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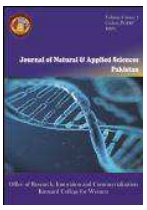

EFFECTIVE PANCREATIC CANCER DIAGNOSIS USING ADAPTIVE NEURO FUZZY INFERENCE SYSTEM

Zunaira Munawar[1], Marium Mehmood[1], Fahad Ahmad[1*]
[1]Department of Computer Sciences,
Kinnaird College for Women, Lahore, Pakistan.

Article Info

*Corresponding Author
Tel: +92 0333-0969489
Email Id:
fahad.ahmad@kinnaird.edu.pk

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Abstract
Artificial intelligence, which is bringing us everything from self-driving cars to personalized ads on the web, is also invading the world of medicine. Pancreatic Cancer early Diagnosis is still in its infancy phase, because the structure and position of the pancreas in the every human body is dissimilar, creating an algorithm is a complicated task that can help the intelligent systems in understanding the both types, i.e., cancer cell patterns and pancreatic tumors. The hybrid technology adaptive networks based Fuzzy inference System is used; it is a tool that allows the pattern recognition system to be streamlined more optimally. Pancreatic cancer can be diagnosed in its early stage by using adaptive control systems using ANFIS. The Hybrid approach helps to detect cancerous cells in the pancreas. Many lives can be saved if the computer scanners having the state-of-the-art technology is used to diagnose cancer of pancreas at early stage, and patients can get best treatment earlier. AI provides us with the optimized results of CT/PET scan which lead us to point the cancer which cannot be seen with human eye.

1. Introduction

What if the Pancreas is removed from the human body? This is a very common question asked by the people, as pancreas is playing a very vital role in human body it is regulating blood and sugar, insulin in the body is controlled by it. In any swear case if the medics have to remove pancreas then the patient need to live the rest of the life very carefully by following all the medical prescriptions and one's life is always in danger.

Pancreas is an organ which is located behind the stomach, pancreas has two main functions exocrine and endocrine, and it helps to regulate blood and sugar in the body. It plays a vital role in the body it converts the food into fuel for body cells. It produces insulin and helps in digestion of food [1].

The risk of pancreatic tumor is the abnormal growth of pancreatic cell due to changes in DNA. Nonetheless, scientists can not reveal any definitive cause of pancreatic cancer [2].

The early symptoms of pancreatic cancer can lead to early diagnosis but unfortunately the researchers are unable to diagnose the patterns [3].

Due to morphology of this organ it is difficult for a radiologist to do proper diagnosis. We can take

advantage of technology in this case which can lead us to do CT scan with software employed in it, using a cancer detection algorithm.

The world of medicine is conquered by artificial intelligence. AI enables healthcare professionals to effectively treat different types of cancer. State-of -the-art technology is being incorporated in the equipment to diagnose cancerous cells and tumors. But early-stage pancreatic cancer diagnosis is still unsuccessful due to dissimilar pancreatic alignment and position, as pancreatic structure varies from person to person and is located throughout the abdomen. This reason makes a challenging situation for computer aided scanners to detect the tumors [4].

Artificial intelligence and radiology seem like a natural match, since so much of the task of reading images involves pattern recognition [5]. It was a vision of the future that has been made for decades. The main purpose is to make an algorithm that can be used in the software which may help to point out the cancer in the pancreas at early stages. Pancreatic cancer is a huge challenge. Only 7% people suffering from Pancreatic cancer are diagnosed and treated at early stage, the only reason the success rate is too low is just because mostly it is detected when it is too late to treat. The aim is to take innovation in this world to help healthcare professionals identify cancer early on, one approach is to train machines to recognize the different patterns, and this can be implemented by using machine learning reinforcement technique and neural networks.

For the detection of pancreas, we are using CT/ PET scans [6]. It will help us to locate and detect the pancreas with a vivid view. The hybrid approach ANFIS is one way which can reduce the model complexity and can detect the cancerous cells in the pancreas. The segregation technique supports to classify the normal and cancerous pancreas.

