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OPTIMAL OBJECT IDENTIFICATION PROCESS IN STRUCTURED IMAGES USING NEURAL NETWORKS APPROACH

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Abstract:
The process of identifying the objects from a given set of structured images is an ambiguous one to implement due to its immense architecture of defining the image components and distinguishing it with the proper features. Neural networks play a vital role in the field of image processing through its dense approaches for handling the image components by its existing feature existence. Object extraction and interpretation are the basis for identifying the objects from the structured image. The process of learning interesting information from the images through iterated network training provides the expected results for optimal identification of objects from the structured images when compared with normal object extraction and interpretation approaches. The proposed methodology of this paper deals with the optimal object identification through neural networks based feature extraction, classification, and verification. In future this research article will be extended by implementing the Artificial Intelligence based soft computing approach towards the exact ideal matching in object identification with image processing approach.

Keywords: ***imageobject, image feature,object identification, neural networks,optimal identification***

I.INTRODUCTION

Feature extraction in neural networks contains the representations that are learned by the previous network to extract the interesting features from new samples [2, 3]. The features are then run through the new classifier which is already trained from scratch. Many types of features are used for object recognition [8]. Most features are based on either regions or boundaries in an image [6]. It is assumed that a region or a closed boundary corresponds to an entity that is either an object or a part of an object. Some of the commonly used features are as follows.

Global Features:
Global features usually are some characteristics of regions in images such as area (size), perimeter, Fourier descriptors, and moments obtained by considering all points, their locations, intensity characteristics, and spatial relations.

Local Features:
Local features are usually on the boundary of an object or represent a distinguishable small area of a region. Local features can contain a specific shape of a small boundary segment or a surface patch. Some commonly used local features are curvature, boundary segments, and corners.

Neural Networks:

Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning [1, 5].

Object identification:

Object recognition is the technique of identifying the object present in images and videos. It is one of the most important applications of machine learning and deep learning. The goal of this field is to teach machines to understand (recognize) the content of an image just like humans do [4].

Fig.1: Object detection from an image [10]

II.PROPOSED METHODOLOGY

The proposed methodology focuses on the optimal object identification from the image extracted components using neural networks based feature extraction, classification, and verification. The process of identifying the objects with proper training of feature extraction pooling with Euclidean distance classification and graph isomorphic verification is the underlying schema for this proposed methodology as in Fig.2.

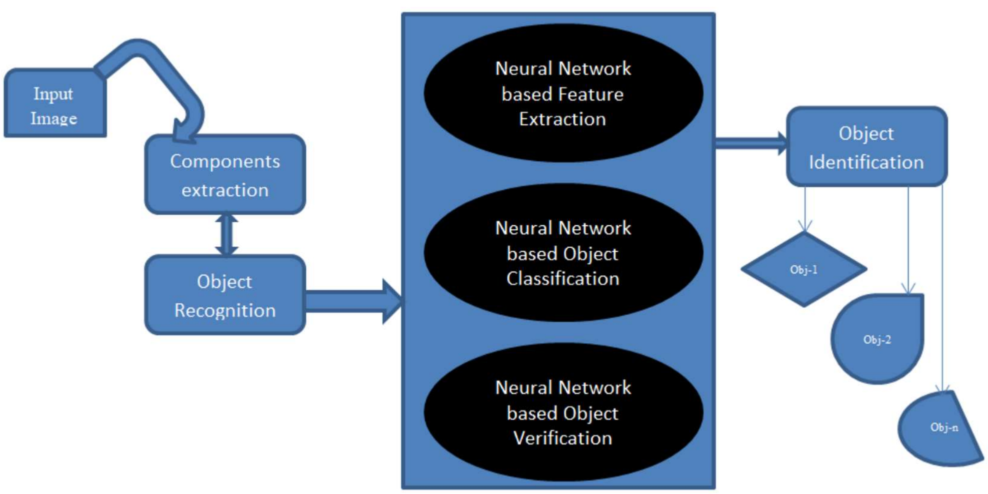

Fig.2: ProposedNeural based optimal image object identification methodology

The proposed methodology performs the object extraction and interpretation in the initial phase, followed by the neural network based feature extraction, classification, and verificationprocedures. The final phase focuses on the object identification with accuracy through proper object labels.

