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Research Article

Fuzzy Genetic Grey Wolf based Deep Learning Model For Classification on Breast Cancer Dataset

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Abstract: Neural Network is based on biological evolution of human brain. It is an emerging approach used to develop new and robust competing techniques. For solving learning and data analysis problems neural network techniques are used for better performance. In Medical data analysis, neural network, genetic and fuzzy techniques are widely used. In this paper, we proposed a new fuzzy genetic grey wolf based deep learning model on breast cancer dataset. Deep Convolution Neural Network (CNN) is an evolutionary algorithm, which mimics the process of human brain.CNN algorithm frequently used to solve classification problems. In medical domain, we need more accuracy when compared to other domains, because it closely related with the human life. Breast Cancer is one of the dangerous diseases among women in India as well as in the whole world.Deep learning based techniques has developed rapidly in recent years, mostly in classification. The proposed fuzzy genetic grey wolf based deep learning model produces better accuracy for classification on breast cancer dataset.

Keywords**:** *Breast Cancer, Convolutional Neural Network (CNN), Fuzzy logic, Deep learning, Genetic algorithm.*

1. Introduction

1.1 Breast Cancer

Breast Cancer is the most common cancer in most cities and the second most common in rural India. Breast Cancer accounts for 25% to 32 % of female cancers in all cities across India. In India, one woman is diagnosed with breast cancer every 4 minutes. One woman dies of Breast Cancer, every 13 minutes in India. In recent years, Deep Learning technique is applied in many domains especially in medical domain. Many researchers are contributed their deep learning CNN based research work on Breast Cancer detection, diagnosis and prediction.

Cancer begins when healthy cells in the breast change and grow out of control, forming a mass or sheet of cells called a tumor. A tumor can be cancerous or benign. A cancerous tumor is malignant, meaning it can grow and spread to other parts of the body. A benign tumor means the tumor can grow but will not spread.

Breast cancer spreads when the cancer grows into adjacent organs or other parts of the body or when breast cancer cells move to other parts of the body through the blood vessels and/or lymph vessels. This is called a metastasis.

1.2 Deep Learning

Neural Network is introduced by Warren McCulloch and Walter Pitts in early 1950.Deep Neural Network is a new area which became popular in the recent years. The main difference between neural network and deep learning is in neural network neurons are used to transmit data in the form of input and output values through connections. Whereas, deep learning related with extraction of feature which is associated with neural responses present in brain.

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind many domains especially in medical domain. In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

Deep Learning is an AI function that mimics the working of the human brain in processing data for use in detecting objects, recognizing speech, translating languages and making decision. Deep learning AI is able to learn without human supervision, drawing from data that is both unstructured and unlabeled. In recent, a variety of DeepCNN algorithms have been proposed in various domains like medical, pattern recognition, etc.

2. Literature Review

2.1 Fuzzy System

Abir Alharbi et al [13] proposed genetic fuzzy algorithm on breast cancer dataset. They combined genetic algorithm and fuzzy algorithm. The three fuzzy rules are achieved. Their result achieved high accuracy with simple rule.

Bekaddour Fatima et al [14] proposed neuro fuzzy inference model for breast cancer recognition. Wisconsin breast cancer dataset (UCI) was used for their study. Classification of breast cancer is done by neuro fuzzy approach.

Arpita Das et al [15] proposed genetic based neuro-fuzzy techniques for breast cancer identification. On their research they used genetic algorithm for searching feature vectors. Then they applied adaptive neuro-fuzzy based classifier for classification. They yield good result.

In [16], Bura Lakshmi Ramani et al proposed a Deep learning model with Fuzzy Rule Based hybrid fusion. They introduce new novel technique called robust grey wolf based sine cosine Algorithm based fuzzy system.

Hussein A.Lafta et al [18] used genetic fuzzy rule based system for diagnosing breast cancer. WBCD dataset is used for their research. The resulting system had a few simple rules.

