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Diagnosis of cancer using artificial neural network

Research Article

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Abstract: Diagnosis of cancer using a neural network has become one of the widest used techniques. Generally, privacy and medical record access. It is the new developmental framework proposed for cancer which is efficiency and accuracy for diagnosis. In the present paper, the use of neural networks in diagnosis of cancer has been described especially, a feed forward neural network model.

MSC: 92B20 • 92B05

Keywords: Artificial neural network • Training algorithm • Cancer • Image segmentation

1. Introduction

Neural networks are important tools for cancer diagnosis and monitoring. Kenji Suzuki [1] investigated a pattern-recognition technique based on an artificial neural network (ANN). The ability of the physicians to effectively treat and cure cancer is directly dependent on their ability to detect cancers at their earliest stages. An initial diagnosis called early diagnosis is made based on the demographic and clinical data of the patient via which more than 30 cancer deaths are preventable. Artificial neural networks offer a completely different approach to problem solving and they are sometimes called the sixth generation of computing. Over the last two decades, a tremendous amount of research work has been conducted for automated cancer diagnosis. Gutte and Henrik [2] developed a completely automated method based on image processing techniques and artificial neural networks for the interpretation of combined fluorodeoxyglucose (FDG) positron emission tomography (PET), computed tomography (CT) and natural products (NP) images for the diagnosis and staging of cancer. Many natural bioactive compounds such as paclitaxel [3], Cordicepin [4]. Vincristine and vinblastine etc. [5] and [6] are used for anticancer drugs in present time.

2. What is artificial neural networks ?

Artificial neural network (ANN), a mimic of Biological Neural Network, is a massively parallel distributed processing system which is made up of highly interconnected neural computing elements that have the ability to learn and thereby acquire knowledge and make it available for use [7]. Artificial neural networks are simplified imitations of the central nervous system, and are aggravated by the kind of computing performed by the human brains [8]. Neurons are the structural entities of human brain and perform computations such as cognition, logical inference, pattern recognition and so on, where ANNs are simplified models of the biological nervous systems [9]. Hence the technology, which is built on such a simplified imitation of neurons is termed as Artificial neural system technology or ANN or simply neural networks and neurons.

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3. Cancer

Cancer as the term defines is a class of disease characterized by an out-of-control cell growth. There are over 100 different types of cancer, and each is classified by the type of cell that is initially affected [10]. Cancer starts when cells in a part of the body start to grow out of control in comparison to the normal cell growth. Instead of dying, cancer cells continue to grow and form new, abnormal cells. This equilibrium between genesis and destruction of cells is disturbed in cancer. There are two main types of cancer: benign and metastatic where the benign cancer lacks the ability to invade neighboring tissues whereas metastatic cancer travel to other parts of the body via the body's bloodstream or lymph vessels and form new tumors. Over time, these tumors replace normal tissue, crowd it, or push it aside. The process of cancer spreading is called metastasis [11].

4. Causes of cancer

There is no one single reason for cancer where an integrated approach leads to cancer in an individual the factors involved may be genetic, environmental, or constitutional characteristics of the individual. The following risk factors and mechanisms have been proposed as contributing to cancer:

- Life style factors.
- Family history, inheritance, and genetics.
- Some genetic disorders.
- Exposures to certain viruses. Epstein Barr virus and HIV.
- Environmental exposures.
- Some forms of high-dose chemotherapy and radiation.

The fundamental cause of cancer is damaged or faulty genes which are a set of instructions that tells cells to what to do. Genes are encoded within the DNA, so anything that damages DNA can increase the risk of cancer. There are mainly three main types of genes that are involved in the cell growth, and when altered (mutated) leads to certain types of cancers for more details see [12], [16] and [17].

5. Neural networks architecture

For many years, ANNs have been studied so to achieve human-like performance in the fields of speech and image recognition. Different ANN architectures are widely used by researcher; in this work we suggest three layers network: input layer contained 32 inputs neurons, hidden layer has 185 neurons with sigmoid activation function tansig., and output layer contained one neuron, with fully connected neurons between each layer. The input layer neurons receive the input signals and output layer neurons receives an output signal. Thus, it is known as acyclic in nature (Fig. 1). Once a network has been structured for a particular application, that network is ready to be trained. To

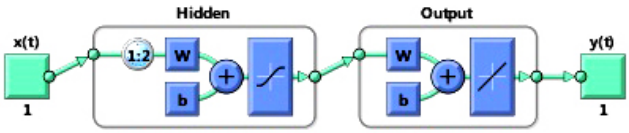

Fig. 1. Architecture of suggested ANN

start this process the initial weights are chosen randomly, then, the training begins. The ANN is trained by exposing it to a set of existing data (based on sonar image) where the outcome is known. Multilayer networks use a variety of learning techniques; the most popular is back-propagation (BP) algorithm [13]. It is one of the most effective approaches to machine training algorithm information which flows from the direction of the input layer towards the output layer.

