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Artificial Neural Network:Overview

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Abstract - *Artificial neural network is tool of Artificial intelligence which is recently most popular research area in the field construction field as it doesn't requires the traditional programming based on the mathematical formula etc. In this paper introduction to neural network and the application of neural network in construction industries are Discussed. Neural network is mimic of human brain system, in ANN perceptron is a identical element with neuron in brain. ANN is mostly used to mimic the functions of brain such as storage, think and recall Based on this function ANN is used in construction industries to solve the regression, classification problems.*

***Key Words*: ANN, Neural Networks, Deep Learning, Neural Networks, Artificial Intelligence.**

1. INTRODUCTION

An artificial neural network belongs to artificial intelligence (AI) data modelling tool that can store and represent complex input / output relationships. Research in artificial network grown up with the idea to simulate the functioning of human brain.Scientist are trying to make the modelling tool which can learn store, think and retrieve the data or complex relationship like human brain Artificial neural networks are particularly useful for modelling underlying patterns in data through a learning process. The knowledge of a neural network is stored within the strengths of connection between neurons known as 'synaptic weights'. The main advantage of neural networks is ability to represent both linear and non-linear relationships and their ability to learn these relationships. ANNs can be used for many tasks such as pattern recognition, function approximation, optimization, forecasting, data retrieval, and automatic control. As many of the managerial works in construction industry is based on past experience of the manager which he cannot justify providing a fix rule or mathematical formula. Artificial neural networks are getting too much popularity in construction application because it does not require a mathematical rule or fix programme to perform the task likr traditional computing models.

1.1 Historical developments of Neural Network

Widrow and Hoff (1960) developed a mathematical method which adapts the Weights, a gradient search method was utilized with assumption that a desired answer existed, which was based on minimizing the squared error. Pao (1989) developed a technique to improve the initial representation of the data to the neuronal network he introduced functional links to linear input.. The functional links area try to find simple mathematical correlations between input and output, such As a periodicity or terms of a higher network order. Functional links are very important in preprocessing of the data for the neural network. A functional link is sometimes called conditioning the entrance. There is a parallel between adaptive and neuronal control networks. A functional link in its simplest form could restrict the entry of neuronal network. If the input of the neuronal network is poorly conditioned, the functional link makes the entry more usable by the neural network. Calvin et al. (1993) He developed a method called gray layer. A gray layer uses the neuronal output of network to incorporate a priori information of the system. Hung and Adeli (1993) presented a Mathematical model for resource planning considering Characteristics of project scheduling which are ignored in previous investigations, including precedence relationships, multiple crew strategies and cost-time compensation. Previous resource scheduling formulations have traditionally focused on minimizing the duration of the project. Raja R.A. Issa (1995) tried to predict the construction material prices using ANN but he was unable to find the suitable input parameter to predict the construction material prices. Mohammad and Haykin (1995) formulated the problem of allocating the available annual budget optimally to Projects of rehabilitation and replacement of bridges between a series of alternatives such as Optimization problem using the Hopfield network. I-Cheng Yeh (1995) used annealed neural network for planning construction site layouts. adeli (1998) presented a regularized artificial neural network to estimate the construction cost of the highways by training the network with past examples. Wilmot(2005) used artificial neural network model to predict the highway construction cost using previous trends.Arazi (2011) has developed a model using ANN to predict the cost of labour that has also Taking into account the subjective factors. Factors that influence the productivity of The work on the site identified through the literature review includes the lack of material and Equipment, inadequate drawing, weather, project location, incompetent site. Supervision, change orders, absenteeism, etc. Among these, the most common factors present have been identified during the data collection. Mostafa A. Abo-Hashema (2013) used artificial network model to predict the asphalt concrete temperature in pavement with air temperature as a input parameter.Naik (2015) implemented the artificial neural network tool to optimize the construction cost and duration of the project.

2. MODEL REPRESENTATION OF NETWORKS

Artificial neural network consist of number of neurons connected with strings called synaptic weights. A neuron is fundamental operation unit of neural network which processes the information .Neuron is a junction at which all the inputs gets linearly summed.

Neural network can be classified based on connection structures:

A) Feed forward Network B) Feedback network

Feed forward network is classified further based on their number of layers of neurons as

a) Single layer linear models (Traditional models)

b) Multilayer perceptron models (MLP)

In ANN neurons are arranged in groups called layers as in Traditional linear models only single layer of neuron exist.Hence they are unable to perform well when it deals with the nonlinear data(Naik 2015). The most commonly neural network model is the multilayer perceptron (MLP). As the name suggest it contain more than one layers of neurons including input layer, output layer and hidden layers. This type of neural network comes under supervised network as it requires a input –output historical data in order to train the network. The objective of this type of network is to create a model that correctly maps the input to the output using historical data so that the model can then be used to predict the output when the desired output is unknown. A structural arrangement of an MLP is shown in Figure 1.

