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# An Expert System for Identifying Cardio Vascular Disease

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**ABSTRACT-** The heart circulatory system is composed of the heart and blood vessels, including arteries, veins, and capillaries. Our bodies actually have two circulatory systems: The pulmonary circulation is a short loop from the heart to the lungs and back again, and the systemic circulation (the system we usually think of as our circulatory system) sends blood from the heart to all the other parts of our bodies and back again.The heart gets messages from the body that tell it when to pump more or less blood depending on an individual's needs.

Cardio vascular disease affects the heart circulatory system and damages the system also damages the valves resulting in heart attack or heart failure. To avoid such a situation a clinical expert system is developed to identify CVD in advance and to reduce the level heart failure and death. The expert system is developed with the help of the neural network. The back propagation algorithm is used to train the neural network for diagnosing the cardio vascular disease and to take precautionary actions.

**KEY WORDS:** Neural network, Back propagation algorithm, Cardio vascular disease, Training state.

## I. INTRODUCTION

### 1.1 OVERVIEW

#### 1.1.1 Introduction To Neural networks

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one neuron to the input of another.In computer science and related fields, artificial neural networks are computational models inspired by animal central nervous systems (in particular the brain) that are capable of machine learning and pattern recognition. They are usually presented as systems of interconnected "neurons" that can compute values from inputs by feeding information through the network.

For example, in a neural network for handwriting recognition, a set of input neurons may be activated by the pixels of an input image representing a letter or digit.

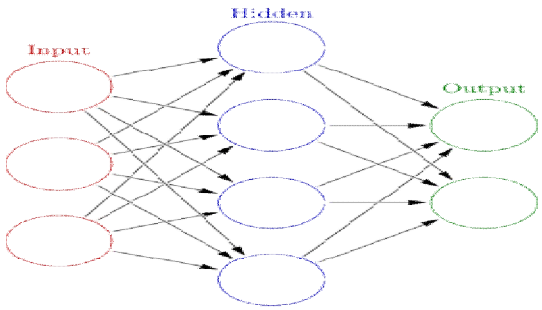


Fig 1 Artificial neural networks

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The activations of these neurons are then passed on, weighted and transformed by some function determined by the network's designer, to other neurons, etc., until finally an output neuron is activated that determines which character was read.

### 1.1.2. Use of Neural Network

Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer "what if" questions. Other advantages include:

**Adaptive learning**: An ability to learn how to do tasks based on the data given for training or initial experience.
**Self-Organisation:**An ANN can create its own organisation or representation of the information it receives during learning time.
**Real Time Operation**:ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
**Fault Tolerance via Redundant Information Coding:**Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

### 1.2 PROBLEM STATEMENT

Cardiovascular diseases are a group of disorders of the heart and blood vessels among which the major diseases are:
**Coronary heart disease**: disease of the blood vessels supplying the heart muscle;
**Cerebrovascular disease:** disease of the blood vessels supplying the brain;
**Peripheral arterial disease:** disease of blood vessels supplying the arms and legs;
**Rheumatic heart disease:** damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria;
**Congenital heart disease:** malformations of heart structure existing at birth;
**Deep vein thrombosis and pulmonary embolism:** blood clots in the leg veins, which can dislodge and move to the heart and lungs.

Heart attacks and strokes are usually acute events and are mainly caused by a blockage that prevents blood from flowing to the heart or brain. The most common reason is a build-up of fatty deposits on the inner walls of the blood vessels. Strokes can be caused by bleeding from a blood vessel in the brain or by blood clots.

### 1.3 OBJECTIVE

To develop an Clinical Expert System (CES) using neural networks to identify the level of risk in cardio vascular disease. To help the patients in taking precautionary actions to stretch their life span.57% of death occurs due to CVD.

To assist medical practioners to diagnose and predict the probable complications well in advance. To build a clinical expert system which will diagnose the presence of Coronary Heart Disease with the help of the neural network which implements the back propagation technique.

