



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 11, November 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

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# Neural Network in Manufacturing Industry

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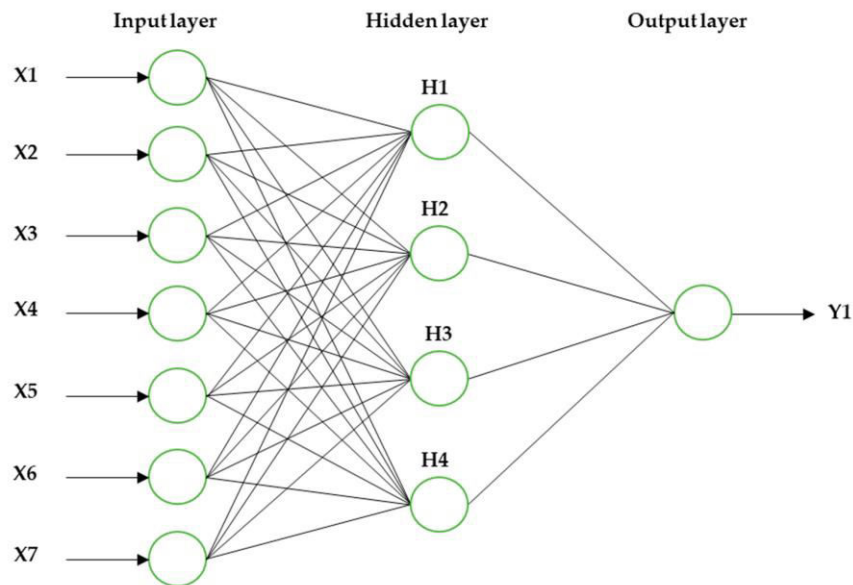
Research Guide, Amity University, Lucknow, India<sup>2</sup>

**ABSTRACT:** Artificial intelligence has been claimed to yield radical advertisements in manufacturing. While most of the review papers about artificial intelligence in manufacturing industries have been focused on score and knowledge expert systems, fewer advances have been paid to neural networks. However, neural networks are capable to learn, accept to changes, and can mimic human beings viz. their thought processes with little human interferences. They could be of enormous help for the advanced computer-integrated mechanized and the future intellectual manufacturing systems. This review paper presents a state-of-the-art inspection of neural network applications in manufacturing. The basic aim here is to modernize information about the applications of neural networks in manufacturing, which will offer some guidelines and bibliography for the follow a line of investigation field and its implementation.

**KEYWORDS:** artificial intelligence, neural network, manufacturing, industry, expert, knowledge

## I. INTRODUCTION

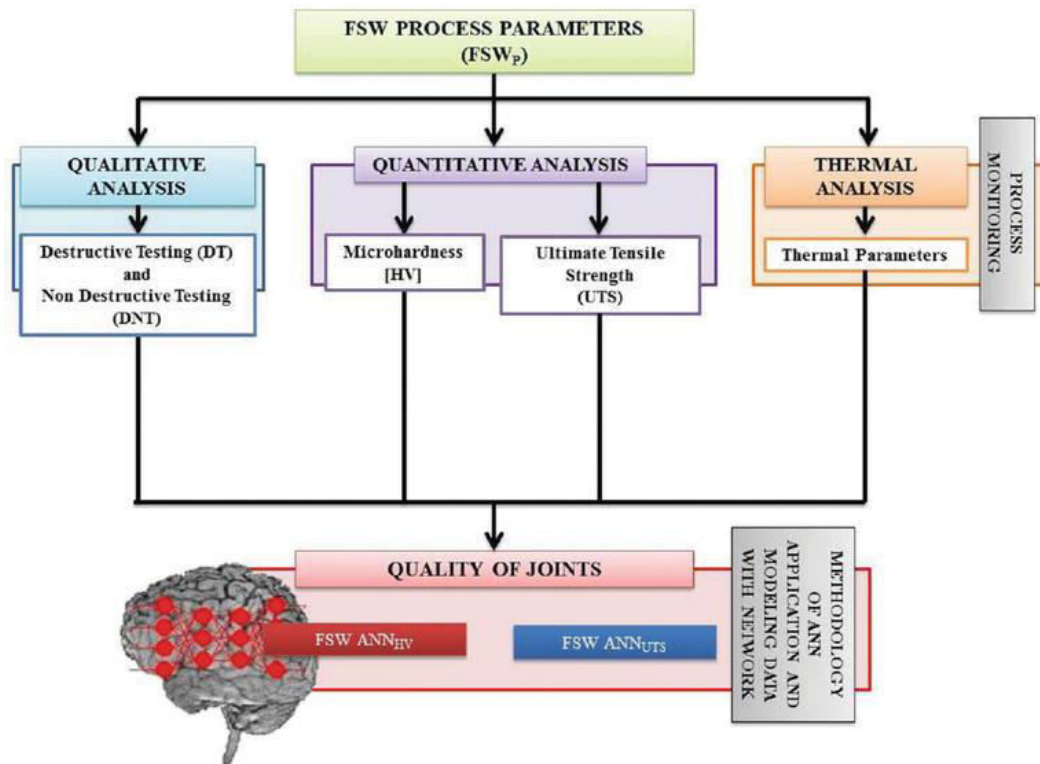
The present scenario has intense competition which in global and domestic markets is continuously demanding manufacturers to inculcate products of higher quality with much less cost. The implication of this is that today's manufacturing systems needs to be optimised with such functionalities as intelligence, efficacy and flexibility, thus having high demands with a new paradigm shift in manufacturing technology.[1]



