FUZZY METHOD FOR EARLY DETECTION OF LUNG CANCER

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Abstract **:** Cancer can start any place in the body. It starts when cells grow out of control and crowd out normal cells. There are many types of cancer. It's not just one disease. Cancer can start in the lungs, the breast, the colon (large intestine), or even in the blood. The cells in our bodies all have certain jobs to do. Normal cells divide in an orderly way. They die when they are worn out or damaged, and new cells take their place. Cancer is when the cells start to grow out of control. The cancer cells keep on growing and making new cells. They crowd out normal cells. This causes problems in the part of the body where the cancer started. In this paper we focus on reviewing the artificial intelligent techniques for early detection of lung cancer detection. The CT scan images are the foremost widespread technique used for identification of cancer. The determination of abnormalities may be a terribly tough task. Computerized assisted identification systems are terribly useful for specialist in detection and identification abnormalities earlier and quicker than ancient screening programs. This method has been terribly effective for the automated diagnose and classification of probabilities of cancer. The projected fuzzy knowledgeable system attains best classification rates for symptoms (subjective) parameters and risk parameters. When check the strength of system the accuracy for subjective parameters is 87% and for risk parameters are 91% and with fuzzy system is 96%.

Index Terms- **Cancer, Lung Cancer, Fuzzy** Logic, **Early Detection, Diagnosis, CT Scan.**

I. INTRODUCTION

Lung Cancer is reported as the first deadliest cancer in the world on which public awareness has been increasing during the last few decades [1]. Lung cancer is one of the causes of cancer deaths. It is difficult to detect because it arises and shows symptoms in final stage. However, mortality rate and probability can be reduced by early detection and treatment of the disease [2]. Best imaging technique Computed Tomography (CT) imaging are reliable for lung cancer diagnosis because it can disclose every suspected and unsuspected lung cancer nodule [3].The rate of survival is assured by only 15% survival chances, for a survival period of 5 years. [4]. The main cause of such high death rate is the detection in later stages, thus leading to delayed treatment. If lung cancer is detected at an earlier stage, chances of survival can increase up to 50-70% [5]. A cancer that begins in the lungs and most often occurs in people who smoke. More than 1 million cases per year in India are treatable by a medical professional. For treatment it requires a medical diagnosis and Lab tests or imaging [6]. Two major types of lung cancer are non-small cell lung cancer and small cell lung cancer. Causes of lung cancer include smoking, second-hand smoke, exposure to certain toxins and family history. Symptoms include a cough (often with blood), chest pain and weight loss. These symptoms often don't appear until the cancer is advanced. Treatments vary but may include surgery, chemotherapy, radiation therapy, targeted drug therapy and immunotherapy.Lung cancer may not cause any signs or symptoms in its early stages. Signs and symptoms often appear when the tumor grows large enough or when the cancer spreads to surrounding tissues and organs. Other health conditions can cause the same symptoms as lung cancer. Late signs and symptoms occur as the cancer grows larger or spreads to other parts of the body, including other organs [7].

Fuzzy logic was developed in 1965 by Dr. LotfiZadeh a professor at the University of California, Berkley. It is useful for real world problems where there are different kinds of uncertainty. One kind of uncertainty is fuzziness that is no sharp transition from complete membership to non-membership. In human reasoning much of the logic is not based on two values, it is not even multi-valued but fuzzy truth. In conventional logic everything is considered true or false, black or white but nothing in between. Fuzzy logic on the other hand takes into consideration all values in between [8]. A fuzzy expert system is an expert system that uses fuzzy logic instead of conventional logic. It uses a collection of fuzzy membership functions and rules to facilitate reasoning. Since it uses rules, it falls into the category of rule-based expert systems. Rules can easily demonstrate human thinking as they are easily formulated. Fuzzy expert systems are used to provide non-experts with some expert's skills. According to fuzzy expert systems are categorized into two types. First are fuzzy control systems. Which accepts inputs as numbers? The input number is then translated into a linguistic term [9].

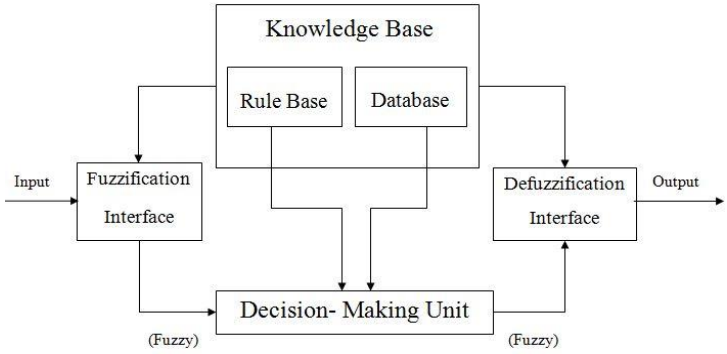


Fig.1: Fuzzy Expert System Architecture [1]