III.IMPLEMENTATION

a.The Neural network based feature extraction includes the following:

i. Convolution layer
ii. Max pooling layer
iii. Activation function such as sigmoid, tanh, and ReLU

i. Convolution layer

Multiple convolution filters or kernels that run over the image and compute a dot product. Each filter extracts different features from the image.

2	1	5	3	3
6	3	1	4	2
2	6	2	4	1
4	3	1	5	2
1	5	3	5	3

1	2	3
4	5	6
7	8	9

f1	f2	f3
f4	f5	f6
f7	f8	f9

5x5 Image X Filter = Feature

F1=2*1+1*2+5*3+6*4+3*5+1*6+2*7+6*8+2*9=144
F2=1*1+5*2+3*3+3*4+1*5+4*6+6*7+2*8+4*9=155
F3=5*1+3*2+3*3+1*4+4*5+2*6+2*7+4*8+1*9=111
F4=6*1+3*2+1*3+2*4+6*5+2*6+4*7+3*8+1*9=126
F5=3*1+1*2+4*3+6*4+2*5+4*6+3*7+1*8+5*9=149
F6=1*1+4*2+2*3+2*4+4*5+1*6+1*7+5*8+2*9=114
F7=2*1+6*2+2*3+4*4+3*5+1*6+1*7+5*8+3*9=131
F8=6*1+2*2+4*3+3*4+1*5+5*6+5*7+3*8+5*9=173
F9=2*1+4*2+1*3+1*4+5*5+2*6+3*7+5*8+3*9=142

The final feature extraction result is

144	155	111
126	149	114
131	173	142

ii. Max pooling layer

The reduced size of convolution feature is max pooling feature. It is similar to the convolution layer but instead of taking a dot product between the input and the kernel we take the max of the region from the input overlapped by the kernel.

144	155	111
126	149	114
131	173	142

Convolution Feature = Reduced

f1	f2
f3	f4

Max pooling Feature

F1=Max (144,155,126,149) =155

F2=Max (155,111,149,114) =155

F3=Max (126,149,131,173) =173

F4=Max (149,114,173,142) =173

The final max pooling feature values are,

155	155
173	173

iii. Activation function such as sigmoid, tanh, and ReLU

Activation functions introduce non-linearity to the model which allows it to learn complex functional mappings between the inputs and response variables. Sigmoid and tanh are nonlinear complex functions whereas RelU (Rectified Linear Unit) Activation Function is a linear function RelU function is a piecewise linear function that outputs the input directly if is positive i.e. > 0, otherwise, it will output zero.

ReLU(x) =max (0, x)

b. Neural Network based classification

The basic idea in classification is to recognize objects based on features.

Nearest Neighbor Classifiers

To decide the class of the object, we measure its similarity with each class by computing its distance from the points representing each class in the feature space and assign it to the nearest class. The distance may be either Euclidean or any weighted combination of features. In general, we compute the distance dj of the unknown object from class j as given by

$$\text{Dist}(i) = \{\sum_{j=1}^{N} (\text{Unknown}(j)-\text{Feature}(i)(j))^{2}\}^{1/2}$$

The unknown object will be assigned to the nearest known class with Min (Dist (i))

c. Neural Network Based Verification:

Feature indexing approaches use features of objects to structure the model base. When a feature from the indexing set is detected in an image, this feature is used to reduce the search space. More than one feature from the indexing set may be detected and used to reduce the search space and in turn reduce the total time spent on object recognition. The verification can be done in optimal way by using the graph isomorphism approach.

