Hybrid Proposed Model for Automatic License Plate Recognition and Distinction (ALPRD)

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Abstract:

This paper provides the overview of proposed Hybrid Model to construct a method to distinction between all types of cars plate's numbers. Plate's distinction system (PDS) for public, private and governmental cars plates' numbers identification and verification by using neural networks and genetic algorithm (NNGA) is proposed. This proposed algorithm demonstrated its efficiency and accuracy through the satisfactory results. It was proved a higher performance of the results. The model consists of three phases. The first phase applied the pre-processing over the plate number images. The second phase is extract the features of inputted plate, which will be passes as nodes of neural network .The third phase is pass the result of neural network to the genetic algorithm and then classify the output of cars plates numbers as private or public and governmental plates .

طريقة هجينة آلية لتشخيص وتمييز ارقام السيارات

المستخلص

تقدم هذه الورقة طريقة مقترحة هجينة تلقائية لبناء وسلة لتمييز بين جميع ارقام السيارات. هذا النظام هو نظام عام بإمكانه التمييز بين ارقام السيارات العمومية والخصوصية وذلك باستخدام الشبكات العصبية والخوارزميات الجينية. اثبتت هذه الخوارزمية ومن خلال النتائج المرضية قوتها وكفاءتها . تكون هذه الطريقة المقترحة من ثلاث مراحل اساسية: المرحلة الاولى هي مرحلة المعالجة الاولية لصور ارقام السيارات المدخلة الى النظام. المرحلة الثانية هي مرحلة استخلاص ملامح الصورة المدخلة (ملامح الارقام والاحرف وغيرها) والتي يتم تمريرها الى عقد الشبكة العصبية الموجودة في النظام . اما المرحلة الثالثة فتشمل تمرير مخرجات الشبكة العصبية بعد ان تم تدريبها ال الخوارزمية الجينية كمدخلات لها. وفي النهاية يتم تصنيف مخرجات ارقام السيارات وتمييزها على انها لوحات خاصة او عامة اعتماداً على مكونات اللوحة المدخلة.

الكلمات المفتاحية: الشبكات العصبية ، الخوارزميات الجينية، ميزة الاستخراج، الخوارزمية الجينية العصبية .

Keywords— Artificial Neural Networks, Feature Extraction, Genetic Algorithm, NNGA

1. INTRODUCTION

Today's, people depend on machines especially computer in their daily lives. Where computer play important role to resolve most of big problems.

With increasing of digital technology, the digital computer became century leader, as well as digital technology and it was open new horizons for humanity to enter a new world known as the technological world. Computer vision is one of the basic ingredients of the life and the main objective of the computer vision is matching, recognition subjects in human life. [1]

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The idea of matching license plate numbers coming through many incidents that happen daily, especially with regard to security and safety of citizens.

During the past years has been proposed several methods to get to know things during matching parts. hybrid algorithm has been developed to recognize things .It is easy and quickly model if it was compared with other models due to it is depend on neural networks that are faster in signals transfer and weights adjustment if any error happened. GA is looking for best chromosome from initial population coming from output of neural networks As well as genetic algorithms that deal with variables that are considered essential input of neural networks. [2],[3]

2. NEURAL NETWORKS

The neural network is an information-processing system based on how the human brain processes information. The neural network is composed of processing elements and their connections. Each processing element has a single output signal that fans out along the connections to other processing elements. The output

signals of the processing element are delivered to the processing element in the next layer. The neural network depends on the neural interconnection architecture, and on the activation function that transforms input and output signals in the neural network. The most common type of neural networks consists of input layer, hidden layer and output layer. [4]

Learning is a major process of the neural network, where the learning process can modify the connecting weights. Two types of learning are commonly used: supervised learning and unsupervised learning. [5], [6]

3. GENETIC ALGORITHMS

Genetic algorithms have been used in conjunction with neural networks in three major ways:

First, they have been used to set the weights in fixed architectures. This includes both supervised learning applications and reinforcement learning applications. In related work, genetic algorithms has been used to set the learning rates which in turn are used by other types of learning algorithms. Genetic algorithms have also been combined with more traditional forms of gradient based search. [7]

Second, genetic algorithms have been used to learn neural network topologies. When evolving neural networks topologies for function approximation, this includes the problem of specifying how many hidden units a neural network should have and how the nodes are connected.

A third major application is the use of genetic algorithms to select training data and to interpret the output behavior of neural networks.