## II. SYSTEM ORGANIZATION

### 2.1.EXISTING SYSTEM

Ideally, doctor will screen our regular physical exams for risk factors that can lead to a heart attack.If you're having a heart attack or suspect you're having one, your diagnosis will likely happen in an emergency setting. You'll be asked to describe your symptoms and will have your blood pressure, pulse and temperature checked. You'll be hooked up to a heart monitor and will almost immediately start to have tests done to see if you are indeed having a heart attack.

The medical staff will listen to your heart and lung sounds with a stethoscope. You'll be asked about your health history and the history of heart disease in your family. Tests will help check if your signs and symptoms, such as chest pain, signal a heart attack or another condition. These tests include:

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- **Electrocardiogram (ECG).** This is the first test done to diagnose a heart attack. It's often done while you are being asked questions about your symptoms and often by the first responders from emergency medical services. This test records the electrical activity of your heart via electrodes attached to your skin. Impulses are recorded as waves displayed on a monitor or printed on paper. Because injured heart muscle doesn't conduct electrical impulses normally, the ECG may show that a heart attack has occurred or is in progress

- **Blood tests.** Certain heart enzymes slowly leak out into your blood if your heart has been damaged by a heart attack. Emergency room doctors will take samples of your blood to test for the presence of these enzymes.

**Additional tests**

If you've had a heart attack or one is occurring, doctors will take immediate steps to treat your condition. You may also undergo these additional tests:

- **Chest X-ray.** An X-ray image of your chest allows your doctor to check the size of your heart and its blood vessels and to look for any fluid in your lungs.

- **Echocardiogram.** This test uses sound waves to produce an image of your heart. During an echocardiogram, sound waves are directed at your heart from a transducer, a wand-like device, held on your chest. The sound waves bounce off your heart and are reflected back through your chest wall and processed electronically to provide video images of your heart. An echocardiogram can help identify whether an area of your heart has been damaged by a heart attack and isn't pumping normally or at peak capacity.

- **Coronary catheterization (angiogram).** This test can show if your coronary arteries are narrowed or blocked. A liquid dye is injected into the arteries of your heart through a long, thin tube (catheter) that's fed through an artery, usually in your leg or groin, to the arteries in your heart. As the dye fills your arteries, the arteries become visible on X-ray, revealing areas of blockage. Additionally, while the catheter is in position, your doctor may treat the blockage by performing an angioplasty, also known as coronary artery balloon dilation, balloon angioplasty and percutaneous coronary intervention. Angioplasty uses tiny balloons threaded through a blood vessel and into a coronary artery to widen the blocked area. In most cases, a mesh tube (stent) is also placed inside the artery to hold it open more widely and prevent re-narrowing in the future.

- **Exercise stress test.** In the days or weeks after your heart attack, you may also undergo a stress test. Stress tests measure how your heart and blood vessels respond to exertion. You may walk on a treadmill or pedal a stationary bike while attached to an ECG machine. Or you may receive a drug intravenously that stimulates your heart similar to exercise.
  Stress tests help doctors decide the best long-term treatment for you. Your doctor also may order a nuclear stress test, which is similar to an exercise stress test, but uses an injected dye and special imaging techniques to produce detailed images of your heart while you're exercising.

- **Cardiac computerized tomography (CT) or magnetic resonance imaging (MRI).** These tests can be used to diagnose heart problems, including the extent of damage from heart attacks. In a cardiac CT scan, you lie on a table inside a doughnut-shaped machine. An X-ray tube inside the machine rotates around your body and collects images of your heart and chest.
  In a cardiac MRI, you lie on a table inside a long tube-like machine that produces a magnetic field. The magnetic field aligns atomic particles in some of your cells. When radio waves are broadcast toward these aligned particles, they produce signals that vary according to the type of tissue they are. The signals create images of your heart.

## 2.2 PROPOSED SYSTEM

Artificial Neural Network (ANN) is a computational model, which is based on Biological Neural Network and is often called as Neural Network (NN). An ANN is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. ANNs like people, learn by example. An ANN is configured for a

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specific application, such as pattern recognition or data classification, through a learning process. To build artificial neural network, artificial neurons, alsocalled as nodes, are interconnected. The architecture of NN is very important for performing a particular computation. Some neurons are arranged to take inputs from outside environment.