1. Graph Isomorphism:

Given two graphs (VI, E1) and (V2, E2), find a 1:1 and onto mapping (an isomorphism) f between VI and V2 such that for u1,u2 Ɛ VI, V2 , f(u1) = u2 and for each edge of El connecting any pair of nodes u1 and u1' Ɛ VI, there is an edge of E2 connecting f(u1) and f(u1'). For feature verification complexities using graph isomorphism approach the alternate analog methodology is used.

The sample java code for graph isomorphism checking:

```
graph1.addNode (a1);
graph1.addNode (b1);
graph1.addNode (c1);
graph1.addNode (d1);
graph1.addNode (e1);
graph1.addNode (f1);
graph1.addNode (g1);
graph1.addNode (h1);

a1.addChild (b1);
b1.addChild (c1);
b1.addChild (d1);
c1.addChild (e1);
d1.addChild (f1);
d1.addChild (e1);
e1.addChild (g1);
f1.addChild (g1);
g1.addChild (h1);

graph2.addNode (h2);
graph2.addNode (b2);
graph2.addNode (c2);
graph2.addNode (d2);
graph2.addNode (e2);
graph2.addNode (f2);
```

```
graph2.addNode (g2);
graph2.addNode (a2);

h2.addChild (b2);
b2.addChild (c2);
b2.addChild (d2);
c2.addChild (e2);
d2.addChild (f2);
d2.addChild (e2);
e2.addChild (g2);
f2.addChild (g2);
g2.addChild (a2);

    Map<DirectedGraphNode, DirectedGraphNode> isomorphism =
checker.getIsomorphism (graph1, graph2);
AssertNotNull (isomorphism);
Assert True (Utils.isIsomorphism (isomorphism));
```

2. Analog approach:

A measure of similarity between two curves can be obtained by comparing them on the same frame of reference and directly measuring the difference between them at every point.

The image feature extraction collection contains the existing possibilities of image objects to be connected with the proper implementation of neural networks based approaches. The accuracy in the optimal object identification is entirely supported by the efficient neural feature extraction along with the classification and verification. The proposed methodology provides 95.9% accuracy in the object identification from the given set of images. The existing approach for object identification using Edge detection method produces 39% of valid results only whereas the proposed methodology provides 58% more efficiency in the object detection approach in the field of image processing.

IV. RESULTS AND DISCUSSION

The proposed methodology implementation towards the sample images taken from various image resources is as follows in Table-1,

Table-1: Proposed methodology implementation results for image object detection

Image Resource Type of each 50	No of Objects Detected	No of objects Identified by proposed optimal method	Success rate %
Mobile images	364	360	98.90
DigiCam images	241	235	97.51
Web images	471	452	95.97

Scanned images	96	90	93.75
Stored/Shared images	286	262	91.60
Total	1458	1399	95.94

The following Fig.6 shows the graphical representation were obtained after the implementation of the proposed optimalmethodology implementation results for image object identificationas in table-1 asfollows