### Application of neural networks

Performing this important task consists of several distinct technological steps:

- (1) Identifying the attribute changes of a process
- (2) Estimating the changes of the product quality
- (3) Correcting the process maneuver, overserving the resulting product eminence and comparing the observed quality with the desired[2,3]

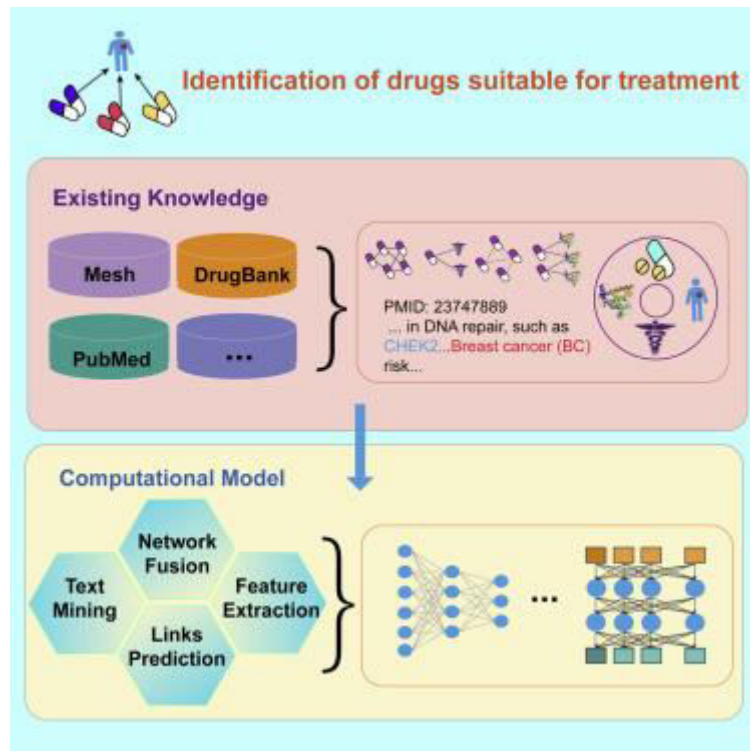


**Artificial neural network**

Most of manufacturing process have the characteristics of indecisive, time-varying, highly nonlinear and complex system. This may be attributable to the fact that they are open to the elements to external disturbance and noise and often subjected to factor variations. Furthermore, the input variables operating the processes are interacted with each other, and each character effect on quality can not be assessed clearly. Due to these characteristics their quality often varies from product to product, impairing its uniformity and decreasing the capitulate of the product. These actually bring about degradation of product quality and even cause malfunction and collapse of machines in the process. Due to this reason manufacturers have needed to believe on somewhat an intelligent method which can exhibit the capabilities of infonnation storing, learning, logic and decision making. [4,5]

**II. OBSERVATIONS**

Inputs to the neurons consisting of the output layer of the classifier are determined by the input vector composed of the raw image data along with the synaptic weights which correspond to the prototype vectors. The outputs of the neural network are expressed by the correlation of the input vector and the prototype vectors. The output of each neuron is positive-feed backed to itself and negative-feed backed to the other neurons. Then only one neuron with the maximum value converges to high positive value and the others converge to zero. In other words, the only one neuron of the very near prototype vector to the current input vector which is called "winner" is selected and input image is classified into the class of the winner. Therefore, the position of the prototype vectors representing the classes determines the decision surfaces which separate the vectors into classes.[7,8]