These neurons are not connected with each other, so the arrangement of these neurons is in a layer, called as Input layer. All the neurons of input layer are producing some output, which is the input to next layer. A neural network is a set of connected input/output units in which each connection has a weight associated with it. The Artificial Neuron receives one or more inputs and sums them to produce an output. Usually the sums ofeach node are weighted, and the sum is passed through a function known as an activation or transfer function. During the learning phase, the network learns by adjusting the weights so as to be able to predict the correct class label of the input tuples.

Neural network learning is also referred to as connectionistlearning due to the connections between units. We can train a neural network to perform a particularfunction by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. There, the network is adjusted, based on a comparison of the output and the target, until the network output matchesthe target.

A feedforward neural network is an artificial neural networkwhere connections between the units do not form a directed cycle. This is different from recurrent neural networks.The feedforward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network.

**The Training Process:**

The Training of neural network can be done with the help of back propagation algorithm. Back propagation learns by iterativelyprocessing a set of training samples. The weights are modifiedto minimize the mean squared error between the network'sprediction and the actual class for each training sample. Thesemodifications are made from the output layer through eachhidden layer down to the first hidden layer.

The algorithm will be described in four steps

**Algorithm**: Back propagation

**Input:**

- D, a data set consisting of the training tuples and their associated target values;
- l, the learning rate;
- Network, a multilayer feed-forward network.

**Output:** A trained neural network.

**Method:**

Steps:

*Initialize all weights and biases in network*

*While terminating condition is not satisfied {*

*For each training tuple X in D {*

***//Propagate the inputs forward:***

For each input layer unit *j {*

*Oj = Ij*//output of an input unit it's Input value

For each hidden or output layer unit *j {*

$Ij = \sum_i W_{ij} O_i + \Theta_j$ // compute the unit*j* with respect to the previous layer, *i*

$Oj = 1/(1+e^{-Ij})$ // the output of each unit

//***Back propagates the errors***:

For each unit j in the output layer

*Errj = Oj (1-Oj) (Tj - Oj)* // compute the error

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For each unit j in the hidden layer, from the last to the 1st hidden layer
$Errj = Oj\ (1 - Oj) \sum_k Err_k w_{jk}$//error with respect to
the Next higher layer, *k*
For each weight *wij*in network {
$\Delta Wij = (l)\ Err_j O_i$ //weight increment
$Wij = w_{ij} + w\Delta$weight update
For each bias Θ*j* in network {
$\Delta\Theta j = (l)$ Errj //bias increment
$\Delta\Theta\ j = \Theta j + \Delta\Theta j\}$//bias update
}}

The result of training process will be the error level associated with the original data. We can find the level of risk associated with the patient by seeing the error rate. If the rate is too high the patient may get the heart attack soon and he is in high level of risk. If the error rate is medium then he will get the chance of getting heart attack some times after. To avoid such a situation he needs to take some precautionary actions. If the error rate is low then the patient may or may not get the heart attack. It depends on the activity of the patient.

## III. CONCLUSION

In the present study, an automatic system for the classification of ICU patients employing ANN techniques for decision-making was developed and implemented. The decision-making was performed using features extracted from ECGs. Emphasis was placed on selection of the characteristic features and for the accurate extraction of these features.The proposed approach exhibited a superior performance in terms of classification accuracy and was also easier and simpler to implement and use, as it only requires the ECG signal to determine the patients' states.

It has been so hard for the doctors to diagnose the cardio vascular diseases in advance. This system will predict the risk level of the patient whether he will get the heart attack or not. This expert system implements the neural network to diagnose the heart diseases. The training process of this system is based on the back propagation algorithm which predicts the error rate more accurately. Based on the error rate a decision will be taken that a patient has this certain level of risk associated with him. It will help the medical practioners to diagnose the valvular disease and to advice the patients to take precautionary actions to stretch the lifespan of a patient.

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