A Novel Hybrid Application of Radial Basis Function Neural Network and Fuzzy Logic for Detection and Diagnosis of Lung Cancer

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Abstract:
In this paper a novel guideline based remedial model is proposed to recognize and examine lung infection. The Training and Testing of if-then guidelines is controlled by using a Radial Basis Function Neural Network (Train the Rules and Testing for new indications) and Fuzzy Rule Base, populated by principles made for different sorts of lung development. The count uses the yield of the standard base (i.e. the disorder name) and the appearances entered by the patient; it moreover uses the need and reality qualities to choose the period of malady the patient is in. Both these results (disease name and stage) help the specialist to choose the treatment for the patient with precision. The proposed therapeutic determination deals with a mind boggling examination of the considerable number of information collected about danger reactions. Space expert's learning is collected to deliver manages and set away in the standard base and the rules are given up when there exist appropriate signs. The structure is executed for the therapeutic conclusion and treatment for the patients and moreover it can be used to help the experts.

Keywords: Radial Basis Function Neural Network, Fuzzy Rule Base, mind boggling examination, therapeutic examination of the Disease

I. Introduction

Lung disease is the irregular development of cells in one or both lungs, and ordinarily happens in cells that are in the way of air trade. Anomalous cells won't create solid ordinary tissues; they will partition quickly and structure tumors. Location of lung growth in early stages is altogether essential in treatment. In America, 1 of each 14 men, and 1 of each 16 ladies are having lung malignancy. The measure of danger for smoking individuals is considerably more. The greater part of the patients of the lung disease is analyzed at 60 years old. There are 2 distinct sorts of lung growth, of this as well, little cell lung malignancy is more forceful, it implies that in the early stages it can spread quicker to alternate organs of the body. Little cell lung growth is connected especially to smoking, and is infrequently found in non-smokers. Non-little cell lung tumor is becoming slower in the body, however it is more basic, and it covers right around 90 percent of all the lung growth cases.

There are 4 classes for organizing the lung tumor, in any case, in total, arranging is isolated into 3 general phases of the malady:

Stage 1: the range is little and limited to the lung and 85 to 90 percent of the time it’s treatment with surgery is sufficient.

Stage 2: range is little, and it incorporates the lungs and lymph hubs and treatment is chemotherapy or chemotherapy consolidated with radiation treatment and surgery.

Stage 3: range is bigger and notwithstanding lungs and lymph hubs, it has spread to different organs and treatment is chemotherapy and once in a while chemotherapy consolidated with radiation treatment

1.1 Proposed Research Work

This proposed work manages the procedure used to decide the infection name, stage and the symptomatic treatment utilizing the calculations RBF Neural Network and a Fuzzy rule base (generated particularly for a disease). Here the doctor takes the symptoms of a patient as data and in light of his manifestations, appropriate demonstrative treatment is recommended to a patient. Every manifestation has its own need esteem and the doctor does out priorities to the phonetic variables i.e. slight, low, medium, high and critical. Here the priority values are appointed by symptoms. For instance, if blood in sputum is the key manifestation that decides the event of lung disease then it is given higher need when contrasted with different symptoms. The enrollment qualities are allotted in the middle of 0 and 1. The ultimate goal is to describe a fuzzy logic technique used to determine the disease name, stage and the diagnostic treatment for the lung diseases based on the patient symptoms. In the proposed work the patient will enter the symptoms as data and in light of the symptoms diagnosis will be recommended to a patient. Every symptom has its own need esteem and an allocated enrollment qualities to the semantic variables i.e. low, low, medium, high and high. The calculation created utilizes the rules base to decide the disease name taking into account the symptoms.
entered by the patient. This rule base comprises of standards created for a specific kind of lung growth which are trained by a RBF Neural Network and decides the sort of lung disease a patient has. Based on the severity of the symptoms entered the algorithm calculates the total membership of the symptoms and the threshold value for this total membership. Then it creates the ranges which represent the different stages of cancer such as Limited, Extensive, and Stage I-III. The diagnosis logic based on these results (i.e. the disease name and the stage) and the rule base developed determines the appropriate diagnostic treatment for the patient. The rules populated in this rule base are developed for different types of lung cancer. These rules take into account the disease and the cancer stage determined by the algorithm to prescribe the treatment.