In [17], P.Ganesh Kumar et al proposed an improved genetic algorithm approach for the optimal design of the fuzzy system for the classification. Stanton R.Priceet al [24] proposed fuzzy layers for deep learning. The proposed fuzzy layer is capable for implementing any fuzzy aggregation method.

In [25], R.Keerthiga et al proposed deep learning based breast cancer detection and classification using fuzzy merging techniques. The novel multilevel saliency nuclei detection technique is integrated with deepCNN.

2.2 Genetic Algorithm

Genetic Algorithm (GA) is a partial search inspired by the process of natural selection that belongs to the larger class of evolutionary algorithms (EA).Genetic algorithms mainly used in optimization and search problems. GA is inspired from biological operators such as selection, crossover, and mutation. John Holland [11] introduced genetic algorithm in 1970 based on the concept of Darwin's theory of evolution.

Marisa Dolled et al [19] classifies the breast cancer data using genetic algorithm for Tissue microarrays. Marisa Dolled et al used a genetic algorithm was used to develop a multiplex marker assay for separation of prognostic groups based on expression of ER, GATA3, and NAT.

Lukasz Chomatek et al [20] proposed new measures for identifying outliers using genetic algorithm for breast cancer dataset. After the experiment they found that an objective can be successfully applied in the fitness function for the multi objective genetic algorithm. Such a measure cannot be directly applied to the deterministic algorithms, because they are not iterative. The proposed fitness function and the method for acquiring the accuracy can be used with all of the most popular genetic algorithms.

2.3 Grey Wolf

In 2014, Seyedali Mirjalili et al proposed [12] Grey Wolf optimization algorithm. It is Meta- heuristic based optimization algorithm .Which has become more popular in recent decades because of its simplicity. Grey Wolf lives in a group which native is Canidae family.GWO mimics the leadership hierarchy for group hunting of wolves. It is one of the famous techniques among various Swarm Intelligent techniques.

Seyedali Mirjalili et al Proposed [21] a novel optimization technique called as Grey Wolf Optimizer(GWO).The proposed work actually mimic of hunting of Grey Wolves especially Canis Lupus. They used twenty nine test functions in order to bench mark the performance of the proposed algorithm. The proposed technique performs well when compared to other existing Meta heuristic algorithm.

In 2018, Shankho Subhra Pal et al [22] proposed Grey Wolf Optimization based Feed forward Neural Network for Breast Cancer Classification. By Applying Grey Wolf Optimization they achieved good accuracy rate.Many researcher enhanced the Grey wolf Optimization algorithm.

Qiang Lie et al [23], enhanced Grey Wolf optimization (GWO).They used GWO for feature selection, extreme learning machine for diagnosing medical data. Qiang et al proposed, an improved grey wolf optimization, IGWO, for selecting the most informative features in the specific medical data.

2.4 Convolutional Neural Network

A convolutional neural network (CNN) is neural networks that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other domains. A convolution is essential sliding filter over the input.

Convolutional neural networks, also called ConvNets, were first introduced in the 1980s by Yann LeCun, a postdoctoral Computer Science Researcher. The early version of CNNs, called LeNet which recognize handwritten digits.

Murtada k. Elbashir et al [10] proposed a light weight convolution neural network for classification of breast cancer data on RNA sequence expression data. The gene expression is downloaded from Pan Cancer Atlas using R studio.

In 2020, J. Zuluaga-Gomez et al [1] proposed a CNN based methodology breast cancer diagnosis using thermal images. They showed that a well-delimited database split technique assures the bias and overfitting decreasing during the training process. In addition, this paper conveys the first state-of-the-art benchmark of CNN architectures such as ResNet, SeResNet, VGG16, Inception, InceptionResNetV2 and Xception. Their study establishes the first CNN hyper parameters optimisation in a thermo graphy database for breast cancer

S. Akila Agnes et al [2] proposed multi scale convolutional Neural Network (MA-CNN). The proposed MA-CNN model successfully recognizes the category of the mammogram images, thus it provides an assistive cancer detection tool to the radiologist for an effective diagnosis of breast cancer from mammogram images.