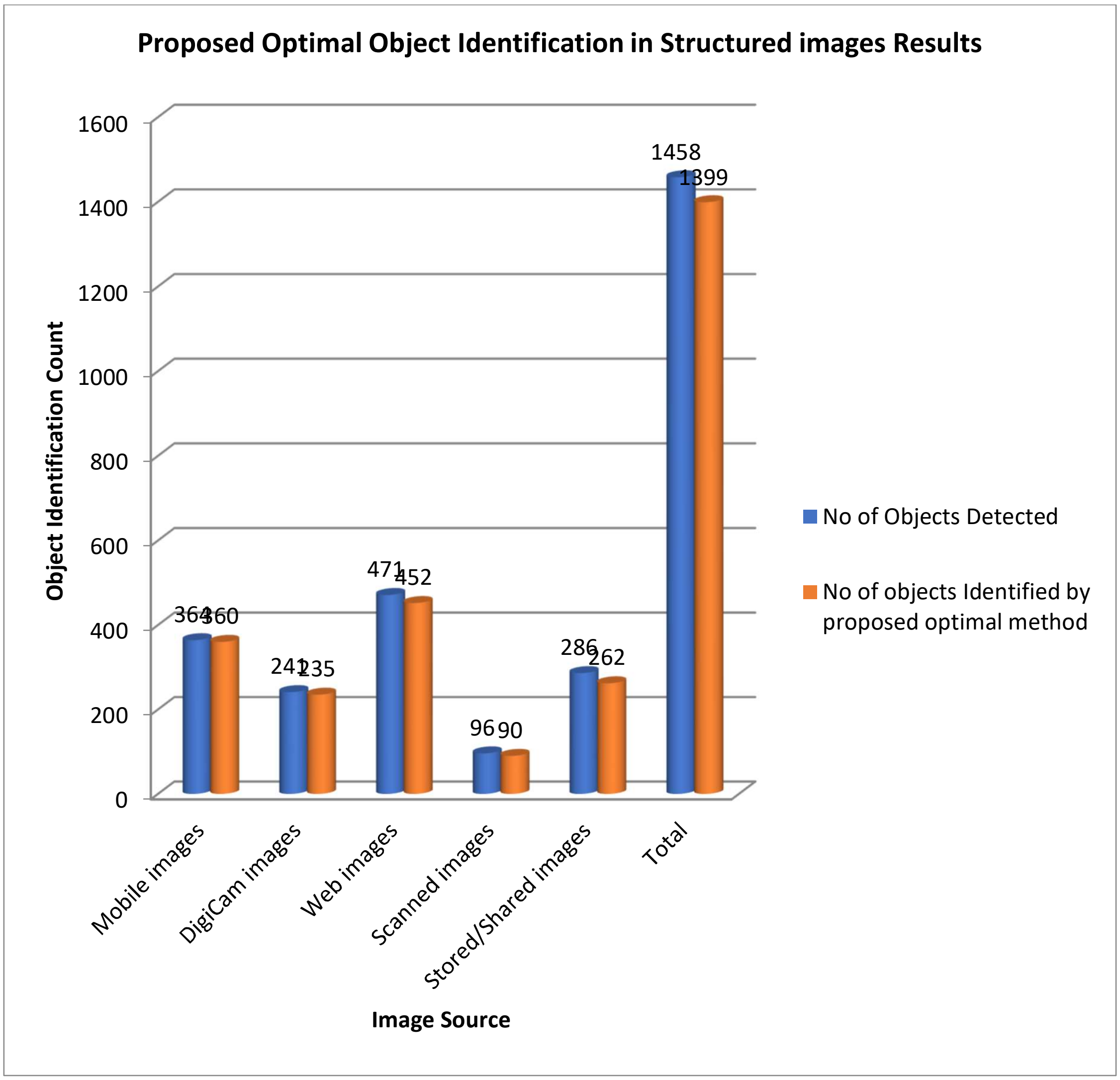

Fig.6:Proposed methodology implementation results for image object detection

The proposed methodology provides 1399 out of 1458 in efficient object identification which resembles the 95.9% gain as efficiency in the performance rating for the proposed methodology.

V.CONCLUSION

The initial phase of the proposed methodology focuses on the objects extraction and recognition from the images. The middle phase concentrates on the neural network based feature extraction using the convolution layer, max pooling layer and the activation function followed by the neural networks based classification through Euclidean distance approach and the final work concentrates on the neural network based verification through graph isomorphism approach. The process of feature extraction strengthens the object identification in structured images when compared with the existing edge detection techniques since the proposed methodology produces 95.9% success whereas the edge detection approach produces only 39% success. Moreover the neural networks based feature extraction, classification and verification approach is better when compared with the normal neural mapping strategy for object identification since it produces only 87% success which is less then he proposed methodology success by 8%.In near future we will implement the artificial intelligence based object detection and identification system for the best maximum success efficiency.

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