2. Literature Review

Pancreatic cancer is a digestive track tumor that is difficult to detect both for its stage of development nature and silent symptoms. Just because of what early phase treatment is difficult to complete. In its preliminary stage, computer-aided detection has enabled a course for spotting pancreatic cancer, and CAD incorporates the most advanced methods in machine learning and deep learning. Pancreatic cancer diagnosis is done through PET/CT scans in the same session. PET images provide metabolism information of every major organ where CT images are used to detect structure information[7].

For the clear scans of pancreas, the scientists proposed automated pancreatic scans in which the first idea is to do automated segmentation of the pancreas. The problem of different shape and location was solved by spatial standardization and segmentation technique. Dense path labels were recognized by Neural Networks and random forest technique. For the classification of pancreatic disease MPCA and QSA algorithm were used which gave the apt results [8].

The proposed pancreatic cancer identification model shows that the two scans are done simultaneously which are PET/CT. Firstly the original CT is converted into pseudo-color images and pancreatic ROI CTs are obtained. Secondly all the features are collected for the accurate classification. Lastly, the pancreas is marked as being healthy or cancerous or in which class it exists.

As previously mentioned, the PET/CT data only provides the identification labels of normal pancreas or pancreatic cancer and we thus test our proposed segmentation method on the NIH dataset. Four commonly used segmentation metrics are considered, represents the number of all pixels in the pancreas regions. Pixel SR and pixel TR are the pixels in the segmentation regions (SR) and ground truth regions (TR), respectively. DI is the Dice index and JI denotes the Jaccard index. P and R represent the precision and recall, respectively [6].

The segmentation method using NIH is better method than the previous methods for the detection of pancreatic cancer, but still more efficient methods are required to detect it.

Pancreatic cancer is the fourth most common cause of cancer-related deaths across the globe and it is one of the most difficult cancer types to recognize early. Microarray gene method is one of the proposed methods to diagnose pancreatic cancer at early sage, in this method K-Neareast neighbor (KNN) is used, Anova was used to reduce the size of the High dimensional pancreatic cancer. Artificial Neural Network (ANN) were used to classify pancreatic cancer gene expressions [9].

The accuracy of the classification by using KNN and ANN is not 100% it is still 82%-84% approximately [10].

3. Methodology

Test data from people with pancreatic cancer and who do not have will be used for computer learning. The artificial intelligence is used by combining Neural Networks along with fuzzy systems to diagnose the pancreatic cancer by reducing time complexity. The hybrid approach is used to diagnose pancreatic cancer at early stage.

The proposed hybrid model i.e. Adaptive Neural-Fuzzy Inference System (ANFIS) model is used for diagnosing pancreatic cancer. We have inputs for patients who have symptoms such as Belly or Back-Pain, Weight-Loss, Nausea/Vomiting, Gall Bladder/Liver Enlargement, Diabetes. Patients' symptoms are taken as inputs and process them through our proposed model. We identify fuzzy logic classifiers (input/output variables) from patient's data, select suitable range for them. Subsequently, membership functions are defined. Data authenticity is very necessary, convert data into modules, made refine it. We form rules for fuzzy system such as patient is diabetic, his liver is enlarged, he has back pain, his weight is decreasing continuously and suffering from severe vomiting, then he will have high probability of suffering from pancreatic cancer. When Fuzzy rules are defined, we will transfer our values to model using program code. When patient's severity level increases, we will recommend him for CT-Scan and PET-Scan and their numerical values will be stored in a memory for future use.

PET-Scan is used to have a result of the cells which are cancerous and can't be seen with other scans, this is one of the state-of-the-art technologies, in this any kind of inflammation or any cells which are leading towards cancer is identified. Early detection of cancer is made possible through this. The combination of CT-Scan and PET-Scan generates more accurate results.

There are two types of memory, ontogenetic and phylogenetic memory. Phylogenetic memory is used to store trained data and ontogenetic memory is for temporary use in which testing data is stored temporarily and when it becomes trained data after several tests then it will be transferred to trained data for permanent storage from where we can easily get information next time for the same case and directly diagnose disease without going through the model.

