 2. Proposed Flow Chart

EXPERIMENTAL ANALYSIS

From the discussion of problem formation, solution, we conclude the research objectives to compare the different classifiers such as MSVM, Hybrid Genetic Transformation, CNN and Efficiency Scale Space using MATLAB Simulation Tool. Before defining the simulation of these methods, initial describe the detail introduction about MATLAB with GUI.

The research software is simulated in MATLAB and co-operating GUI with Project Desktop Application is developed. In this analysis, 5 class's images of MSRC dataset were taking under camera and almost 36 image from each class were taken for train and Test module. Proposed defined methodology, object images were saved in *.jpg, *.jpeg image format. The research software or system has improved the presentation compared with other image segmentation, FE (Feature Extraction) and selection approaches which can be realized in different parameters such as FAR, FRR, MSE, Accuracy Score and PSNR rate.

Initial, the entire window seperated into two phases such as following:

(i) Train and (ii) Test

B. Train Phase:

This is one Button in it, Knowledge Domain. The train module is trained the various class of the image samples and saved the feature values in the databases and classify them into various function using MSVM.

C. Test Phase:

Test module is defined to test analysis button. Several features of MSRC data set images are extracting and select the features which are compared with several characteristics of train samples. Then the FM (Feature Matching) is completed or correct sample is classified or detected according to the classes and if incorrect then detection failure occurs. After the feature matching, the successful detection of various classes of MSRC data set images, it evaluates the system presentation parameters such as: (i) FAR (ii) FRR (iii) MSE (iv) Accuracy Score and (v) PSNR.

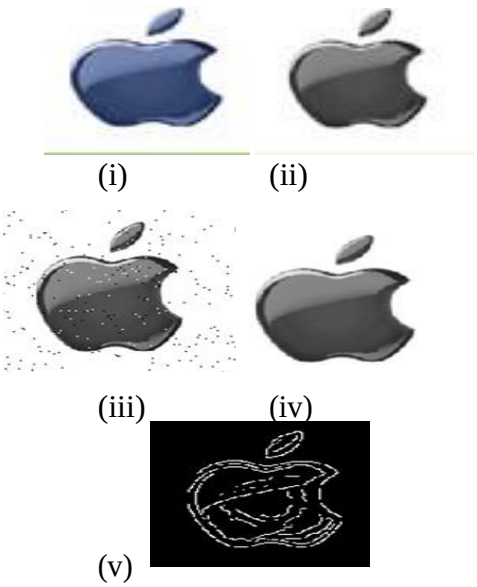


Fig 3. (i) Upload Image (ii) Gray Scale (iii) Noisy Image and (iv) Filter Image and (v) Edge Detection

Figure 3(i) defines the testing window. Figure 2(ii) defines the test image folder. Figure 3(ii) defines the test image uploaded; it reduces the size of the input image (256*256). It converts the Red, Green, Blue image into GRAY-SCALE MSRC data set image. It optimizes the size or image dimensions of the uploaded image. Figure 3(iii) and (iv) defines, detect the unwanted noises, after that introduced the hybrid filtration method is used to improve the noise image. Fig (v) the edge detection system is based on convolving the sample image with small, separate and number value filter in the horizontal and vertical edges and is therefor, a costly in term of evaluations. It detects the overall edges of the input image.

Fig 4. Edge Detection Image

Fig 4 shows the detection of Region of Interest using Kmeans Clustering method. It is easy to detect and classify the area of image in the form of clusters. It calculates the centroid of the uploaded image and it helps to find the main regions of the image.

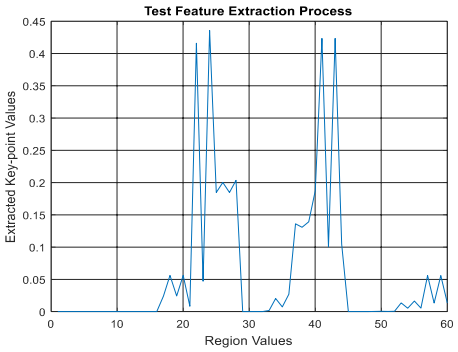


Fig 5. Feature Extraction Process

Fig 5 shows the feature extraction using SURF Algorithm. SURF algorithm is robust and speed up method for extract the local feature set. The main purpose of this method used the fast calculation of operators using three- box Filtration. SURF algorithm is two steps:

(i) Feature Descriptors and

(ii) Extraction.

It extracts the interest point in the input image.