Christian Szegedy et al [6] proposed deep convolution neural network architecture. The main thing of this architecture is the improved utilization of the computing resources inside the network and it is also based on hebbian principle and multi-scale processing.

Xiang Yu et al [8] introduced a new method called SCDA and they developed a diagnostic system for a breast classification. CLAHE contrast enhancement method is used for pre-processing. To specify the CNN models showing best performance on the binary classification task, they explored the models with state-of-the-art connection methods including inception (GoogLeNet, Inception v3), residual learning (ResNet), dense connection (DenseNet), depth wise and point wise convolution (Xception). The experimental results show that ResNet-50 gives the best performance amongst all of those models.

In 2019, Yuanqin Chen et al [7] proposed ResNet model which classifies breast cancer images. For this research they used CBIS-DDSM scanned film mammography. They focused on training time and reduced the over fitting. The main contribution is to produce transfer learning and data augmentation for automatic mammography classification.

2.5 Deep Convolutional Neural Network

Alex Krizhevsky et al [3] introduced a new CNN model named AlexNet. On their research they used non saturating neurons for training. Dropout method is used to reduce over fitting in the fully connected layers.

Xin Zhao et al [4] proposed a new deep neural network model to classify malignant and benign in digital mammograms. On their proposed model they improved AlexNet. MIAS dataset was used which contains 4600 images. They achieved 97.57 accuracy. Normally AlexNet structure consists of 5 conv layer, 3 max pool layer and 3 fully connected layers. In their proposed work they changed the neurons and filter settings of part layers.

Vaira Suganthi et al [5] proposed a deep learning algorithm for breast masses classification in mammograms. On their work they introduced three class CNN model. The model is experimented with two breast cancer datasets.

In reference [9], Wajahat Nawaz et al proposed modified AlexNet model; for the classification of breast cancer dataset H and E stained dataset is used for their research.Wajahat et al reduced the size of fully connected layer to avoid overfitting. Patch wise, image wise classification is used for performance evaluation. The modified AlexNet achieved good result.

3. Methodology

3.1 Fuzzy System

Fuzzy logic is introduced by Lotfi zadeh in the year 1965. Fuzzy logic is a form of many valued logic, which deals with reasoning that is approximate rather than fixed and exact. Compared to traditional binary sets (where variables may take on true or false values), fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to manage the concept of partial truth (range between completely true and completely false)[13].

3.1.1 Fuzzy System Architecture

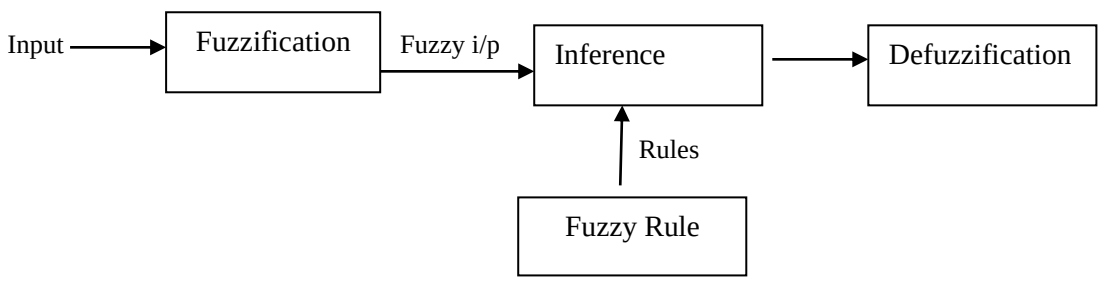

Fig 1 - Basic Fuzzy System

a. Fuzzy Sets

Fuzzy set theory generalizes classical set theory to allow partial membership with boundary. The degree of membership in a set and a number between 0 and 1.It means 0 is entirely not in the set and 1 means entirely in the set. Mathematically, a fuzzy set A in the universe of discourse X is defined to be a set of ordered pairs

$$A = \{(x, \mu_A(x)) | x \in X\} \quad (1)$$

Where $\mu_A(x)$ is called membership function of x in A.The triangular membership function is shown below:

$$\mu_A(x) = \begin{cases} 0 & x < a) \\ (x-a)/(b-a) & a < x < b) \\ (c-x)/(c-b) & b < x < c) \\ 0 & x > c) \end{cases} \quad (2)$$

b. Fuzzy If then Rules

Fuzzy rule based diagnostic system consist of interpretable if –then –rules representing