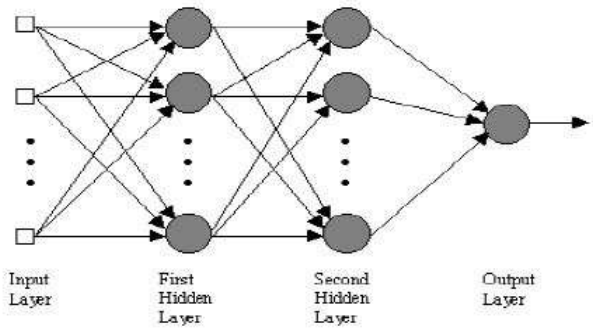

Fig -1:.Multiplayer perceptron (MLP with two hidden layer.

In neural network the input data parameters given to network are linearly summed and get multiplied with the synaptic weights at each layer each layer is associated with the transfer function which process data. Most commonly used transfer function is hyperbolic tangent. Out pur from input layers get transferred to hidden layer again here it get multiplied with the synaptic weights and get transferred to output layer through transfer function , hidden layers are most useful to deal with the non linear type problems.

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3. CHARACTERISTICS OF ANN

Salient Characteristics of ANN are as follows.

- ANN is particularly suited for pattern recognition task.
- They produce fast responses, irrespective of their requirement of large computer time for learning. This is due to the parallel structure of neural networks
- They could extract classification (clustering) characteristics from a large number of input examples, as in the case of unsupervised learning. If, for example, a large number of field data are collected from a construction site, a suitable network can identify the different clusters (groups or classes) that characterize the whole population.
- They have distributed memory; the connection weights are the memory units of the network. The value of the weights represent the current state of knowledge of the network. A unit of knowledge, represented for example by an input/desired-output pair, is distributed across all the weighted connections of the network.

4. LEARNING OF ANN

The MLP and many other neural networks learn using an algorithm called backward propagation. With backward propagation, the input data is repeatedly presented to the neural network. With each presentation, the output of the neural network is compared with the desired output and an error is calculated.

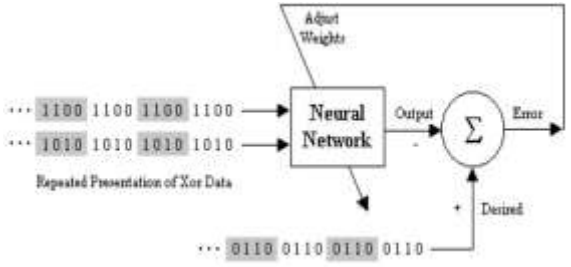

Fig -2:. Learning of a neural network

This error feeds back (spreads again) to the neural network and is used to adjust the weights so that the error decreases with each iteration and the neural model gets closer and closer to the desired output. Figure 2 shows the process of learning of neural network techniques.

There two types of learning

A) Supervised Learning B)Unsupervised learning

In supervised learning data is trained along with the desired output and in unsupervised neural network target ouput values are not trained. Supervised learning gives the maximum efficiency as the error in supervised learning are less as compared to unsupervised learning.

5. POTENTIAL AREAS OF NERAL NETWORK APPLICATION IN CONSTRUCTION.

1. Estimation and classification. For example, a pattern representing a project environment could associate an estimated productivity factor or select one of the existing productivity classes, representing different performance levels of a certain trade. As another example, a project performance pattern could associate estimated values for the schedule and the cost indices. Probability and percentage of cost overruns could also be estimated.

2. Selection between alternatives. For example, a pattern representing the soil conditions of a construction site could be associated with an approximate value for the bearing capacity, degrees of suitability of different types of foundation, appropriate dewatering methodology, and so on. Other examples include formwork and equipment selection.

3. Diagnostic problems such as those encountered in building and facility defects and the needed establishment of causation in construction dispute management and their respective claim analyses.

4. Dynamic modelling. For example, construction projects with varying performance levels measured in the different reporting periods could indicate a projection of relative time and/or cost overruns. Another example is modelling during periods of rapid fluctuations in inflation or escalation rates. These data could be used to give an indication about the market condition so that proper bidding decisions could be made.

5. Optimization tasks. For example, applications regarding the optimization of construction activity and resource usage could be experimented.

6. Real-time applications such as those associated with time-dependent changes (e.g. material costs, inflation rate, etc.).

7. CONCLUSION

Artificial Neural network is a deep learning tool in branch of artificial intelligence which efficiently mimic the brain functioning .using artificial modelling different models can be created to perform pattern recognition, function approximation, optimization, forecasting, data retrieval, and automatic control. Recently In construction industry artificial neural networks are used for predicting construction cost and optimizing the construction cost and duration.

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