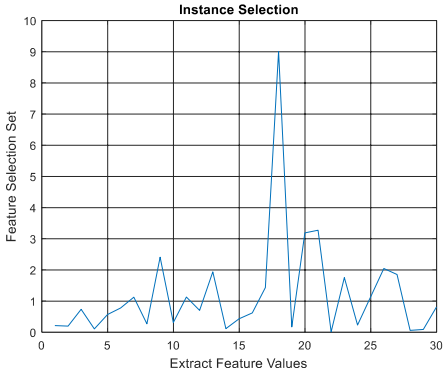
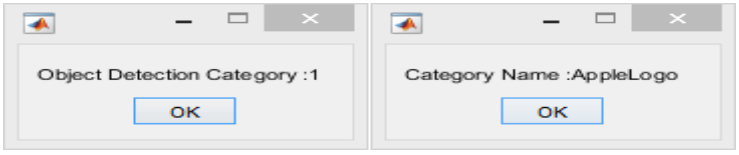
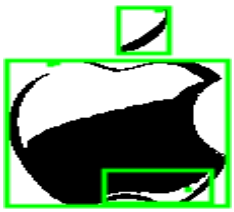


Fig 6. Instance Selection Process

Fig 6 defines the selection of the feature sets based on PSO (Particle Swarm Optimization) algorithm. PSO approach is a computation approach that reduces the feature set values and improved the CS (Candidate Solution) with related to a defined quality feature set. It is a valuable method to select the feature set and saved in the *.mat file and shown in graphical representation.



(i)



(ii)

Fig 7. Detection or classify the object

Above figure 7 shows the detection of the object and when the "Detection Rate/ Optimized MSVM" button is clicked, the MSRC data set sample of uploaded image of the object is detected and classified using Multiclass (SVM) method. It classifies the MSRC data set image object with class accordingly and computes the performance metrics like accuracy score, FAR, FRR, MSE and PSNR. Subsequently, clicking "Parameter" button, FAR, FRR, MSE, PSNR and Accuracy Score graphs are showing as figure.