A genetic algorithm emulates biological evolution to solve optimization problems. It is formed by a set of individual elements (the population) and a set of biological inspired operators that can change these individuals. According to evolutionary theory only the individuals that are the more suited in the population are likely to survive and to generate off springs, thus transmitting their biological heredity to new generations. [8],[9]

4. SYSTEM OVERWIEW

Plates distinction system (PDS) can be classified into two categories: (1) The first part is Image Processing (IP) of all inputted cars plates numbers: consists of plate numbers image acquisition from portable digital camera through scanning, perform many operations of image, detect edges by using Canny Edge Detection

Filter (CEDF).[1],[5] CEDF is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. Gaussian Convolution Filter (GCF) or (3x3) averaging mask are used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image) [12]. It is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise .Finally Feature are extraction of image to become input variables to the neural network [5]. The operation of GCF looks for edges in both horizontal and vertical directions, then combine the information into a single metric. (2) The second part is Matching Techniques (MT) i.e: recognition: consists of the main idea of this papers. Fig (1) .[10],[11]

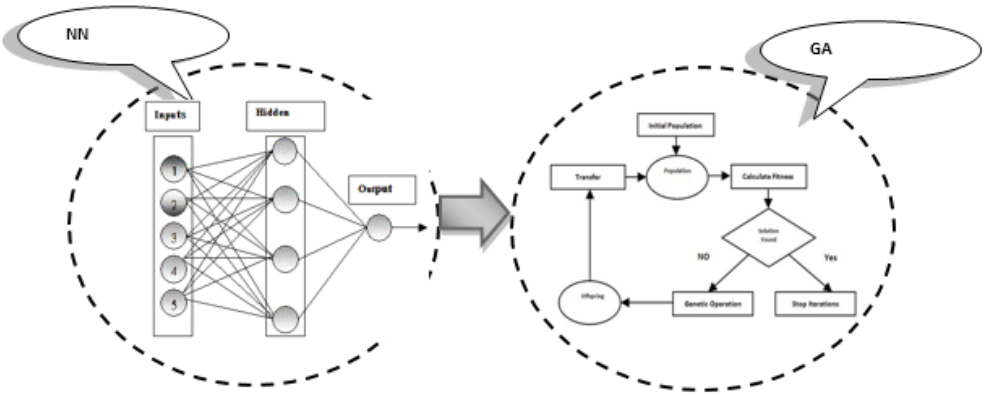

Figure (1) General form of NNGA

The first part of PDS consists of many image processing techniques. Firstly, plate numbers image acquisition is achieved by digital web camera or portable digital camera or fixed digital camera or using scanner. Then apply image clipping by using Cohen – Sutherland Detection Algorithm (CSDA) for front plates cars plates numbers and Polygon Clipping Detection Algorithm (PCDT) for side cars plates numbers. Then the edges of numbers and characters are detected by using Canny Edge Detection Filter (CEDF). At these case, any camera (portable, fixed, web or scanner) can perform main three operations: zone view, regional view and fast check to hunt numbers plates of any car traffic violation. Below, a brief description of proposed model algorithm: Fig. (4) [13],[14],[15]:

1- Start

2- A series of image acquisition by (portable , fixed , web camera or scanner) ,these images are saved into various formats (Bitmap, JPEG, GIF and TIFF).

3- For pre-processing task we use:

a. Smooth filter to simple noise elimination by using Gaussian Convolution Filter(GCF) or 3x3 averaging mask. Fig. (2)

b. Threshold image to get binary image.

c. Apply Canny detection filter (CDF) to detect edges of cars plate numbers(CPN) .Fig. (3)

4- Clip Image/Images by using The Cohen Algorithm(front plates cars plates numbers and Polygon clipping algorithm (side cars plates numbers) .

5- Perform edge detection by using Canny Edge Detection Filter(CEDF)

6. Convert the images series to binary code by code converter .

public:

Image Converter( )

BW = im2bw(I, level)

BW = im2bw(X, map, level)

BW = im2bw(RGB, level)

7. Put the iterations of images continuously as input of Neural Network.

8. Adjusted weights of all Processing Elements (PS) if any ERROR.

9. The output of Neural Network became input of Genetic Algorithm

10. Perform GA Operations:

a. Reproduction: The act of making a copy of a potential solution:

b. Crossover: The act of swapping gene values between two potential solutions, simulating the "mating" of the two solutions.

c. Mutation: The act of randomly altering the value of a gene in a potential solution.