### Drugs repositioning based on various networks

1. In modeling the processes, the networks are utilized like a transfer function which just maps the input data into the output variables. The fit fall of this is that this method is just a black box approach, since the networks do not know what are going on with regard to physical phenomenon of the processes.
2. In pattern recognition and clustering, there still remains a limitation to use the networks. Their performance here somewhat depends upon statistical properties of sampled data. Accuracy clustering data located at the proximity of border lines of each group still needs to be improved, since most of manufacturing processes require nearly 100% of correct judgment.
3. In process control, the networks take roles in identification and/or generation of control signal based upon sensors informations. As in other problems, here, the robustness and accuracy are the key issues to promote their implementation in real processes.

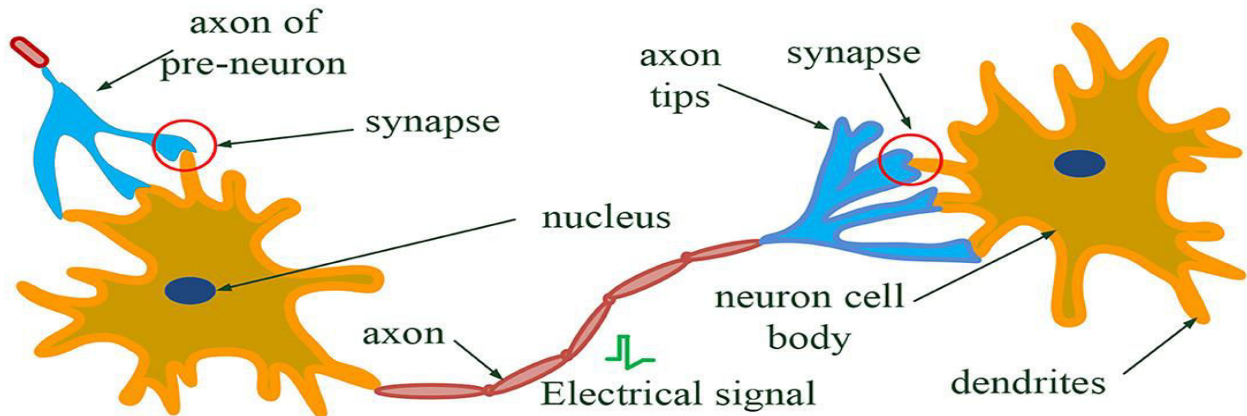
### III. DISCUSSION

Machine Vision solutions today have two distinct branches – Traditional Machine Vision and Machine Learning (neural network or artificial intelligence) approach. Both branches have developed tremendously in recent years through advancement in both camera and computing technologies. [9]

In a traditional Machine Vision approach, engineers will use a camera and lighting system to acquire an image that clearly identifies the desired features to be analyzed. Software based processing algorithms further enhance these features and image measurement tools classify or inspect the features accordingly. These systems can be implemented reliably, however, for some challenging applications, they may not perform as well as the human eye.

For those applications, Machine Learning may be more appropriate. In such a system, the algorithm is “trained” by feeding it pre-classified images of known good products and bad products with known flaws. The computer now has a guideline for classifying new images correctly. At this point, the limitations are only those of the software available.

There are a number of machine learning tools available for image processing, with different levels of algorithm transparency and adjustable features.



**Advances in memristor based neural network**

David Chargin, Project Manager & Senior Automation Engineer for Fraunhofer USA Center for Manufacturing Innovation CMI, notes that in some applications, both techniques can be combined in a hybrid approach, with a traditional machine vision system pre-processing images to highlight relevant details before handing them over to a machine learning algorithm. [10]

