Applications of Artificial Neural Network in Image Processing: A Survey

Poorva Arya, Dr. Uma Shankar Modani

Abstract— Image processing using artificial neuronal networks (ANN) has been successfully used in various fields of activity such as in quality control, sign language recognition, human computer interaction, transport, remote sensing, civil engineering and many more others. Image processing is not a single step process, it contains multiple processes in it those are image pre processing, segmentation, image recognition, image classification.ANN can be applied at various such processes of image processing. This paper presents Artificial Neural Networks (ANNs) as a means of image processing. ANN is a powerful technology used in image processing to solve many real-world problems. The primary purpose of this paper is to put light on various work in this area to solve various real world issues which will hopefully motivate other researchers in to utilize this technology in resolving the problems in various such fields.

Index Terms— Artificial neural network, Classification, Feature extraction,image processing,Gesture recognition,Segmentation,Pre-processing.

1 INTRODUCTION

Processing of images with ANN involves different processes such as Image preprocessing an operation which shows a picture (contrast) enhancement, noise reduction with the same dimensions as the original image, Data reduction or feature extraction involves extracting a number of features smaller than the number of pixels in the input window, segmentation, recognition and classification.

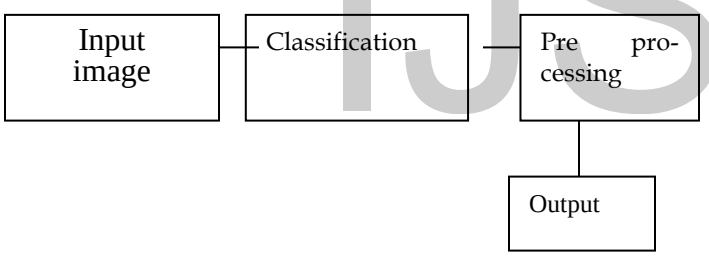

Fig.1. Steps for image processing

2 OVERVIEW OF ANN

Neural network system is an extremely ground-breaking and hearty grouping strategy which can be utilized for foreseeing for the known information, yet in addition for the obscure information. It functions admirably for both direct and nonlinear detachable dataset. NN has been utilized in numerous territories, for example, translating visual scenes, discourse acknowledgment, face acknowledgment, unique mark acknowledgment, iris acknowledgment and so forth. An ANN is made out of a system of fake neurons otherwise called "nodes ". These hubs are associated with one another, and the quality of their associations with each other is appointed an esteem dependent on their quality restraint or excitation .On the off chance that the estimation of the association is high, at that point it shows that there is a solid association.

2.1 Definition

An artificial neuron network (ANN) is a computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output.

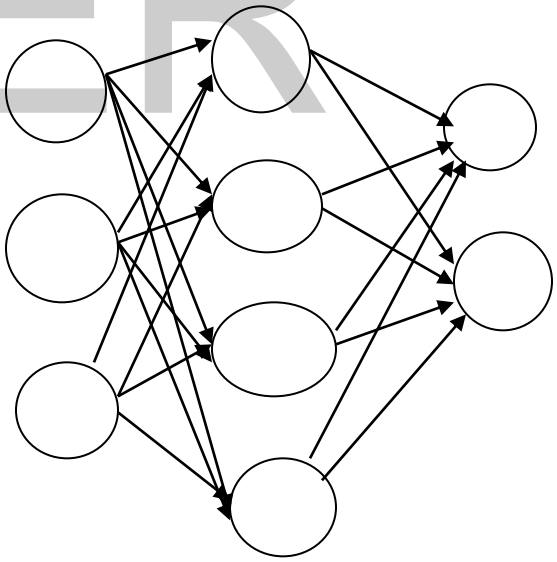

Fig. 2 Neural network

ANNs are considered nonlinear statistical data modeling tools where the complex relationships between inputs and outputs are modeled or patterns are found.ANN is also known as a neural network. An ANN has several advantages but one of the most recognized of these is the fact that it can actually learn from observing data sets. In this way, ANN is used as a

International Journal of Scientific & Engineering Research, Volume 10, Issue 9, September-2019
ISSN 2229-5518

random function approximation tool. These types of tools help estimate the most cost-effective and ideal methods for arriving at solutions while defining computing functions or distributions. ANN takes data samples rather than entire data sets to arrive at solutions, which saves both time and money. ANNs are considered fairly simple mathematical models to enhance existing data analysis technologies.