If {antecedent clauses} then {consequent clauses}

c. Fuzzy Inference

It is the method of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made.

d. Deffuzzification

Defuzzification is the process of producing a quantifiable result in crisp logic, given fuzzy sets and corresponding membership degree. There are many different methods of defuzzification

1. Basic Defuzzification Distributions (BADD)
2. Bisector of Area (BOA)
3. Center of Area (COA) or Centroid etc.

Here, we used Centroid function for defuzzification.This method determines the center of area of fuzzy sets and returns the corresponding crisp value.

3.2 Genetic Algorithm

In Genetic Algorithm, there are four phases namely, Population, Selection, Crossover and Mutation. Population is the first phase in genetic operation, which is known as set of individual. An individual is characterized by a set of parameters (variables) known as Genes. The combined Genes are known as Chromosome which is solution. The fitness function is used to find, how fit it is when compared to other individuals and fitness score is calculated for each individual. According to the fitness score the individual will be selected for reproduction. Selection is the next process in the genetic algorithm. Population produces chromosomes which will be act as parents to crossover. According to Darwin's evolution theory, the best ones should survive and create new offspring. Chromosomes can be selected in many ways. There are many methods how to select the best chromosomes. After Selection, Crossover is the most significant phase in a Genetic Algorithm. Crossover means mating the parents. A crossover point is used for in which each pair of parents to be mated at random (genes).In certain new offspring formed, some of their genes can be subjected to a mutation with a low random probability. This implies that some of the bits in the bit string can be flipped.

Pseudo code for Genetic Algorithm

1. Input the data.
2. Start
   Generate the Initial Population
   Compute Fitness, Repeat Selection, Crossover, and Mutation
   Compute Fitness until Population has converged

Stop

3.3 Grey Wolf Optimization

The stages of Grey Wolf optimization are:

1. Alpha (α)
2. Beta (β)
3. Omega (Ω)
4. Delta (Δ)

In the above hierarchy of Grey Wolf, the Alpha (α) is the head or it has authority to take decision. Beta (β) is known to be advisor to the Alpha or in other words it is the second level leader. Third level is omega (Ω) which obeys Beta and Alpha. Delta (Δ) wolves are another type of wolves.

Pseudo Code for Grey Wolf Optimization

1. Initialise the population of Grey Wolves

Do

For each particle

a. Calculate the fitness value of search agent agents.

(Alpha is the best Solution, Beta is the Second best and Gamma is the Third best)

b. Update the current Search agent

c. Calculate the fitness value of all search agents and grading them

End For

While the end condition is not satisfied

2. Return Alpha Best as the best estimation.

3.4 Deep Learning CNN Model

There are five different layers in CNN

a. Input Layer
b. Convolutional Layer
c. Pooling Layer
d. Fully Connected Layer
e. Output Layer

3.5 Proposed Fuzzy Genetic Grey Wolf based Deep learning Model

Fuzzy logic is a form of many valued logic, which deals with reasoning that is approximate rather than fixed and exact. In Fuzzy rule based systems, fuzzy sets and fuzzy logic are used as tools for representing different forms of knowledge. Genetic Algorithm is a generalized search and optimization technique inspired by the theory of biological evolution. Genetic Algorithm produces multiple solutions to a given problem and evolves through number of generations. Grey wolf is another emerging optimization technique which is incorporate with genetic algorithm produce high accuracy. Genetic algorithm is optimization technique which is hybrid with neural network also produces high result. In this paper, we proposed Fuzzy Genetic Grey Wolf based deep learning model. The output of the fuzzy system is given as input to the deep CNN. The deep convolutional neural network is trained with genetic grey wolf model. The proposed genetic grey wolf fuzzy based deep CNN model produces high accuracy.