There are three approaches to training: supervised, semi-supervised and unsupervised. Supervised training involves a mechanism of providing the network with the desired output either by manually "grading" the network's performance or by providing the desired output with the inputs. Unsupervised training is where the network has to make sense of the inputs without outside help [14] and [15].

Training in ANN's is achieved via examples adjusting the connection weights in ANN's iteratively. The number of iterations of the training algorithm and the convergence time varies depending on the weight initialization. After the repetition of the processes, for a sufficiently large number of training cycles, the network usually converges to a state where the error in the calculations is small thus implying the network to be learned to a certain target function.

In the training process, initially, the weights on all the interconnections are set at small random numbers and the network is said to be "untrained". The weights of each neuron were randomly initialized to values between -1 and +1. Weight training in ANN's is usually formulated as minimization of an error function has the mean square error between target and actual outputs averaged over all examples, by iteratively adjusting connection weights. The weights are adjusted in such a way that each weight adjustment depending on efficient algorithm such Levenberg-Marquardt training algorithm (trainnlm). To adjust, weights are calculated and the weights are then changed such that the error is decreased (thus going downhill on the surface of the error function).

6. Data description and training data

The data obtained from different hospitals in Baghdad city, Iraq are used for studying cancer and sonar image for various types of cancer. The data distributed in three sets: training set, validation set and testing set.

The choosing of training set is the key of accurate discretionarily of the diagnosis cancer in image samples. For the choosing of the training set, 60 from all image samples, 20 for validation set and 20 for testing set.

7. Results and discussions

The proposed technique is used for many images of bladder suffering from cancer. The seed operation is performed for given image; Fig. 2 showing the concentration profile over time of chemoattractants and growth factors; In Fig. 3 we show the temporal evolution of the enzyme-induced degradation of the extracellular matrix. The extracellular matrix is degraded by the enzymes produced by the cancer cells that are in contact with it. Therefore, degradation of the extracellular matrix mirrors the tumour's growth. The dark area represents the degraded extracellular matrix.

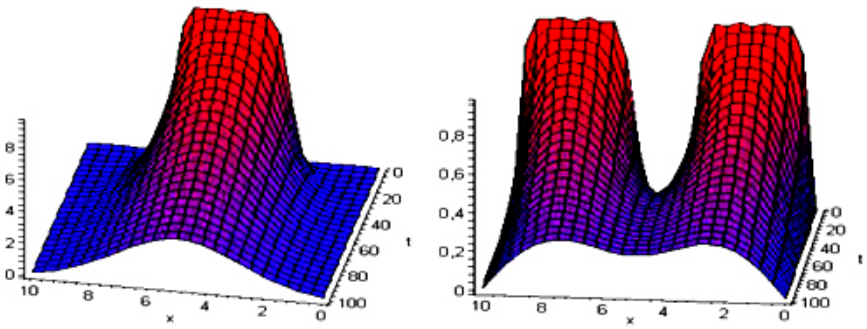

Fig. 2. The left-hand side shows the profile created by a single cell on the surface of a petri dish. Figure at the right hand side shows the profiles for two nearby cells

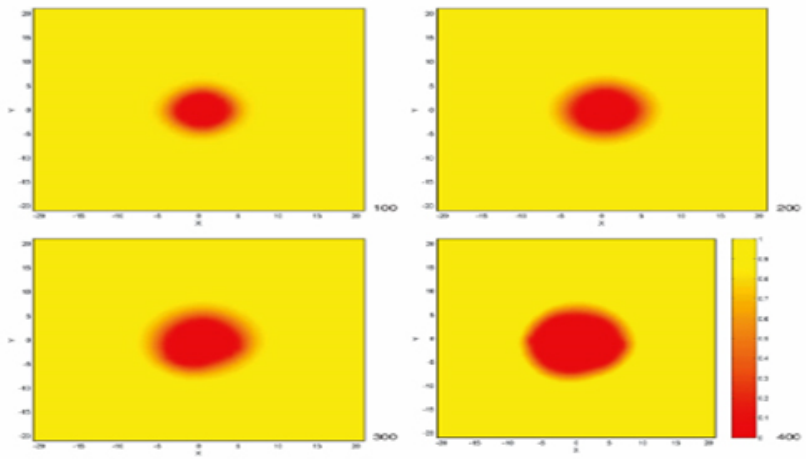

Fig. 3. Showing the spatiotemporal evolution of the extracellular matrix density

8. Conclusion

In recent times, the diagnosis of cancer is carried out using ANN and the implementation in a cloud environment enhances the efficiency and accuracy of diagnosis. This paper suggest three layer ANN to diagnose cancer and the results of training suggested network shows the suggested network is a ready to diagnose actual patients. These prove useful for medical diagnostics and achieve maximum perfection with an increase in samples. People would be checked for cancer quickly and painlessly thereby detecting the disease at an early stage. Thus, indicating neural networks as an effective option for cancer diagnosis so to help clinicians and oncologists in the prediction and prognosis of cancer.

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