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Prediction of Heart Attack risk from Behavioral habits and Demographic variables: An Artificial Neural Network approach

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Abstract: *Generally heart attack considered as an old-age ailment but now become a common lifestyle concern. Statistics shows that the rate of heart diseases in India is double that of the national averages of western countries. Heart disease is increasing in younger generation also with a significant risk in both male and female. Despite being grown concerns, many of us are not aware of it. So this research aims to predict heart attack risk from behavioral habits and demographic variables. Data collected by questionnaire method. Database includes behavioral habit variables such as Smoking habit, Drinking alcohol habit , Drinking soda(sugar) habit, Eating fruits habit, Eating vegetables habitand Doing exercises habitand Demographic variables such as Marital Status, Income level and Age. WEKA 3.8 is used to analyze the dataset. Multilayer Back propagation algorithm is used for training and testing of the data. It predicts whether there is heart attack risk or not from the Behavioral habits and Demographic variables. By this, individual can make life style changes as a preventive health care. It also creates awareness about the heart attack risk.Back Propagation neural network architectures used for training and testing purpose is:1. An input layer (9 nodes), one hidden layer(5 nodes) and an output layer(2 nodes).2. An input layer (9 nodes), two hidden layers (5, 6 nodes) and an output layer(2 nodes). An input layer (9 nodes), three hidden layers (5, 6, 5 nodes) and an output layer(2 nodes).*

This research work predicts the risk of heart attack based on behavioral habits and demographic variables of an individual. This enables individuals to make life style changes to promote their health. We contribute a preventive health care for individual and it may be used by governments to frame campaigns and policies countering heart attack.

Keywords: *Artificial Neural network, Back Propagation Algorithm, Behavioral habits, Demographic variables and Heart attack..*

I. Introduction

This study analyses the risk of heart attack due to behavioral habits and demographic variables. While a person's genetic disposition and family history remain as the most common and uncontrollable risk factors, majority of heart diseases may be caused bypressure diabetes, smoking, sedentary life style, unhealthy diet, stress and weight issues. In today's scenario, our life style emerges as the biggest risk factor.Heart diseases are the leading cause of deaths among Indians, who account for 60% of all the heart patients worldwide, a study by Registrar General of India and Indian Council of Medical Research found.In the present research, we predict the risk of heart attack from behavioral habit variables such as Smoking habit, Drinking alcohol habit, Drinking soda(sugar) habit, Eating fruits habit, Eating vegetables habit, Doing exercise habit and Demographic variables such as Martial Status , Income level and Age. This result may be used for preventive health care purpose.Behavioral habits are controllable factors in heart attack. So research in this behavioral habit used to create awareness in public and promotes preventive healthcare. The goals of preventive care are broader than the issues of illness and life expectancy. Practicing prevention involves not only reducing primary risk factors or screening for disease, but also encompasses psychological, environmental and social issues as these affect health and well-being..

II. Related research

Theresearchaimstoexploretheassociationbetweenbehavioralhabitsandchronicdiseases, and to identify a portfolio of risk factors for preventive healthcare. The data is taken from the behavioral risk factor surveillance system (BRFSS) database of the centers for disease control and prevention, for the year 2012. Using SPSS modeler, we deploy neural networks to identify strong positive and negative associations between certain chronic diseases and behavioral habits[1].The aim of this study was to develop an artificial neural networks-based (ANNs) diagnostic model for coronary heart disease (CHD) using a complex of traditional and genetic factors of this disease [2].A four compartment model of the cardiovascular system is developed. To allow for