After testing the dataset, fuzzy inference system (FIS) report will be generated. Defuzzify fuzzy labels into crisp data and report of the patient will be established. In the report it is identified that which scan needs to take place if the patient condition is too severe then he will have PET–

Scan as it will pin point the region which is having cancerous cells or tumor, now if the patient condition is moderate then he will be asked for PET-Scan and CT-Scan simultaneously. It is required procedure because the symptoms at the early stage are quite similar to other diseases which may not refer to pancreatic cancer. For this reason, PET-Scan and CT-Scan are important to diagnose the real problem at the earlier stage.

The suggested model ANFIS produces results that are highly reliable and will assist with improved accuracy in the earlier diagnosis of the patient's disease.

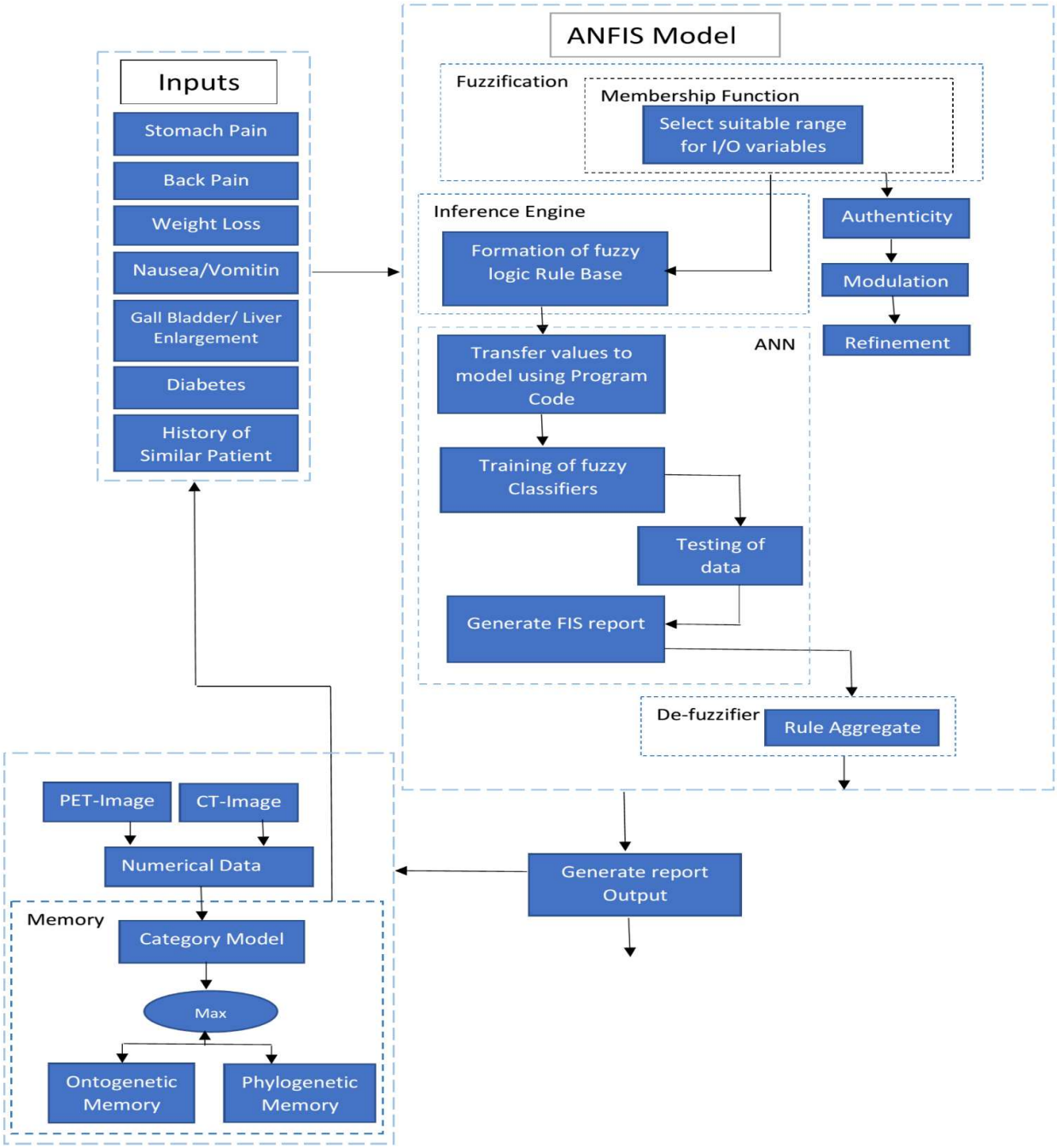

Figure 1: Pancreatic Cancer Diagnosis System

4. Experiment and Results

A fuzzy inference system using Sugeno model is used for the implementation of proposed model. The inputs used in model are Back-Pain, Stomach-Pain, Weight-Loss, Gall-Bladder Enlargement, Nausea/Vomiting and Diabetes are the symptoms which are considered for the early detection of the pancreatic cancer, these are the system's inputs. Finally, Severity Levels are defined as output of the system shown in Figure 2.