3.5.1 Dataset Description

The Wisconsin Diagnostic Breast Cancer Data (WDBC), from the University of California at Irvine (UCI) machine learning repository available on the UCI domain was used. The knowledge acquisition process was carried out by the extraction and analysis of numerical data of WDBC with medical experts. There are three types of breast cancer diagonis: mammography, FNA and surgical biopsies.

In FNA specialist physician uses a thin needle 9which varies from 0.6-0.8 mm) and a syringe to take sample of fluid from a breast cyst or remove cluster of cells in solid mass. The needle inserted into the skin toward the lesion, with the objective of collecting cells for further evaluation.

The WDBC is a public database, consisting of a various breast cancer dataset .The selected database ,WDBC contains 569 records of patients with known diagnosis 357 cases of benign and 212 case of malignant and collected by FNA(Fine Needle Aspirate). The Dataset Contains 569 samples (212 Malignant and 357 Benign) and 32 number of attributes. The analysis made to diagnosis or predicting breast cancer disease. This dataset contains 2 classes one is malignant and other is benign. Dataset contains none missing attribute and Class distribution are 212 malignant, 357 benign. Dataset contains 10 major real-valued features which are computed for each cell nucleus.

3.5.2 Fuzzification Stage

Table 1- Attribute Information

Attribute Name	Range
Area	1-50
Texture	1-10
Perimeter	1-50
Radius	1-50
Smoothness(local variation in radius lengths)	1-10
Compactness	1-10
Concavity(severity of concave portions of the contour)	1-10
Concave points(number of concave portions of contour)	1-10
Symmetry	1-10
Fractal dimension	1-10
Output Class	0 for benign and 1 for Malignant

In this stage input variable is used to find which fuzzy sets they relate, and assigning the respective degree to each. Heuristic method is used to adjust membership function to gain result. Thus, before creation of fuzzy system it was necessary to build membership function which used both fuzzification and defuzzification. Table 1, consists of 10 descriptor such as Area, Perimeter, Radius, Smoothness, Concavity point, Compactness, Symmetry, Fractal dimension, Concave point, texture. Among them Area, Perimeter, and Radius are defined through the membership function described below:

a. Area Membership Function

Area is the one of the important feature. This membership function is composed of high, mid and low and in linguistic term it is represented as $H_{Area,}$ M_{Area} ,$L_{Area.}$

Area Fuzzy set

Low Area(L_{Area}) <50 --->H_{Area}
High Area(H_{Area})>50 ---->L_{Area}
Mid Area(M_{Area})=50 ---->M_{Area}

b. Perimeter Membership Function

This membership function is composed High, Mid and Low perimeter and in linguistic term it is represented as $H_{per,}$ M_{Per}, $L_{per.}$

Perimeter Fuzzy set

Low Per (L_{per}) <50 -- -.> H_{per}
High Per (H_{per}) >50 -----> L_{per}
Mid Per (M_{per}) = 50 ----> M_{per}

c. Radius Membership Function

This membership function is composed high and low perimeter and in linguistic term $H_{radi,}$ L_{radi} ,$M_{radi.}$

Radius Fuzzy set

Low Radi(L_{radi}) <50 ----.> H_{radi}
High Radi (H_{radi}) >50 -----> L_{radi}
Mid Radi (M_{radi}) =50 ------>M_{radi}

d. Fuzzy Rules Definition

The rule has been formed as the follows

Fuzzy rules have the structure of the form;

If {antecedent clauses} then {consequent clauses}
R: {R1, R2, R3 ...R_n} --------> Set of Rules
Desc: {Desc1, Desc2, $Desc_n$,} ------> Set of Descriptors
P : {benign ->B, Malignant->M} --->Parameterization of the Descriptor

Rules Definition

Rule 1: If Area=low and Perimeter=low and Radius=low then Benign
Rule 2: If Area=low and Perimeter=low and Radius=high then Benign
Rule 3: If Area=low and Perimeter=high and Radius=high then Malignant
Rule 4: If Area=high and Perimeter=low and Radius=low then Benign
Rule 5: If Area=low and Perimeter=high and Radius=low then Benign
Rule 6: If Area=low and Perimeter=high and Radius=low then Benign