11. End.

Figure (2) Noise removal by GCF Filter

Figure (3) Edge detection using Canny Filter

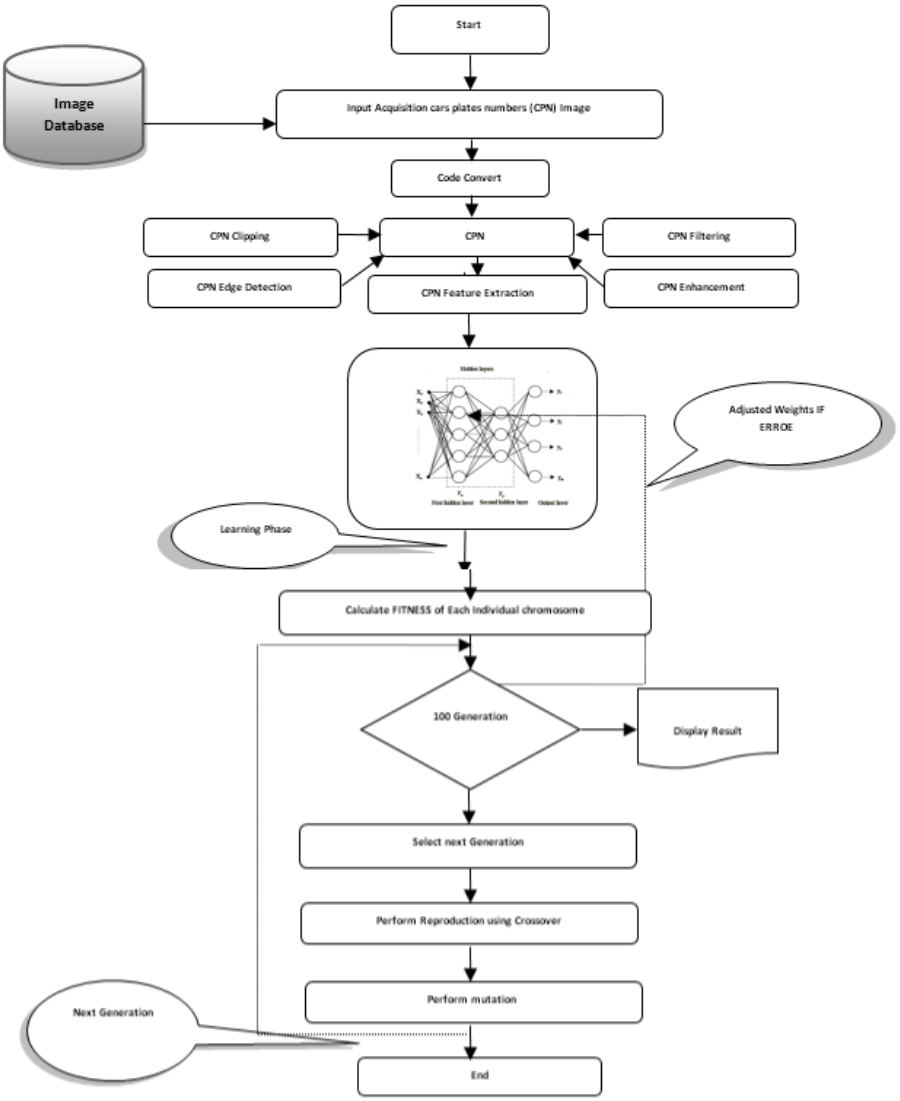

Figure (4) Architecture of Plates distinction system (PDS) using NNGA

5. PDS DEVELOPMENT

To work system properly, the images must be process with several phases, starting with image acquisition portable, fixed, web camera and scanner in order to conduct the matching process after obtaining feature extraction. [16]

After scanning, the image can be saved into various formats such. This PDS can process car plate's numbers images of any format. If inputting image contain any noise, this noise must be eliminate by using sobel filtering technique. The focus is on car numbers, the clipping here are used to obtain the necessary required data and erase others. Here, the Cohen Algorithm (for front plates cars

plates numbers and Polygon clipping algorithm (for side cars plates numbers) are used [12],[17]. fig(5) (a),(b),(c)