**IV. RESULTS**

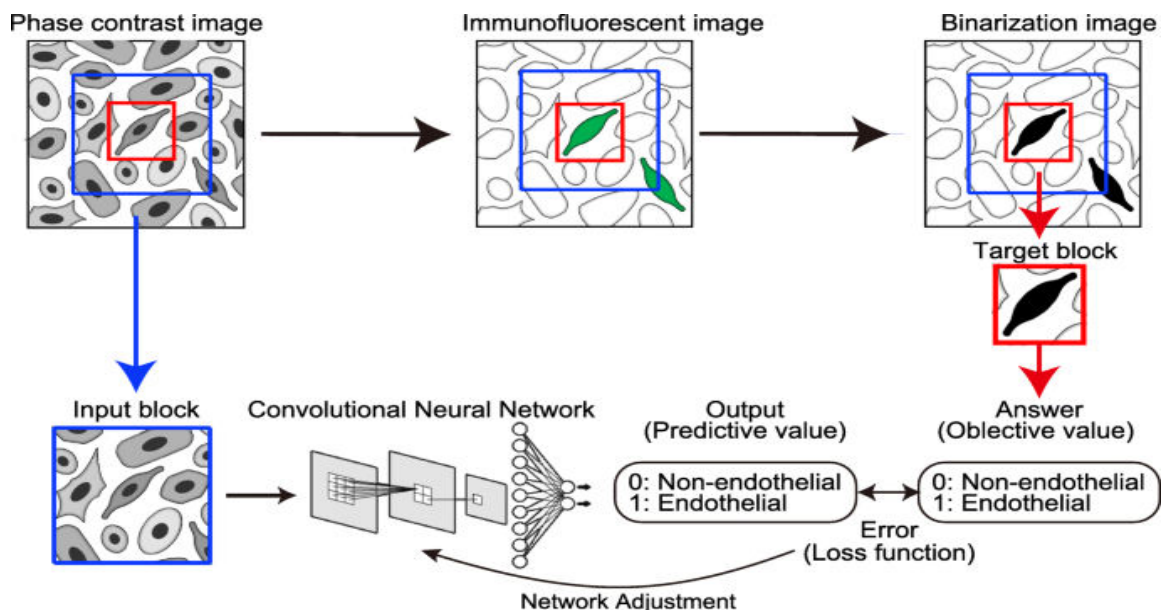
The main features of any network are as follows:

- Architecture — identifies the connections between the neurons and layers
- Dataset splitting — determines the subset data to be used for training, validation and testing for the ANN’s development
- Learning algorithm — designates the weight of the links between the neurons[11]

**Types of Neural Networks**

There are different kinds of deep neural networks – and each has advantages and disadvantages, depending upon the use. Examples include:

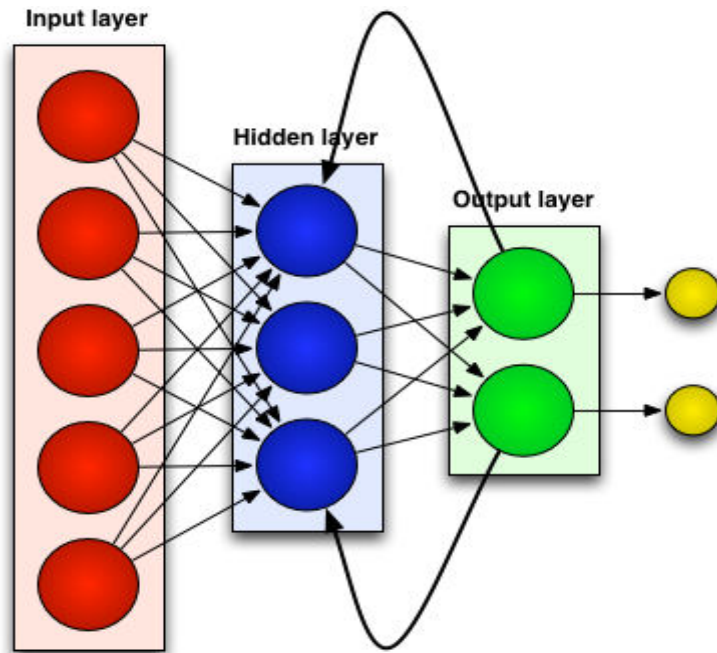
- Convolutional neural networks (CNNs) contain five types of layers: input, convolution, pooling, fully connected and output. Each layer has a specific purpose, like summarizing, connecting or activating. Convolutional neural networks have popularized image classification and object detection. However, CNNs have also been applied to other areas, such as natural language processing and forecasting.[12]