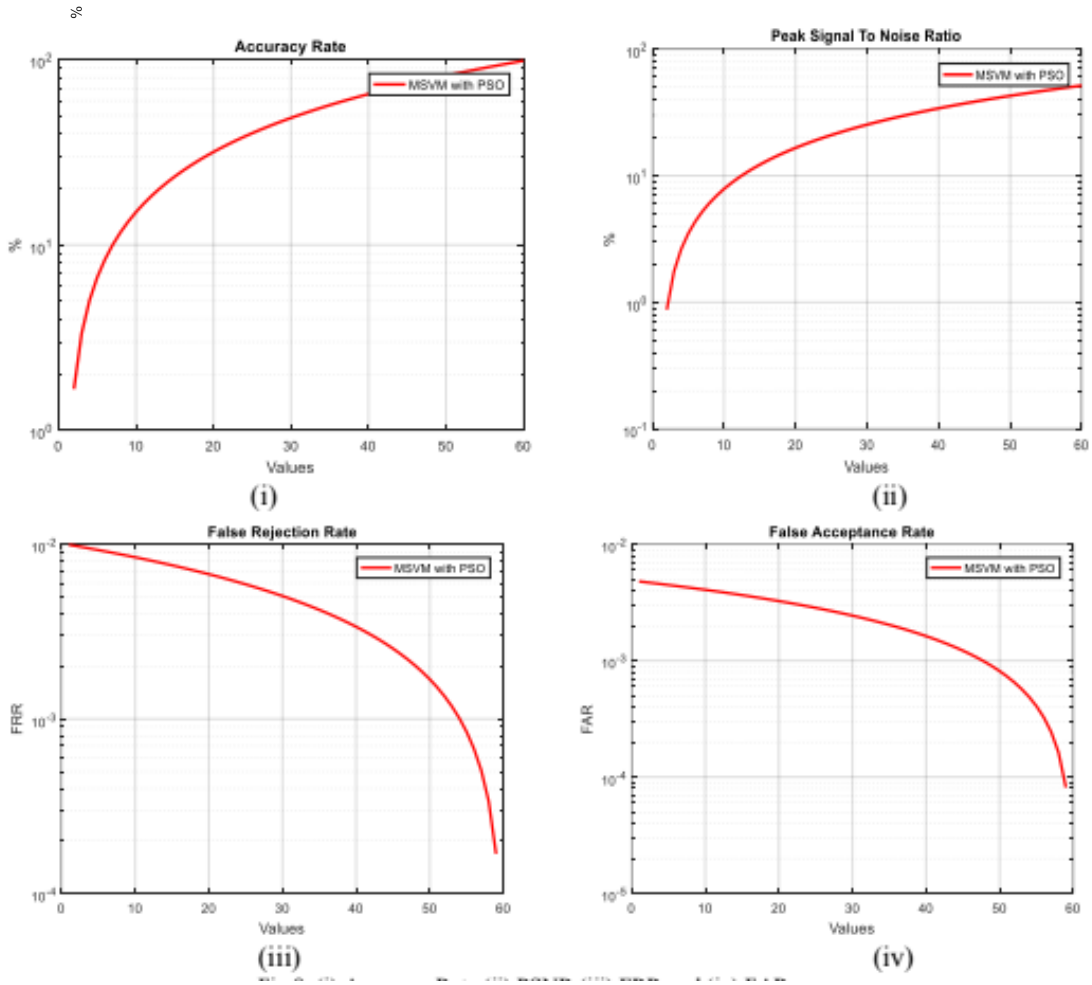


Fig 8. (i) Accuracy Rate (ii) PSNR (iii) FRR and (iv) FAR

Fig 8 (i) show the system performance with accuracy rate evaluated PSO and MSVM method. Research Method has developed in Object Detection System to enhance the accuracy score as compared with the existing methods. 8 (ii) show the system performance with Psnr rate evaluated PSO and MSVM method. It is the ratio among the maximum possible signal of power and distorted that affects the reliability of its representation. It is worldwide dynamic range; PSNR is normally defined in terms of the Log Format or scale. 8 (iii) defines the False rejection score with proposed MSVM and PSO method. FRR shows the wrong feature set values that are not accepting. Metric related to error type in the object detection system. The research system has enhanced the wrong feature value that improved the rejection rate as compared with the various no. of selected feature set values. 8(iv) defines the false acceptance score with MSVM and PSO algorithm. In the acceptance rate, the wrong feature set values are acceptable. Metrics referred to the type of error rate in the object detection system. The research approach has enhanced the incorrect feature set accepted error as compared with the different no. of selected feature values.

Table II PROPOSED PARAMETERS

Parameter	**Values**
MSE	0.0023
FAR	0.0046
FRR	0.0100
PSNR	53.54
Accuracy Score	98.5

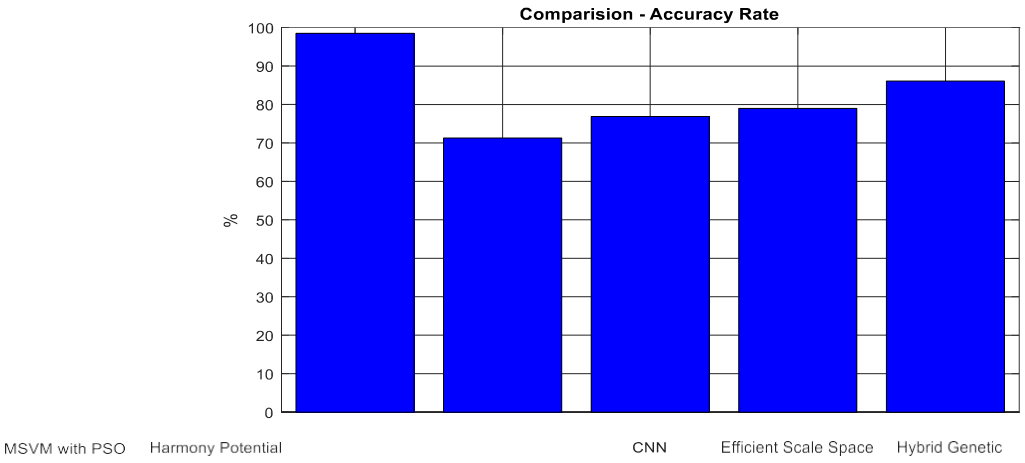


Fig 9. Comparison – Accuracy Rate (%)

The comparative analysis button is clicked, and then defines the figure. Figure 9. shows the parameters with existing and proposed such as accuracy score (%). The proposed method has improved the accuracy score compared with different methods like CNN, Efficient Scale space, Harmony Potential, Hybrid Genetic Transformation method, and MSVM and PSO Algorithm.

Table III. COMPARISON PERFORMANCE METRICS

Methods	**Accuracy Score (%)**
MSVM and PSO	98.5
Hybrid Genetic Algorithm	86.1
CNN [31]	76.9
Efficient Scale Space[32]	79
Harmony Potential[33]	71.30

Table II illustrates the performance parameters with proposed method such as FAR, FRR, MSE, PSNR and Accuracy Score. The proposed parameter values are FAR value is 0.0046, FRR value is 0.0100, MSE value is 0.0023 and PSNR value is 53.54.

Table III show the comparison analysis with various methods such as MSVM with PSO value is 98.5%, Hybrid Genetic Algorithm value is 86.1 %, CNN (Convolutional Neural Network) value is 76.9%, efficient Scale Space value is 79% and Harmony Potential Value is 71.30 %.

CONCLUSION AND FUTURE SCOPE

Object Detection (OD) is the method of identifying and segmenting the objects from normal scenes. In addition, OD is the way of detection of the existence of the set of the classes in image from specific image. Object detection helps in the detection of the real environment like as persons, social animals. This approach is utilized as the retrieval of images, security, medicinal and protection system. It has become the main area of interest in computer vision. Various researchers has been used this in computer vision because it helped to examine the objects or regions that effectively demonstrate scene, a valuable stage in complicated vision issues like as scene understanding. In research method has developed K-means clustering algorithm to extract the regions. It has applied SURF algorithm used to extract the unique key point descriptors (KPD). This method has high accuracy rate and high speed. After that that features extraction, PSO (Particle Swarm Optimization) Algorithm to select the feature set with fitness function. This selection feature is saved in the .mat file. At the last, MSVM classification algorithm to classify the object and evaluate the performance metrics such as FAR, FRR, Accuracy Rate, PSNR and compared with the existing methods. In proposed model has achieved the accuracy rate up to 98.4 per cent and reduced the error rate.

In the future work, the hybridization two models will be implementing to detect the objects. It will increase the efficiency of the Object Detection System. HoG+SURF algorithm will extract the geometric, local and global feature points. It will increase the presentation of the ODS(object detection system).

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