easy interpretation and to minimize the number of parameters, an effort was made to keep the model as simple as possible. Good agreement between the model and measured arterial pressure is demonstrated in all cases [3].Neural network (NN) plays an important role in this respect, especially in the application of breast cancer detection. Despite the large number of publications that describe the utilization of NN in various medical techniques, only a few reviews are available that guides the development of these algorithms to enhance the detection techniques with respect to specificity and sensitivity. The purpose of this review is to analyze the contents of recently published literature with special attention to techniques and states of the art of NN in medical imaging. Itdiscusses the usage of NN in four different medical imaging applications to show that NN is not restricted to few areas of medicine[4]. his work focuses on a Back propagation neural network system to be a framework for a real-time maize plant classifier utilizing advanced machine-vision (single-lens vision) techniques. Back Propagation Neural Network (BPNN) incorporates a single-board computer platform. The proposed framework is tested on images that on images that have no-specific distinguishing geometric pattern, varying light conditions. The obtained BPNN results were found to be encouraging considering the time consuming occurs manually to differentiate the maize plant from the other harmful herbs.[5]In order to update and improve available evidence on associations of physical activity (PA) with cardiovascular disease (CVD) by applying meta-analytic random effects modeling to data from prospective cohort studies, using high quality criteria of study selection, searched thePhysical Activity and Risk of Cardiovascular Disease [6]. This paper deals with the classification of certain diseases using artificial neural network (ANN) and fuzzy equivalence relations. The heart rate variability is used as the base signal from which certain parameters are extracted and presented to the ANN for classification. The same data is also used for fuzzy equivalence classifier. The feedforward architecture ANN classifier is seen to be correct in about 85% of the test cases, and the fuzzy classifier yields correct classification in over 90% of the cases [7]. This paper investigates how consumer behavior can be identified using artificial neural networks, based on information obtained from traditional surveys[8].This proposed method uses Artificial Neural Network for selecting the interesting or important features from the input layer of the network. A Multilayer Perception Neural Network is used for selection of interesting features from a Ischemic Heart Disease (IHD) data base with 712 patients[9]. The font size for **heading is 11 points bold face** and **subsections with 10 points and not bold.** Do not underline any of the headings, or add dashes, colons, etc.

III. Proposed method

WEKA 3.8 is used to analyses the dataset. Data for 100 records were collected by questionnaire method. Questionnaire form consist of ten questions about the habit of the person's Smoking, Drinking alcohol, Drinking of soda(sugar), Eating fruits , Eating vegetables , Doing exercise, Marital status, Income level, age and their history of heart attack. In the data collection behavioral habit variables are Smoking habit, drinking alcohol habit, Drinking of soda (sugar) habit, Eating fruits habit, Eating vegetables habit and Doing exercises habit. Demographic variables are Marital Status, Income level and Age. Even though the demographic variables are not modifiable, they play major role in risk of heart attack. One of the most popular neural network algorithms is back propagation algorithm. Back propagation is a common method for training a neural network. As the algorithm's name implies, the errors,(and therefore the learning) propagate backwards from the output nodes to the inner nodes.The training algorithm of back propagation involves four stages such as Initialization of weight, Feed forward, back propagation of errors and updationof weights.

Total net input for node h1 in a hidden layer is

: neth1=w1 * i1 + w2 * i2 + …Wn * in (1)

where w1,w2,…Wn are weights associated with node h1 and i1, i2,…in are input nodes associated with h1. Then the output of h1 is calculated as follows

: outh1 = 1/ (1 + e –neth1) (2)

Calculate the error each output neuron using the squared error function and sum them to get the total error.

: ∑total = ∑ ½(target – output) (3)

Our goal with back propagation is to update each of the weights in the network so that they cause the actual output to be closer the target output, thereby minimizing the error for each output neuron and the network as a whole.The algorithm is stopped when the value of the error function has become sufficiently small.

In WEKA Multilayer perceptron classifier is used for training and testing purpose. It's a classifier that uses backpropagation to classify instances.This network can be built by hand, created by an algorithm or both. The network can also be monitored and modified during training time.Default number of nodes in hidden layer

is average of input and output nodes. In our training and testing process, we use number of epochs as 500 and 0.3 as learning rate.

Back Propagation algorithm consists of three layers as default. They are input layer, hidden layer and output layer. To our research work input layer consist of nine nodes as there isnine input variables and output layer consist of two nodes as there is only two output as whether there is heart attack risk or not.

Back Propagation neural network architecture used for training and testing purpose is

1. An input layer (9 nodes), one hidden layer(5 nodes) and an output layer(2 nodes).
2. An input layer (9 nodes), two hidden layer(5,6 nodes) and an output layer(2 nodes).
3. An input layer (9 nodes), three hidden layer(5,6,5 nodes) and an output layer(2 nodes).