II. System Architecture

![Diagram of system architecture](image)

III. Proposed Algorithm

The Radial Basis Function Neural Network is used for Training the data. Here 100 Samples are taken and in those 100 Samples 65 are given for Training, 20 are given for Cross Validation, 10 are given for Testing and 5 samples are used for production. After the application of this RBF Neural Network algorithm the following Fuzzy Logic algorithm is applied on the data for removing the ambiguity in the output.

1. Select \( n \) number of symptoms of lung cancer, Assign some priorities values (weight) to the symptoms. For example, \( psymptom_i = p_i \), where \( i = 1 \) to \( n \).

2. Now choose the severity for symptoms and assign some membership values to the linguistic variables; extremely low = 0, Very low = 0.2, medium = 0.4, high = 0.6, very high = 0.8, Extremely High = 1.

3. Symptom \( i \) = very low || low || medium || high || very high; where \( i = 1 \) to \( n \).

4. Calculate the total value

   \[
   \text{Total} = \sum_{i=1}^{n} (\text{symptom}_i \cdot psymptom_i)
   \]

5. Now calculating high and low values
High value = \( n \sum_{i=1}^n (p_{\text{symptom} i} \times 1) \)

Low Value = \( n \sum_{i=1}^n (p_{\text{symptom} i} \times 0) \)

5. Now calculating the membership function i.e fuzzy value(FV)  
\( \text{FV} = \frac{\text{Total value}}{\text{High value (total weight)}} \)  
(or) can say 
\( \text{Support (High value)} = \text{FV} \)

6. Now dividing into N ranges between high and low values, \( B(i+1) = \text{low value} + (k \times \text{high value} / N) \) where \( k = 0 \) to \( N \) and \( i = 0 \) to \( N \).

7. Now Check. For each \( i = 0 \) to \( N-1 \), \( \text{If (total} \geq B(i+1) \) \&\& \( \text{total} < B(i+2) \) \) Then 
\( \text{Stage} = "S_j" \) where \( j = 1 \) to \( N+1 \), Else if (total = \( B(i+2) \)) Then stage = "S_{j+1}"

8. Now check 
For each \( j = 1 \) to \( N+1 \) 
\( \text{if (stage is equal to ("S_j"))} \) 
\{ 
  treatment = "treatment j";
\}

3.1 Fuzzy Rule Base

This proposed research work makes use of RBF Neural Network and fuzzy rule base to make decision for the diagnosis of disease, and the efficiency of the system depends on the fuzzy rules generated. Rule based systems are mainly used in medical diagnosis. In this, the knowledge base stores all information about the symptoms and disease in the form of rules in the Rule base. The rules are generated as per the data gathered from domain expert. The proposed framework comprises of three modules - Doctor Login module, Implementation module and Report module. Specialist Login module is utilized to check the verified specialist. Just the verified specialists have the rights to see the patient records. Usage module is utilized to decide infection and stage in view of the patient chose manifestations. Fuzzy principle is utilized to decide the malady and limit figuring is utilized to decide the phase of the ailment. Report module is utilized to show infection, stage and treatment for the specific malady. It additionally stores the patient data in database for reference by specialist or doctor.

IV. Results

The proposed calculation is executed utilizing a RBF Neural Network for a rundown of patients with the indications. Taking into account the need and seriousness of the indications entered the calculation figures and based on the priority and severity of the symptoms entered the algorithm calculates the total membership of the symptoms and the threshold value for the total membership. Then it creates the ranges which represent the different stages of cancer such as Limited, Extensive, and Stage I-III. Fig.3 Shows the results of RBF Neural Network.

V. Conclusion

The fundamental difficulties in this proposed work is to give precise result to the patient and to make them mindful of lung growth in the early stage itself, along these lines decreasing the multifaceted nature to take treatment at an early stage. The precision of the framework is expanded on the grounds that this framework is actualized with RBF Neural Network. Preparing examination strategies on the same database utilized as a part of the framework alongside the present calculation.

VI. References