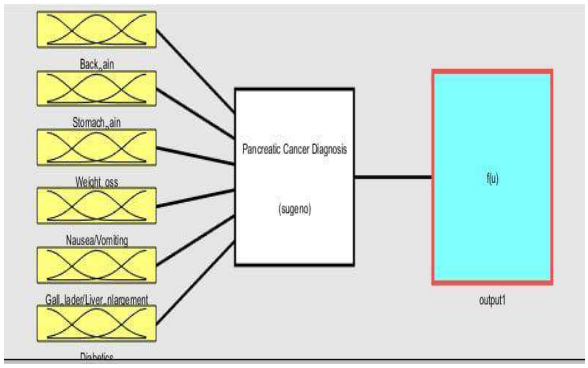

Figure 2: Input and Output

After defining the symptoms as inputs, membership functions are defined with respective ranges in order to generate output defines the Severity Level (Mild, Moderate, Severe) of pancreatic cancer shown in Figure 3.

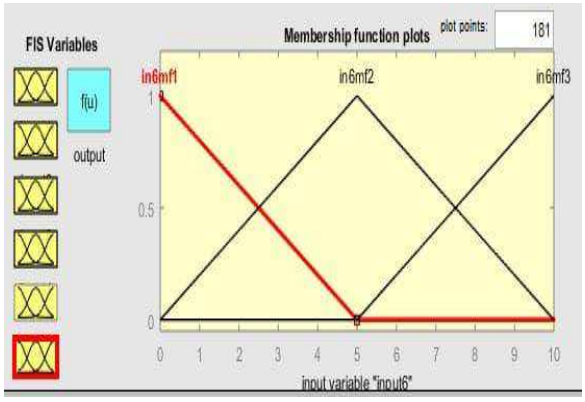

Figure 3: Membership Function

Membership functions are used to shape the if-then-rules and then these rules produce the Rule Viewer. The Rule Viewer presents the on-sight view of the Fuzzy Inference System's process. The Rule Viewer also depicts how the shape of certain membership functions influences the result. Each rule is a row of plots, and each column is a variable. The system has a single output (risk quotient), obtained using weighted average defuzzification process. All output membership functions should be of similar type whether linear or a constant. In this research paper, constant type membership functions are used as shown in Figure 4.

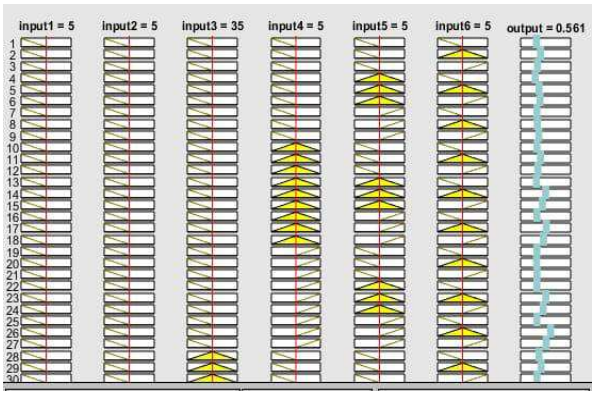

Figure 4: Fuzzy Rule Base

Using Hybrid algorithm. Here "*" represents training data as shown in Figure 5.

