Region based Object Recognition through Colour Segmentation using Simplified Pulse Coupled Neural Network (SPCNN)

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Abstract: *Today's world is developing rapidly in technology such as image segmentation, cyber security, artificial intelligence, machine learning, computer vision, etc. A region-based object recognition through colour segmentation using simplified pulse coupled neural network (SPCNN) is a technique used to recognize objects in cluttered environments as well as in complex real-world scenes. In this proposed method, observation model is proposed.*

Keywords: Object Recognition, Neural network, Automatic parameter setting, SPCNN, Clustering process

1. Introduction:

Region based object recognition through colour segmentation using SPCNN is widely used in cluttered environments, complex real-world scenes, low intensity images. In medical field, it can be used to recognize clots in complex parts of our body. A region- based colour segmentation has been performed using different techniques such as appearance-based method, feature-based method. But these methods have some drawbacks that are

1.they can deal with only grey images

2.can not identify less textured objects

These drawbacks were overcome by proposed method. This proposed method performs colour segmentation using SPCNN. It has feature to set parameter's value automatically. The entire process is depended on linking of neurons and extraction of features. This proposed method preserves temporal pulsing information and spatial distributions of objects or images. There is a drawback of this system is that it is unable to detect object with the same colour. Although it has some drawback it is best method of image recognition among all other methods.

1.1 Framework:

The main components of system are:

1.Image recognition

2.Colour transformation

3.SPCNN

4.Clustering Process

5.Object identification result

Object recognition considers algorithm based on global structure of object called as GRAS (Graph Region Arrow Sort) which is an n*n matrix. Object recognition performed an image or video frame.

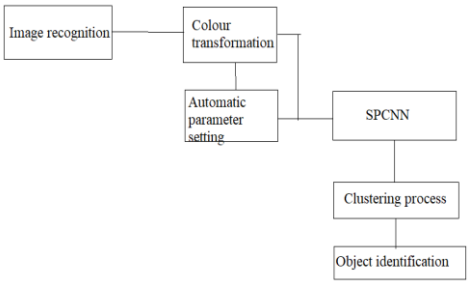

Figure1: Components of system

Colour transformation is used for stability in change and shift in light. In colour transformation RGB is transformed into normalized RGB. And then colour channels are formed. Then SPCNN process firstly performs firing process and with the help of colour channels, firing process and novel segmentation strategy several syn-firing areas are created. After this clustering process is performed. And in last object identification is performed by matching object model image and test image.

2. Object Recognition:

It is computer vision technique used for identifying objects in image or video frame.

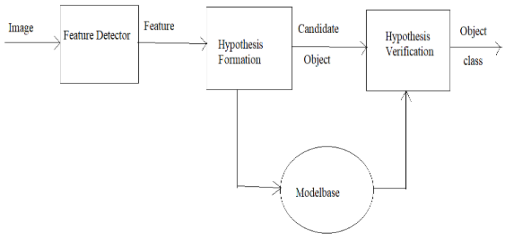

Figure 2: Basic block diagram of Object Recognition

The above diagram shows generalised structure of object recognition. The model-base contains all information known to the system. It depends on approach used for the recognition. When image is recognized, feature detector detects features like size, colour and shape. Then feature detector applies operators to image and identifies location of feature and hypothesis gets formed. In hypothesis verification, system verifies it with model-base. Nowadays object recognition is widely used in automation, driverless cars, industrial security. It is performed with the help of machine learning and deep learning most of the time. The only difference between them is ML is used for detection using different classifiers and Deep learning used for recognition uses artificial neural networks. Below tree diagram shows techniques for object recognition.

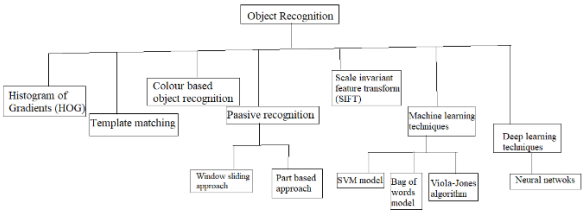

Figure 3: Techniques for recognition

While performing object recognition, feature extraction is done by extracting global and local features. As shown in above figure HOG is used with SVM model. Deep learning uses neural networks which are explained in section 3. SIFT is used first time while developing respected method on MATLAB. Template matching is performed with blob analysis.

Histogram of gradients: It extracts feature of given data by looking variation in intensity and then it gives result.

Template matching: In this method image is considered as template and then similar type of image is searched.

SVM model: It is supervised learning algorithm which makes analysis and classification of data.

Convolutional neural network (CNN): In this type, analysis is done according to connectivity between neurons and given data. There are 3 types of CNN listed below:

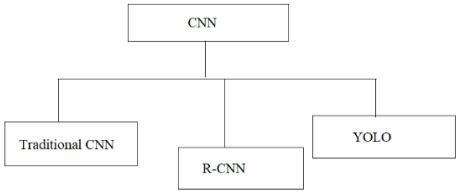

Figure 4: Types of CNN

3. Neural Network:

Neural network methods are used for image segmentation because of signal to noise independency and real time result. It is a simulation of a real nervous system. It consists of number of neurons that communicate with each other. There are two types- supervised and unsupervised neural network.

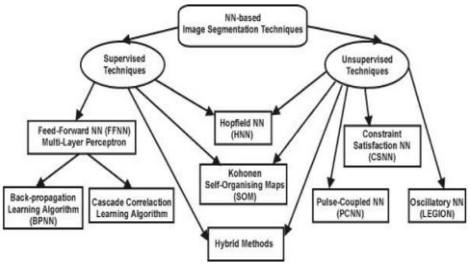

Figure 5: Classification of neural network

Pulse coupled neural network comes under unsupervised technique. It is used for image processing, analysis, including image segmentation. I t is single layered 2-D neural network. It is network of laterally connected pulse coupled neurons. The simplified pulse coupled neural network is modified model of PCNN.