2.2 Structure

ANNs have three layers that are interconnected as shown in fig. 2.. The first layer consists of input neurons. Those neurons send data on to the second layer, which in turn sends the output neurons to the third layer. Training an artificial neural network involves choosing from allowed models for which there are several associated algorithms.

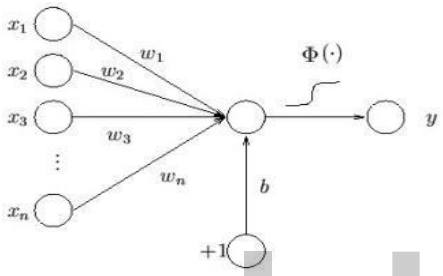

Fig. 3 Operational structure of neural network

2.3 Operation

ANN operational structure is as shown in Fig. 3 and its functional equation is as shown in equation 1.

$$y = \phi \sum_{i=1}^{i=n} (\mathrm{wixi} + \mathrm{b}) \qquad (1)$$

where y is the output signal, φ is the activation function, n is the number of connections to the perceptron, w_i is the weight associated with the ith connection and x_i is the value of the the ith connection. b represents the threshold.

3 APPLICATIONS OF ARTIFICIALNEURAL NETWORKS IN IMAGE PROCESSING

3.1 In quality control

Mostly subjective assessment techniques are used for infrastructure assessment quality inspection. Such subjective assessment techniques can be a critical obstacle for effective quality control. L.M. Chang and Y.A. Abdelrazig [1] proposed a more objective and reliable assessment method to improve the conditions of the infrastructures or the quality of constructed facilities. The proposed system will automate the coating assessment process by using computers to analyze digital images of the areas to be assessed. This image processing system uses the advanced technologies in the fields of machine learning, pattern recognition, and image analysis for steel bridges coating assessment.

Quality is one of the important factors in marketing of agricultural products also. Kadir and Cevat [2] aimed to classify the olives first according to their colour and then according to their sizes by image processing techniques and artificial neural network. The system was trained with pictures of large and small olives to classify olives according to their sizes by using multi layer neural network.

3.2 In human computer interaction

Cemil Oz, Ming C. Leu [3] proposed a Human-Computer Interaction (HCI) system that has been developed with an Artificial Neural Network (ANN) using a motion tracker and a data glove. The HCI system is able to recognize American Sign Language letter and number gestures. The finger joint angle data obtained from the strain gauges in the sensory glove define the hand shape while the data from the motion tracker describe the hand position and orientation. The data flow from the sensory glove is controlled by a software trigger using the data from the motion tracker during signing. Then, the glove data is processed by a recognition neural network.

Hand gesture recognition is used enormously in the recent years for Human Computer Interaction (HCI).Its an efficient way of interacting with machines make it more popular and applicable for many purposes. Gaurav manik Bidgar,Mangesh balasaheb autade [4] proposed a system that consists of four modules: Hand tracking and segmentation, feature extration, neural training, and testing. The objective of this system to explore the utility of a neural network based approach to the recognition of the hand gestures that create a system that will easily identify the gesture and use them for device control and convey information instead of normal inputs devices such as mouse and keyboard.

3.3 In transport

Traffic safety is an important problem for autonomous vehicles. The development of Traffic Sign Recognition (TSR) dedicated to reducing the number of fatalities and the severity of road accidents is an important and an active research area.Sabrine hamdi,chokri souani, Hassene Faiedh,kamal besbes [5]proposes a real-time algorithm for shape classification of traffic signs and their recognition to provide a driver alert system. The proposed algorithm is mainly composed of two phases: shape classification and content classification. This algorithm takes as input a list of Bounding Boxes generated in a previous work, and will classify them. The traffic sign's shape is classified by an artificial neural network (ANN). Traffic signs are classified according to their shape characteristics, as triangular, squared and circular shapes. Combining color and shape information, traffic signs are classified into one of the following classes: danger, information, obligation or pro-

International Journal of Scientific & Engineering Research, Volume 10, Issue 9, September-2019
ISSN 2229-5518

hibition. The classified circular and triangular shapes are passed on to the second ANN in the third phase. These identify the pictogram of the road sign. The output of the second artificial neural network allows the full classification of the road sign. The algorithm proposed is evaluated on a dataset of road signs of a Tunisian database sign.