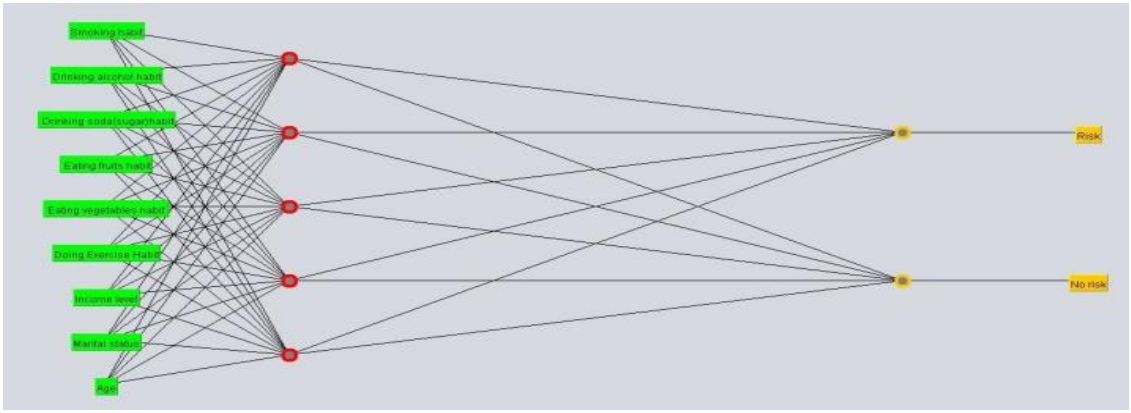

Fig. 1. Architecture of NN with one input layer (9 nodes), one hidden layer (5 nodes) and one output layer (2 nodes) in WEKA.

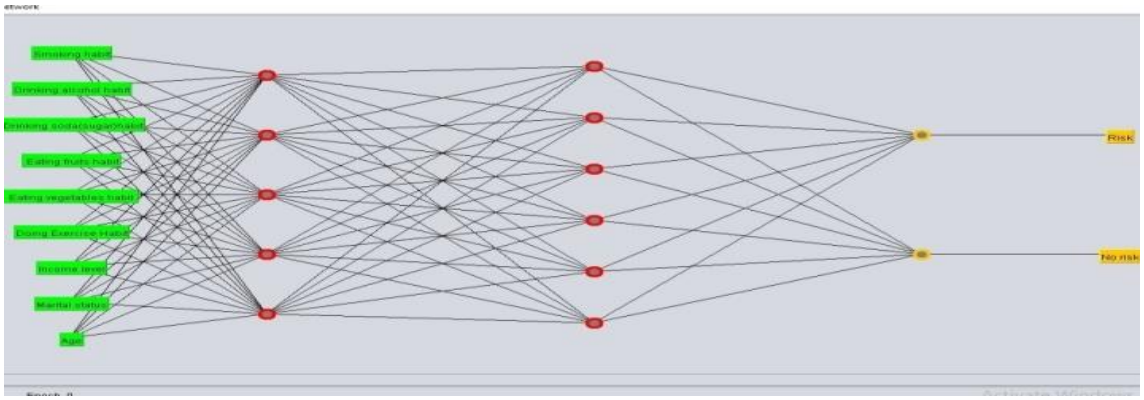

Fig. 2.Architecture of NN with one input layer (9 nodes), two hidden layer(5,6 nodes) and one output layer(2 nodes) in WEKA.

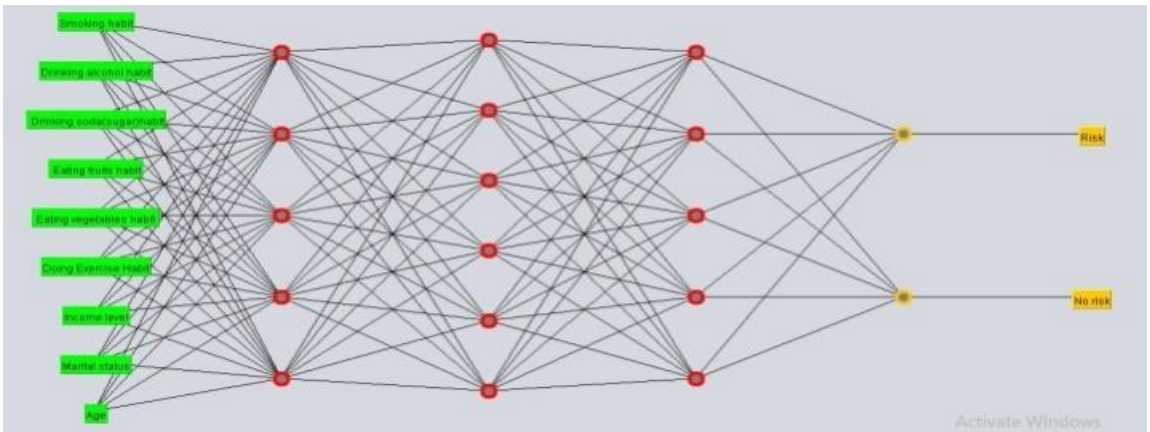

Fig. 3. Architecture of NN with one input layer (9 nodes), three hidden layer(5,6,5 nodes) and one output layer (2 nodes).