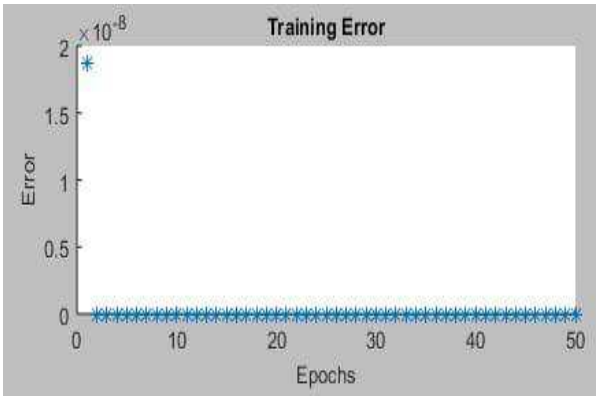

Figure 5: Error Rate During Training of Data.

After training and testing of the processed data, a 3-D surface plot is obtained as shown in Figure 5 with any two input variables on the horizontal & vertical axis and the output variable on the third axis. The surface viewer provides the facility of examining it at different angles for any further corrections as demonstrated in Figure 6.

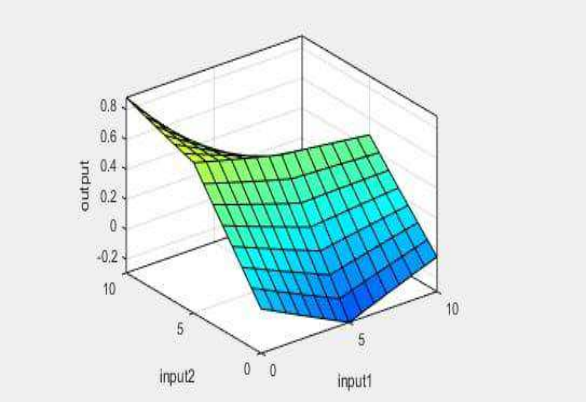

Figure 6: Surface Viewer

After the training of the system is completed using NFIS, the final Neuro-Fuzzy Inference System model is obtained as displayed in figure 7, indicating the five inputs and a output as per their different combinations.

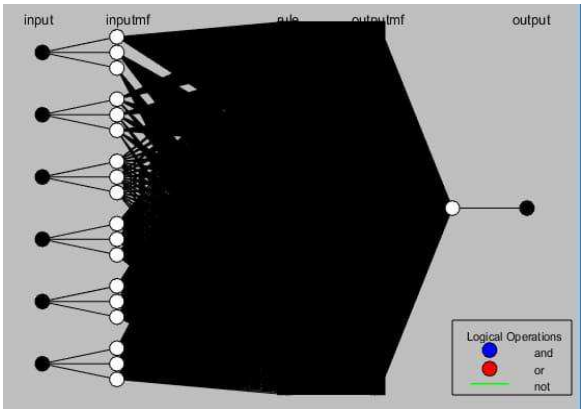

Figure 7: Structure of ANFIS

5. Discussion

The Surface View demonstrate the impact of any two input variables on the output variable. It clearly mentioned that which input variable has close relation with the specific severity level which is very significant in the early diagnosis of the disease.

6. Conclusion

This paper offered a model in which we have used ANFIS hybrid approach to diagnose pancreatic cancer at early stage. Because the diagnosis of this cancer at early stage was in its infancy phase and require more work to be done in this domain. PET-Scan and CT-Scan helps to figure out cancerous cells. PET-Scan is proposed for them which may pinpoint the malignant cells. The diagnose of pancreatic cancer has been made optimized in the proposed model, which help the patient's early diagnosis of illness. The early diagnosis will help them to get best treatment at the right time and will enhance the chances of recovery. The remarkable advancement in the field of artificial intelligence has automated the medicine field and provide the humans all the benefits regarding their health.

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