Xiaolei ma , Zhuang dai , Zhengbing he, Jihui ma,Yong wang and Yunpeng wang [6] proposes a convolution neural network (CNN)-based method that learns traffic as images and predicts large-scale, network-wide traffic speed with a high accuracy. Spatiotemporal traffic dynamics are converted to images describing the time and space relations of traffic flow via a two-dimensional time-space matrix. A CNN is applied to the image following two consecutive steps: abstract traffic feature extraction and network-wide traffic speed prediction. The effectiveness of the proposed method is evaluated by taking two real-world transportation networks, the second ring road and north-east transportation network in Beijing, as examples, and comparing the method with four prevailing algorithms, namely, ordinary least squares, k-nearest neighbors, artificial neural network, and random forest, and three deep learning architectures, namely, stacked auto encoder, recurrent neural network, and long-short-term memory network. The results show that the proposed method outperforms other algorithms by an average accuracy improvement of 42.91% within an acceptable execution time. The CNN can train the model in a reasonable time and, thus, is suitable for large-scale transportation networks.

3.4 In Remote sensing

Data from Remote Sensing Satellites are used for various applications of resources survey and management. For collection and analysis of remotely sensed data, Artificial Neural Network (ANN) have become a popular tool.

Hui Yuan , Cynthia F. Van Der Wiele and Siamak Khorram [7] focused on an automated ANN classification system consisting of two modules an unsupervised Kohonen's Self-Organizing Mapping (SOM) neural network module, and a supervised Multilayer Perceptron (MLP) neural network module using the Back propagation (BP) training algorithm. Two training algorithms were provided for the SOM network module: the standard SOM, and a refined SOM learning algorithm which incorporated Simulated Annealing (SA). The ability of our automated ANN system to perform Land-Use/Land-Cover (LU/LC) classifications of a Landsat Thematic Mapper (TM) image was tested using a supervised MLP network, an unsupervised SOM network, and a combination of SOM with SA network. Our case study demonstrated that the supervised MLP network obtained the most accurate classification accuracy as compared to the two unsupervised SOM networks. It is concluded that our automated ANN classification system can be utilized for LU/LC applications and will be particularly useful when traditional statistical classification methods are not suitable due to a statistically abnormal distribution of the input data.

Although many neural network based Methods has been developed for image classification but some issues still remain to be fixed .Classification' is one of the most common digital technique used as information extraction method from remotely sensed data. In pattern recognition two techniques are used which are supervised classification & unsupervised classification. Supervised Classification is done using Supervised Learning technique according to which the networks know the target and changes accordingly to get the required output corresponding to the input sample data. Already a lot of work has been done in the field of supervised classification. Priyanka Sharma, Urvashi Mutreja [8] proposed a method to examine remotely sensed data analysis with neural network and unsupervised classification method of ANN for classification of satellite images.

3.5 In sign language recognition

Sign Language Recognition (SLR) is the most structured field in gesture recognition applications, such that each gesture has assigned a well-defined meaning. SLR can be defined as a translation system, which translates the signs, performed by deaf and dumb people to the natural language. The main purpose of sign language is to make communication easy between deaf and dumb people and other world. Corneliu lungociu [9] proposed a system that is supervised for recognizing one component of the sign language communication finger spelling in English. For the supervised learning scenario, an artificial neural network he used.

Lorena P. vargas1 , Leiner barba, C O torres and L mattos[10] proposed an image pattern recognition system using neural network for the identification of sign language to deaf people. The system has several stored image that show the specific symbol in this kind of language, which is employed to teach a multilayer neural network using a back propagation algorithm. Initially, the images are processed to adapt them and to improve the performance of discriminating of the network, including in this process of filtering, reduction and elimination noise algorithms as well as edge detection. The system is evaluated using the signs without including movement in their representation.

Magdy mohamed aboul-ela, Ahmed samir [11] proposed system aims to recognize Arabic sign language (ASL) and converts it to the natural Arabic language. Artificial neural network (ANN) is a very powerful tool for pattern recognition applications. The ANN model is a multistage classifier that guarantees the ability generalization. In this they proposed a model on using the graph matching problem and algorithm as suggested solution for connected gestures classification, which is a part of Arabic sign language recognition (ASLR) System, which applied the multi-stage hybrid neural network model for posture recognition.

3.6 In civil engineering

Now a days , ANN is a popular approach to solving difficult and time-consuming civil engineering problems. ANNs have been developed to perform many different problems in areas

International Journal of Scientific & Engineering Research, Volume 10, Issue 9, September-2019
ISSN 2229-5518

in structural engineering. Here we are presenting few number of studies on the use of ANN in IPT in solving or identifying civil engineering problems.