Rule 7: If Area=high and Perimeter=low and Radius=high then Malignant
Rule 8: If Area=high and Perimeter=high and Radius=low then Malignant
Rule 9: If Area=high and Perimeter=high and Radius=high then Malignant

3.5.3 Inference stage

In this stage, fuzzy output is generated with its respective compatibility degree with the help of the input entries. In this, Mamdani is used in which activation function of each rule is enabled and the system of inference determine the degree of compatibility of the rules premises contained in the rule base. In the Next stage output membership function enables the rule. The Output Set (OS) contains all results that are acceptable for the input set. Each case is also considered which is already defining in rule base.

Table 1- Rule Specification

Rule Number	Rule Specification
1	If Area=low and Perimeter=low and Radius=low then B
2	If Area=low and Perimeter=low and Radius=high then B
3	If Area=low and Perimeter=high and Radius=high then M
4	If Area=high and Perimeter=low and Radius=low then B
5	If Area=low and Perimeter=high and Radius=low then B
6	If Area=low and Perimeter=high and Radius=low then B
7	If Area=high and Perimeter=low and Radius=high then M
8	If Area=high and Perimeter=high and Radius=low then M
9	If Area=high and Perimeter=high and Radius=high then M

3.5.4 Defuzzification Stage

This is the final stage; single numeric value is extracted from all possible cases contained in the fuzzy set obtained from inference stage. As a resulting from the relations and variability of descriptors Area, Perimeter, Radius, the function Centroid is used for defuzzification. Defuzzification is composed of "Benign","Malignant". Defuzzification (if 0 < (output) < 5 then malignant else if (5 < (output) < 10 then Benign.

The following is the Pseudo Code of proposed work.

Pseudo code of proposed Fuzzy Genetic Grey Wolf based Deep learning Model

1. Input the data in to Fuzzy System.

Start

Fuzzification
Generate Fuzzy input data
Compute Membership function (Triangle)
Generate Fuzzy rules have the structure of the form;
If {antecedent clauses} then {consequent clauses}
Defuzzification (if 0 < (output) < 5 then Malignant else if (5 < (output) < 10 then Benign

Stop

2. Input the data.

Start

Generate the Initial population
Compute fitness, Repeat Selection (Grey Wolf optimization),
Crossover and Mutation
Compute fitness until population has converged

Stop

3. Train the deep CNN with optimal Chromosome.
4. Add a First Convolution layer (Max Average pooling/ReLu activation function).
5. Batch Normalization is used
6. Drop out layer is used.
7. Fully connected layer (Dense Layer).
8. Output of the first block of conv layer is given input to the second conv layer.
9. Add a second Convolutional Layer (Max Average pooling /ReLu activation function).
10. Fully connected layer (Dense Layer).
11. Fully connected layer (last layer holds the score of each class) softmax is used.

The following figure 2 represents the proposed Fuzzy Genetic Grey Deep learning Model.