Training and testing data percentage for each NN: 60% - 40%, 50% -50% and 70%-30%

Behavioral habits:

S.NO	VARIABLE	DESCRIPTION OF VARIABLE	VALUE	VALUE LABEL
1.	Smoking Habit	Smoking at least 100 cigarettes in the entire life or not	1	Yes
			2	No
2.	Drinking alcohol habit	Number of days of having at least one alcoholic drink per week or per month during past 30 days	101-199	Days per week = 1- -
			201-299	Days in past 30 days = 2- -
			888	No drink in past 30 days
3.	Drinking Soda (Sugar) habit	Frequent of drinking regular soda during the last 30 days	101-199	Times per day = 1- -
			201-299	Times per week = 2- -
			301-399 888	Times per month=3- -
4.	Eating fruit habit	Habit of eating fruits – Time per day, week or month	101-199	Per day = 1- -
			201-299	Per week = 2- -
			300	Less than one time per month
			301-399	Per month = 3- -
			555	Never
5	Eating vegetable habit	Habit of eating vegetables – time per day, week or month	101-199	Per day = 1- -
			201-299	Per week = 2- -
			300	Less than one time per month
			301-399	Per month = 3- -
6	Exercise	Doing exercise	Yes	1
			No	2

Demoographic Variables:

S.NO	VARIABLE	DESCRIPTION OF VARIABLE	VALUE	VALUE LABEL
7.	Marital Status	Married, Divorced, Widowed, Separated, ,Never married, A member of an unmarried couple	1	Married
			2	Divorced
			3	Widowed
			4	Separated
			5	Never Married
			6	A member of an unmarried couple
8.	Income level	Annual income level	1	AboveRs. 9,00,001
			2	Between Rs.7,00,001- 9,00,000
			3	Between Rs. 5,00,001 – 7,00,000
			4	Between Rs. 3,00,001 – 5,00,000
			5	Between 1,00,001- 3,00,000
			6	Below 1,00,000
9.	Age	Age of the Person	Age	Actual age of person

Table 1 Analysis of input variables

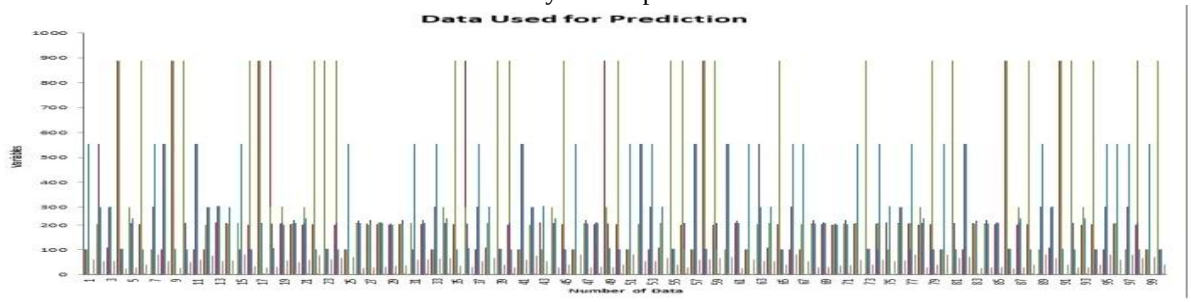

Fig. 4. Graphical representation of Number of data and Variables

Table 2 Analysis of output variable

S. NO	VARIABLE	DESCRIPTION OF VARIABLE	VALUE	VALUE LABEL
1	History of heart attack	Whether particular person has heart attack or not in his history	Yes	1
			No	2

IV. Experimental Results

The data are trained and tested for results. The details of hidden layer, number of nodes, training set, testing set, correctly classified instances and incorrectly instances are given below5

S. NO	HIDDEN LAYER	NO OF NODES	TRAINING SET(%)	TESTING SET(%)	CORRECTLY CLASSIFIED(%)	INCORRECTLY CLASSIFIED (%)
1	1	5	60	40	97.5	2.5
2	1	5	50	50	98	2
3	1	5	70	30	98	2