IPT and ANN have been used together by G. Dogan , M.H. Arslan , M. Ceylan[12] to determine the compressive strength of concrete, a complex material whose mechanical features are difficult to predict. Sixty cube-shaped specimens were manufactured, and images of specific features of the specimens were taken before they were tested to determine their compressive strengths. An ANN model was constituted as a result of the process of digitizing the images.

Alexandrina Elena pandelea,Mihai budescu, Gabriela covatariu and Rares George taran [13] proposes a manner to verify the concrete samples homogeneity using artificial neural networks. The training of the neural network was realise by using backpropagation algorithm and then, in order to separate the regions of interest was used Levenberg – Marquardt algorithm.

Detection of defects including cracks and spalls on wall surface in high-rise buildings is a crucial task of buildings' maintenance. Hoang ND [14] proposed a method that combines the image processing and machine learning algorithms which achieve a good classification performance with a classification accuracy rate 85.33%. A data set consisting of 500 image samples has been collected to train and test the machine learning based classifiers. This newly developed method can be a promising alternative to assist maintenance agencies in periodic building surveys.

4. Conclusion

We have gone through various researchers work which are showing applications of artificial neural network in image processing in various fields like quality control,human computer interaction,transport,remote sensing,sign language recognition,civil engineering.

REFERENCES

1. L.M.chang and Y.A. abdelrazig,"Using images and pattern recognition and neural network for coating quality assessment",digital library of construction informatics and information technology in civil engineering and construction , pg. no.1999-2429.

2. Kadir sabnci , cevat aydin, " using image processing and artificial neural network s to determine classification parameters of olives", Journal of agricultural machinery science, pg. no. 243-246,2014.

3. Cemil oz, Ming C. Leu,"Human-Computer Interaction System with Artificial Neural Network Using Motion Tracker and Data Glove",LNCS 3776, pp. 280–286, 2005.

4. Gaurav manik bidgar,Mangesh balasaheb autade," Hand gesture recognition for HCI (human computer interaction) using artificial neural network",International Journal of technical research and applications ISSN: 2320-8163,vol.-2, issue 2,pg. no. 48-50,Apr. 2014.

5. Sabrine hamdi, Chokri souani, Hassene faiedh,Kamal besbes,"Road signs classification by ANN for real-time implementation",International conference on control, automation and diagnosis (ICCAD),2017.

6. Xiaolei ma , Zhuang dai , Zhengbing he, Jihui ma,Yong wang and Yunpeng wang,"Learning Traffic as Images: A Deep Convolutional Neural Network for Large-Scale Transportation Network Speed Prediction"Sensors based Volume 17(4),Apr. 2017.

7. Hui yuan , Cynthia F. Van der wiele and Siamak khorram," An Automated Artificial Neural Network System for Land Use/Land Cover Classification from Landsat TM Imagery", Remote Sens.,pg. no. 243-265,2009.

8. Priyanka sharma, Urvashi mutreja," Analysis of satellite images using ANN", International journal of soft computing and engineering (IJSCE), Vol.2,issue 6, pg. no. 2231-2307, Jan 2013.

9. Corneliu lungociu, "Real time sign language recognition using artificial neural network", Studia univ. babes bolyai,informatica,vol.4,2011.

10. Lorena P. vargas1 , Leiner barba, C O torres and L mattos ," Sign Language Recognition System using Neural Network for Digital Hardware Implementation ",Journal of physics, Conference series 274, Vol. 4, 2011.

11. Magdy mohamed aboul ela, Ahmed samir,"Arabic sign Language Recognition Using Neural Network And Graph Matching Techniques", pg. no. 163-168,Aug. 2018.

12. G. dogan,M.H. arslan,M. ceylan,"Stastical feature extraction based on an ANN approach for estimating the compressive strength of concrete", Neural network world ,pg no.301–318,June 2015.

13. Alexandrina Elena pandelea, Mihai budescu, Gabriela covatariu and Rares George taran,"Checking the homogeneity of concrete using artificial neural network", pg no. 83-92,Aug 31,2015.

14. Hoang ND," Image Processing-Based Recognition of Wall Defects Using Machine Learning Approaches and Steerable

International Journal of Scientific & Engineering Research, Volume 10, Issue 9, September-2019
ISSN 2229-5518

Filters", Computational Intelligence and Neuroscience Volume
2018, Article ID 7913952,Nov. 2018.