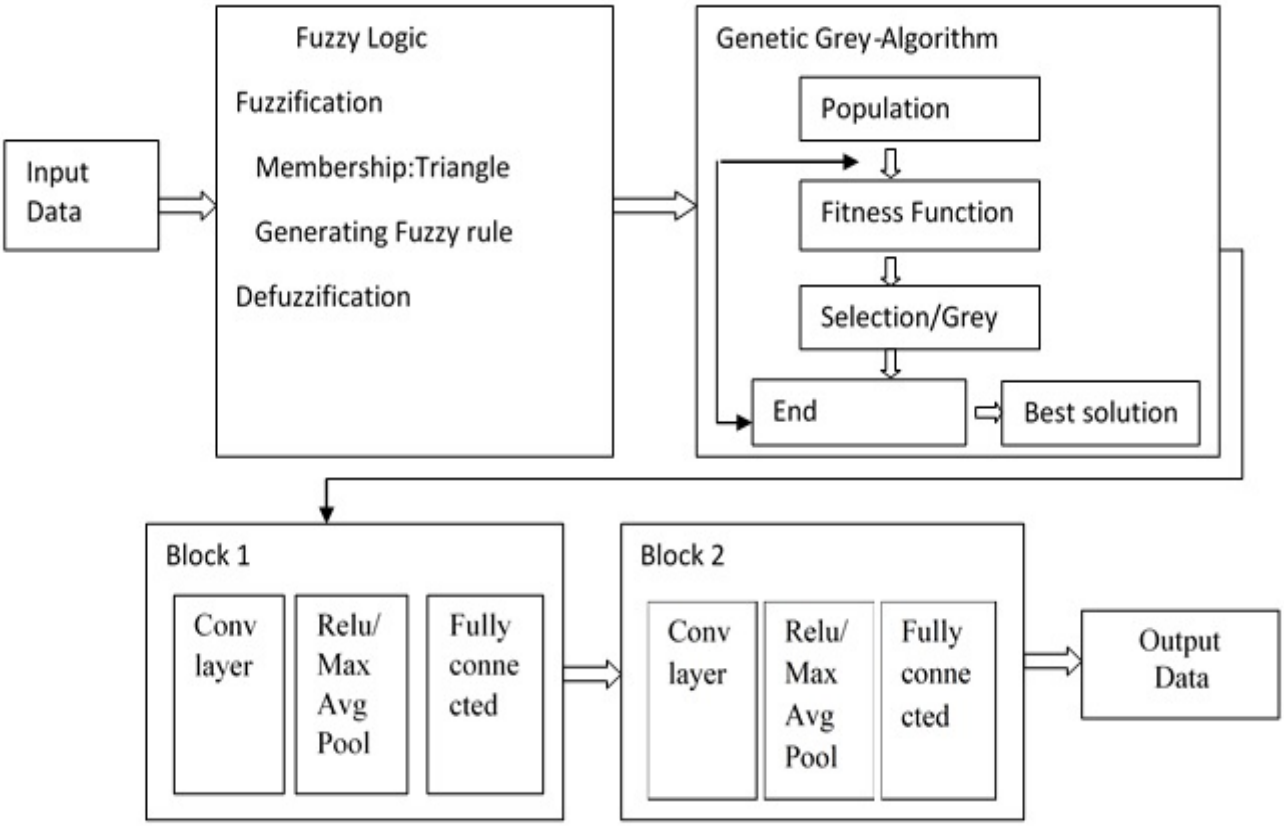

Fig 2 - Proposed Work Architecture

4. Experimental Results

4.1 Dataset Description

Wisconsin Breast Cancer (Diagnostic) Data Set (WBCD) is used for the analysis**.** UCI Machine Learning Repository is a collection of databases, domain theories, and data generators that are used by the machine learning community for the empirical analysis of machine learning algorithms. In this dataset there are a total of 569 cases from which 212 are Malignant and 361 are Benign.

4.2 Implementation Tool

Python language is one of the most accessible programming languages available because it has simplified syntax and not complicated, which gives more emphasis on natural language. Due to its ease of learning and usage, Python codes can be easily written and executed much faster than other programming languages. Python is open source, interpreted, high level language and provides great approach for object-oriented programming. It is one of the best languages used by data scientist for various data science projects and application. It provides great libraries to deals with data science application.

4.3 Results

Table 2 -Summarized result of three parameters crossover, mutation, population

Stage	1	2	3
Crossover Rate	0.1	0.5	0.7
Mutation Rate	0.01	0.05	0.09
Population Size	12	23	30

Table 3- Deep Learning CNN Layers Details

Layer	Kernel Size	Acivation
Convolutional Layer1(conv1)	3x3	ReLu
Max Average pooling1	3x3	Max
Batch Normalization	3x3	ReLu
Drop out	3x3	-
Dense (Fully Connected)	3x3	Softmax
Convolutional Layer2(conv2)	3x3	ReLu
Max Average pooling	3x3	Max
Dense(Fully Connected)	3x3	Softmax