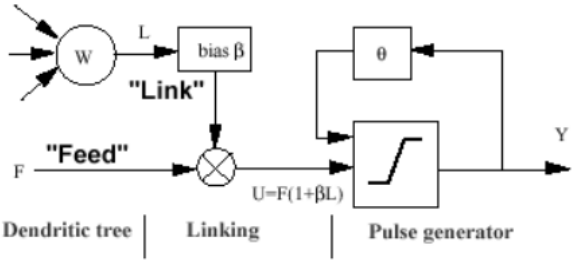

Figure 6: Structure of PCNN

3.1 SPCNN:

Simplified pulse coupled neural network is developed from Zhan SCM model. This process is used for colour segmentation. It has low computational complexity hence it is widely used system. In SPCNN, automatic parameter setting is main part which performs all mathematical functions.

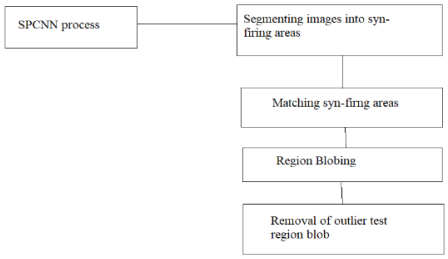

Figure 5: SPCNN process

Automatic parameter setting gives 5 fixed parameters which are used for segmentation of image. Image is going under colour transformation where RGB colour image transformed into normalized RGB colour image and then into opponent colour image which creates colour channels O1, O2, O3, O4 & O5. Then these channels are forwarded to SPCNN, in this firing process is applied on all channels, a novel segmentation strategy used to segment an image into several syn firing areas. These firing areas should include both object and background pixels. These areas are divided into small region blobs to get either object image or background image. Then region blobs with unacceptable size are removed.

3.2 Automatic parameter setting:

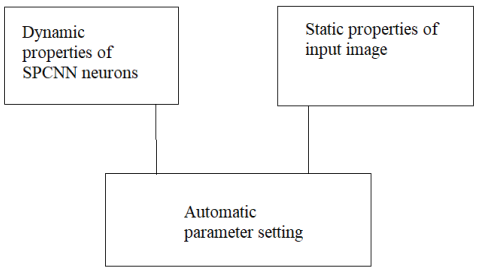

Figure 6: Generalized block diagram

This technique is developed to achieve lower computational complexity. Following are parameters used for SPCNN process:

$$\alpha_f = \ln(1/\sigma(I))$$

$$\beta = \frac{(S_{\max}/S') - 1}{6V_L}$$

$$V_L - 1$$

$$V_E = e^{-\alpha_f} + 1 + 6\beta V_L$$

$$\alpha_e = \ln\left(\frac{\frac{V_E}{S'}}{\frac{1-e^{-3\alpha_f}}{1-e^{-\alpha_f}} + 6\beta V_L e^{-\alpha_f}}\right)$$

4. Clustering Process:

Clustering is process identifying group of similar type of objects and gather into one multivariate dataset. There are different types of clustering used in artificial neural network are connectivity-based clustering, centroid-based (partitioning), distribution based, model based, fuzzy clustering and constraint based (supervised). Among all of these clustering algorithm k-means clustering and hierarchical clustering is widely used techniques.

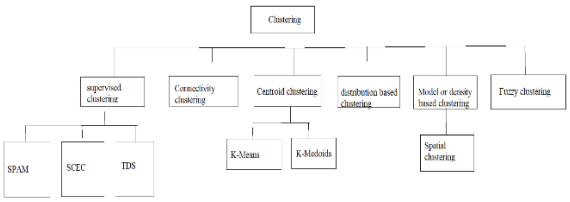

Figure 7: Algorithms of clustering

K-means algorithm: It is algorithm used in unsupervised learning. There is no need of labelling for data to make cluster.

Fuzzy based algorithm: It is similar to partitioning clustering methods. This algorithm gives freedom to every object to get specific cluster.

Density based clustering: It works according to density that is regions with high density are cluttered from low density regions.

K-medoids clustering: In this technique data point near to centre is selected and then clusters are formed.

Supervised Clustering: In this labelled data is required. So that training for data set is must before clustering.

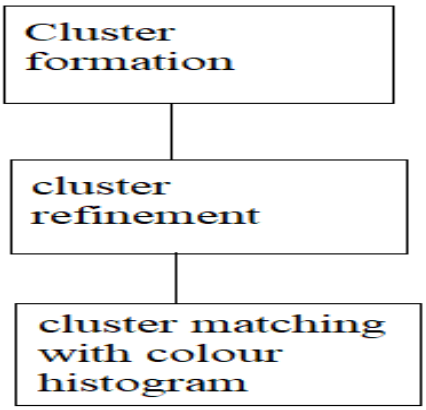

Figure 8: clustering process

In this proposed method, clusters are formed after removal of unacceptable region blobs. Cluster formation is done using two algorithms one is median algorithm and another is step by step modifying algorithm. In cluster refinement clusters with small or high than object image gets removed. Colour histograms are measured using Bhattacharya's distance, then the highest probability cluster as compared with colour histogram and with the object image. Then at last we get our desired output.

5. Conclusion:

RBOR-SPCNN process is a technique widely used to find objects in complex real-world scenes. This method can eliminate non-positive test images which doesn't contain any data regarding object image by setting Bhattacharya threshold. It overcomes the drawback of previously developed methods. This RBOR-SPCNN process has low computational complexity.

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