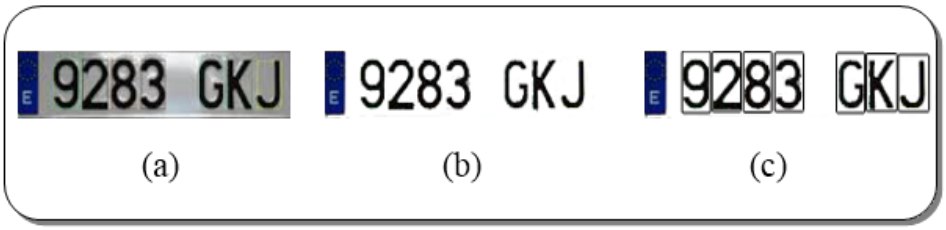

Fig.5 (a) Original Car Plate Number (CPN) (b) CPN after Noise Removal (c) CPN Clipping

After features are extracted, edge detection step is coming. Many steps are achieved in Edge Detection: (1) *Filtering*: Filter image to improve performance of the Edge Detector of noise. (2) *Enhancement* – Emphasize pixels having significant change in local intensity. (3) *Detection* – Identify edges – thresholding. (4) *Localization* – Locate the edge accurately, estimate edge orientation. In this papers, several masks are used to compare the different results such that gradient methods (Roberts Operator). The Roberts operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. It thus highlights regions of high spatial gradient which often correspond to edges. In its most common usage . Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point.[10],[11],[19]

6. SCALING OF PDS IMAGES

Many methods are used to scaling PDS images and the expanding method (shrink) is one of them.

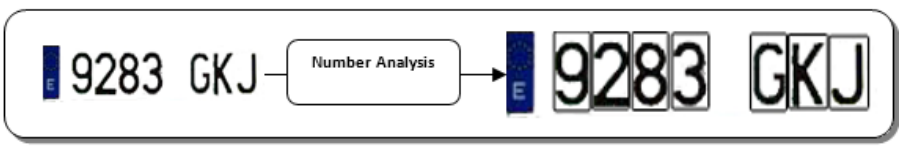

Fig.6. PDS Image Scaling after analysis (40×40)

7. PDS IMAGES FEATURES EXTRACTION (PDSIFE)

To implement PDSIFE at first, the image is converted into a binary. From this binary image the center (X, Y) of the PDS image is calculated using the below equations:

$$X=\frac{\sum mx}{\sum m} \ldots\ldots\ldots (1)$$

$$Y=\frac{\sum my}{\sum m} \ldots\ldots\ldots (2)$$

Where x, y is the co-ordinate values and m=f(x, y) =0 or 1.

Note that only numbers in the plate has been clipped and converted into the gray level and collect features. [18],[20]

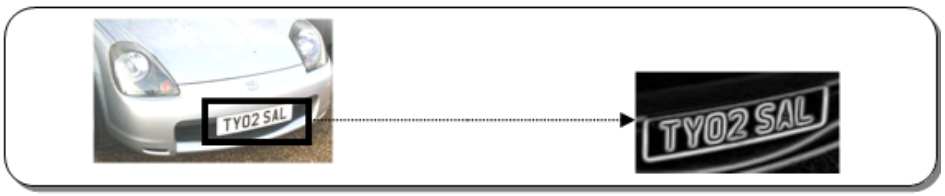

Fig. 7. Feature Extraction of Car Plates Numbers

Fig.8 Practical Example illustrates the form of the output of the system applied

8. BASIC EXPERIMENTAL RESULT

Table (1) Experimental result by ANN and GA individually

License Car Plate Images	Matching by ANN	Matching by GA	accuracy and Efficiency	Error Rate (ER)
7	4	3	70%	1
15	10	11	81%	2
19	15	16	87%	7
24	20	20	85%	5

Table (2) Experimental result by Hybrid System

License Car Plate Images	Matching by Hybrid System	accuracy and Efficiency	Error Rate (ER)
7	5	80%	1
15	13	83%	1
19	16	86%	4
24	22	94%	3

9. CONCLUSION

The accuracy and efficiency of this system can be increased by using high resolution of fixed or removable digital camera or by using high density of scanner due to edge detection and features extraction for smallest detail of license plate.[4]

During training of CPN sample, we not that the error rate of hybrid system is less than error rate of individually artificial Neural Network training .So, the error rate of individually genetic algorithm training is more than error rate of hybrid system .If we compare the obtained result from individually artificial Neural Network and genetic algorithm training, we not that the efficiency and flexibility of the proposed system is pleasurable and acceptable.

10. Recommendations and Future Work

This system can be developed when using Hough Transform developed algorithm to classify fake and real vehicle license plate and discover the details of vehicle license plates in the dark areas or difficult weather conditions or diagnose vehicle plates affected.

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