Table 4 -Performance Comparison with other Approach

METRICS	MWSVM	G^2NN	CNN	Proposed Model (Fuzzy Genetic Grey Wolf based deep learning model)
ACCURACY	0.985	0.989	0.984	0.997
PRECISION	0.962	0.972	0.973	0.984
RECALL	0.975	0.978	0.976	0.987
F1 -SCORE	0.968	0.974	0.974	0.985

The above table 4 shows the classification result of proposed model as well as the existing model such as MultipleWeight SVM, Genetic Grey based Neural Network, CNN model and proposed model.

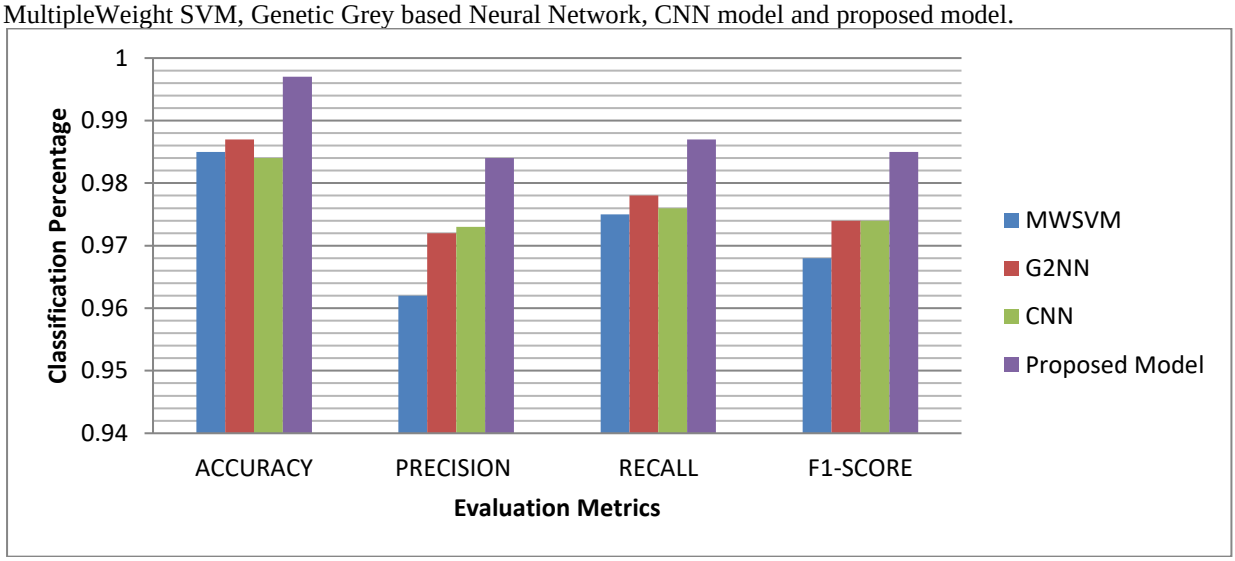

Fig 3- Evaluation Metrics

5. Conclusion

Breast Cancer is the one of the dangerous disease in women in all over world. Many machine learning techniques are used for breast cancer classification. In this paper fuzzy genetic grey wolf based deep learning model is introduced for breast cancer classification. In recent years, deep learning techniques became popular in many domains especially in classification of medical data.Efficient convolution neural network architecture are used to detect and classify the breast cancer which help for the doctors to a greater extent. When genetic algorithm incorporates with neural network it produces high result. The UCI Breast Cancer Data Set is used. First, a fuzzy logic is applied and the output of the fuzzy logic is given input to the deep learning CNN model. Hybrid genetic grey wolf technique is used for training deep convolutional neural network. Evaluation metrics such as Accuracy, Precision, Recall and F1Score are used.We found that fuzzy genetic grey wolf based deep learning model produces high classification accuracy when compared to existing algorithms. We found the accuracy measure of 99.7%, Precision of 98.4%, Recall of 98.7 % and F1 Score of 98.5%.

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