Application of convolution based neural network to stem cell biology

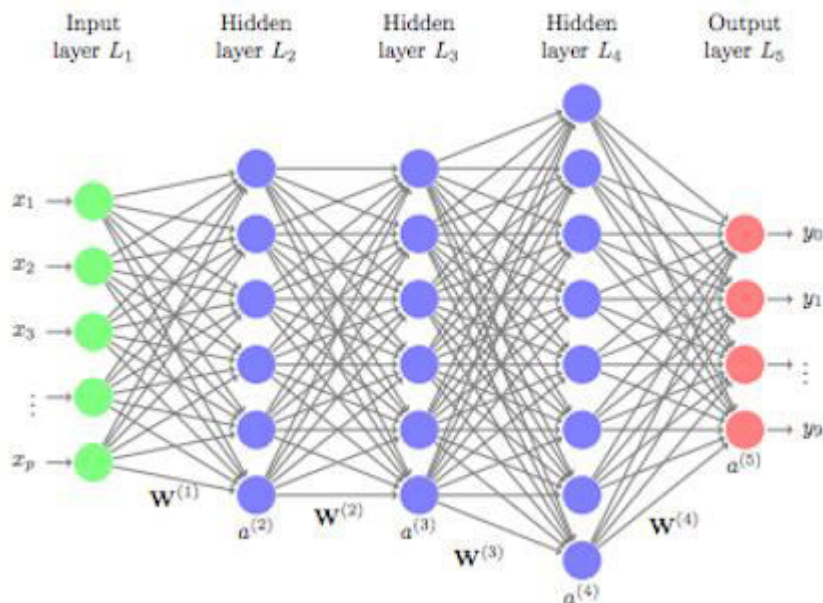


- Recurrent neural networks (RNNs) use sequential information such as time-stamped data from a sensor device or a spoken sentence, composed of a sequence of terms. Unlike traditional neural networks, all inputs to a recurrent neural network are not independent of each other, and the output for each element depends on the computations of its preceding elements. RNNs are used in forecasting and time series applications, sentiment analysis and other text applications.[13]



**Recurrent neural network**

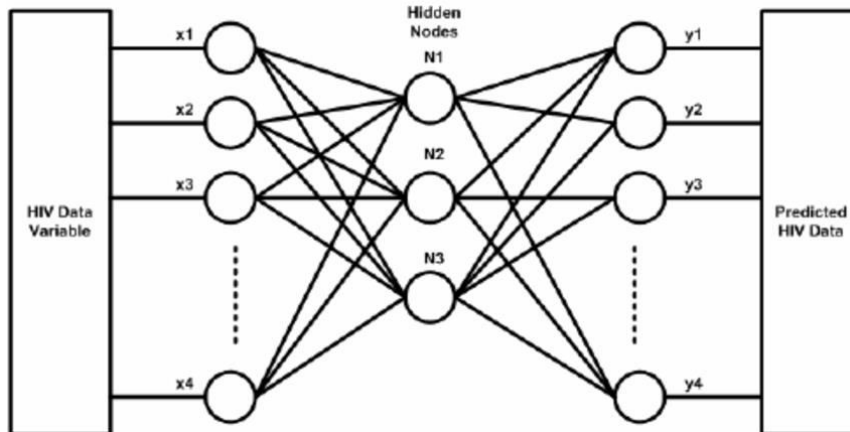
- Feedforward neural networks, in which each perceptron in one layer is connected to every perceptron from the next layer. Information is fed forward from one layer to the next in the forward direction only. There are no feedback loops.[14]



**Feedforward neural network**

- Autoencoder neural networks are used to create abstractions called encoders, created from a given set of inputs. Although similar to more traditional neural networks, autoencoders seek to model the inputs themselves, and therefore the method is considered unsupervised. The premise of autoencoders is to desensitize the irrelevant and

sensitize the relevant. As layers are added, further abstractions are formulated at higher layers (layers closest to the point at which a decoder layer is introduced). These abstractions can then be used by linear or nonlinear classifiers.[15]



Autoencoder neural network

## V. CONCLUSION

ANNs are garnering more interest almost daily, as their expansive list of benefits have become too much to ignore for companies in the manufacturing industry. It is growing in popularity so much in fact, that the algorithms and models that are used are quickly becoming standard tools in information engineering and computer science.[16,17]

Now that they have progressed from adolescence, neural networks have put together a robust set of tools, including computation procedures that feature an undeniable effectiveness and strong theoretical base. For example, in this article the ANN simulation model showed it was efficient at predicting the friction stir welding (FSW) process. Adoption of simulation models like this one can be very beneficial to FSW, and the manufacturing industry as a whole.

In this case, this tool was able to predict the mechanical properties of welds and maintain control of the overall welding process. This decreases the number of repairs that are needed and the inevitable costs that repairs bring. With the constant growth and development of neural networks, the next question is, can we actually build a human brain? While this is still a long way off and an ambitious goal to say the least, the ANN can still imitate and support human behavior. This helps with simplifying the decision-making process, analysis of complicated processes, and increasing evaluation and cognition under stressful conditions, among many other things.[18,19]

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