Table 3 Analysis of output with hidden layer 1 and 5 nodes

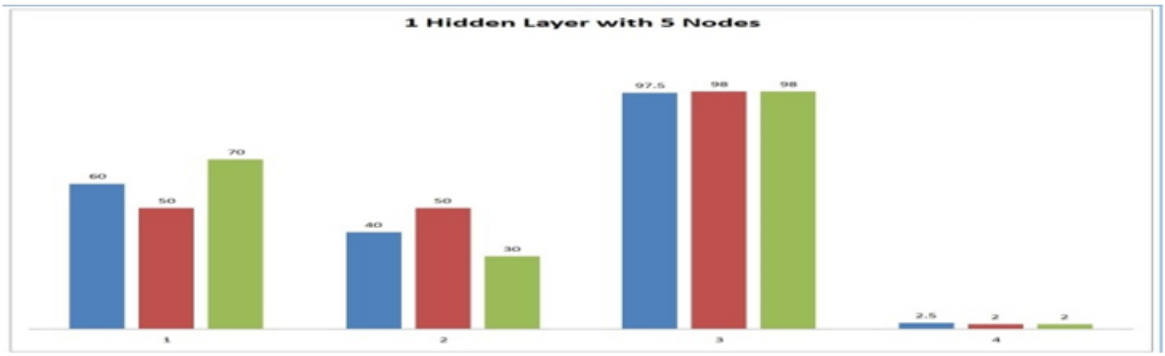

Fig. 4 Graphical representation of analysis of outputwith hidden layer 1 and nodes 5

S.No	Hidden Layer	No of nodes	Training Set(%)	Testing Set(%)	Correctly classified(%)	Incorrectly classified (%)
1	2	5,6	60	40	98.333	1.6667
2	2	5,6	50	50	98	2
3	2	5,6	70	30	97.5	2.5

Table 4 Analysis of output with hidden layer 2 and 5, 6 nodes

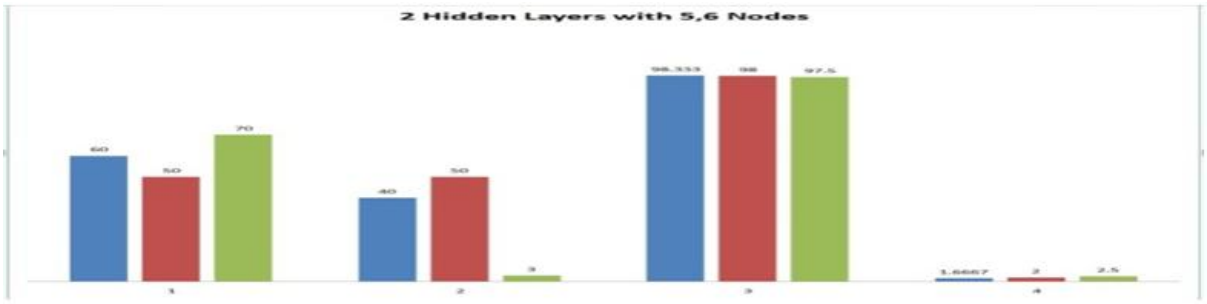

Fig. Graphical representation of analysis of outputwith hidden layer 2 and nodes 5,6

S.NO	HIDDEN LAYER	NO OF NODES	TRAINING SET(%)	TESTING SET(%)	CORRECTLY CLASSIFIED(%)	INCORRECTLY CLASSIFIED (%)
1	1	5,6,5	60	40	97.5	2.5
2	1	5,6,5	50	50	98	2
3	1	5,6,5	70	30	96.667	3.3333

Table 5 Analysis of output with hidden layer 3 and 5, 6, 5 nodes

V. Conclusion

The behavioral habit and demographic variables are trained and tested. This research work predicts the risk of heart attack based on behavioral habits and demographic variables of an individual. This enables individuals to make life style changes to promote their health. We contribute a preventive health care for individual and it may be used by governments to frame campaigns and policies countering heart attack.

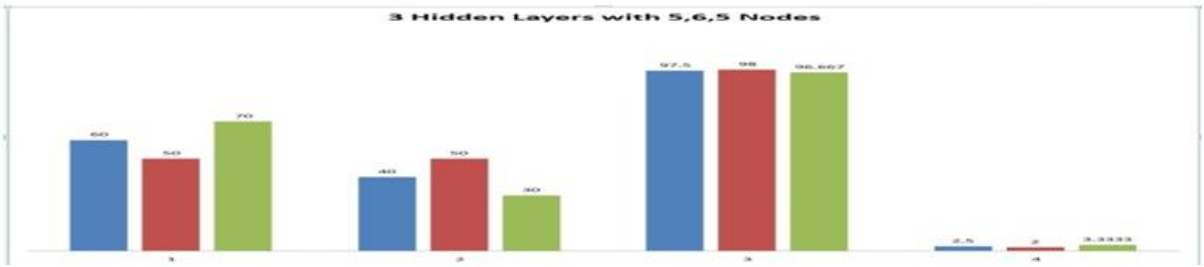

Fig. 6 Graphical Figure representation of analysis of output with hidden layer 3 and nodes 5,6,5

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