II. RELATED WORK

In this section we have done a thorough investigation of literature to grow a simple and correct knowledgeable system for designation of lung cancer. Following is that the survey of literature from totally different purported journals: Roointan A et al. [2018] projected associate early recognition of risk factors and applicable identification and action of lung cancer is biosensors technology. Novel bio sensing based medicine approaches for foretelling biological process risks area unit on the face of it to possess necessary therapeutic and clinical impact among the on the point of future. This text systematically provides a brief outline of various bio sensing stages for identification of malignant neoplastic disease sickness biomarkers, with a particular concentrate on recent advancements in natural science and optical biosensors, analytical performances of varied biosensors, challenges and extra analysis opportunities for routine clinical analysis. The sensing ways that might have nice result among the on the point of future upon routine clinical analysis of biomarkers of pharmacogenomics and genetics interest [10]. Vogeltanz-Holma N et al. [2018] projected the overall public has confused the consequences of chemical element (Rn) with those of oxide. Our review suggests that public information materials regarding Rn want revision. Specially, these have to be compelled to emphasize that Rn cause's cancer that unit oxide observers do not observe it. The tendency to conducted a scientific search of PubMed and PsycINFO databases for English-language studies with humans practice the keyword "radon" with the following terms: public knowledge; awareness; national surveys; screening; mitigation; attitudes; beliefs; subjective; perceived risk; perceived threat; efficacy; health education; risk communication; policy; intervention; strategies; barriers; social marketing; media campaigns; theory; and theoretical model [11]. Kaminetzky M et al. [2018] purposed respiratory organ CT Screening news and data system Tm (Lung-RADSTM) was created to standardize lung cancer screening CT news. The aim of this study was to visualize the effectiveness of lung cancer screening practice Lung-RADS throughout a varied, underserved, tutorial clinical screening program, specializing in whether or not or not Lung-RADS would successfully cut back the twenty-three.3% false-positive rate found among the National Viscus Screening Trial [12]. Farahani F. et al. [2018] introduced a mix methodology for distinctive pulmonary nodules by practice lungs CT footage. The structure of our planned approach was comprised of five entirely totally different phases. First, we've a bent to use the type-II fuzzy algorithm to reinforce the quality of no heritable CT footage [13]. Carr S et al. [2018] planned population-based processed kindred resource connected to a State-wide cancer written account of lung cancer cases (n=5408) was analyzed to gauge the transmissible contribution to malignant neoplastic disease anatomy in smoking (n=1751) and non-smoking cases (n=818). associate mathematics ways that were accustomed have a glance for necessary excess connexion of malignant neoplastic disease cases. a vital excess distant connection was discovered for all lung cancer anatomy subgroups analyzed except the little cell lung cancer set (p=0.213). Once smoking and non-smoking anatomy subsets of lung cancer were thought of, excess connection was discovered exclusively in non-smoking NSCLC (n=653; p=0.026) and considerably, in those non-smokers with non-squamous anatomy (n=561; p=0.036). Sixty-one pedigrees were familiar that incontestable an enormous excess risk of non-smoking, non-squamous lung cancer cases associated a much more than female cases were discovered among the cases in these unhealthy pedigrees. This analysis supports a genetic predisposition to lung cancer carcinogenesis in non-smoking, non-squamous NSCLC cases [14]. Makaju S. et al. [2017] planned analysis is to gauge the various computer-aided techniques, analyzing this best technique and looking for their limitation and downsides and eventually proposing the new model with enhancements among this best model [15]. Amanda G. et al. [2017] analysis on lung cancer remains the second commonest cancer identification among the u. s. and carries an enormous rate of morbidity and mortality. Early identification and treatment area unit essential for semi-permanent patient survival [16]. Vas M. et al. [2017] projected lung cancer detection algorithm practice mathematical morphological operations for division of the lung's region of interest from that possibility area unit extracted and used for cataloging of cancer by artificial neural networks. The methodology adopted throughout this project resulted in associate accuracy of ninety 2 for the hospital information [17]. Park S. et al. [2016] projected a greenhorn predictor for intra and lay to rest third data variation, said as intra- and inter-fraction fuzzy deep learning (IIFDL), where FDL, equipped with respiration clump, predicts the movement accurately and reduces the computation time. Through the experimental results, we've a bent to valid that the IIFDL improved root-mean-square error (RMSE) by twenty-nine.98% and prediction overshoot by seventy.93%, compared with existing ways that. The results collectively showed that the IIFDL raised the common RMSE and overshoot by fifty-nine.73% and 83.27%, severally [18].

After thorough investigation of literature survey following gaps has been observed:

1. The medical experts detect lung cancer based upon their past experience and knowledge which sometimes can lead to wrong decisions. It is possible that radiologists might fail to detect the abnormalities or fail to correctly indicate their regions at certain times [19].

2. The most widespread technique used for detecting lung cancer is CT scan images. Most of the times false negative images are contributed to expert radiologist failure to recognize the lung cancer at an early stage. The reason behind this is lack of knowledge or experience or misinterpretation of data. From a medical point of view, reading and interpretation of images are very important and complex tasks [20].

III. METHODOLOGY

This section describes the systematic methodology that's getting to be followed in analysis work and delineate concisely as follows:

First of all, begin with literature review below this review all options of mathematical logic and lung cancer complete data of the subject ought to be done.

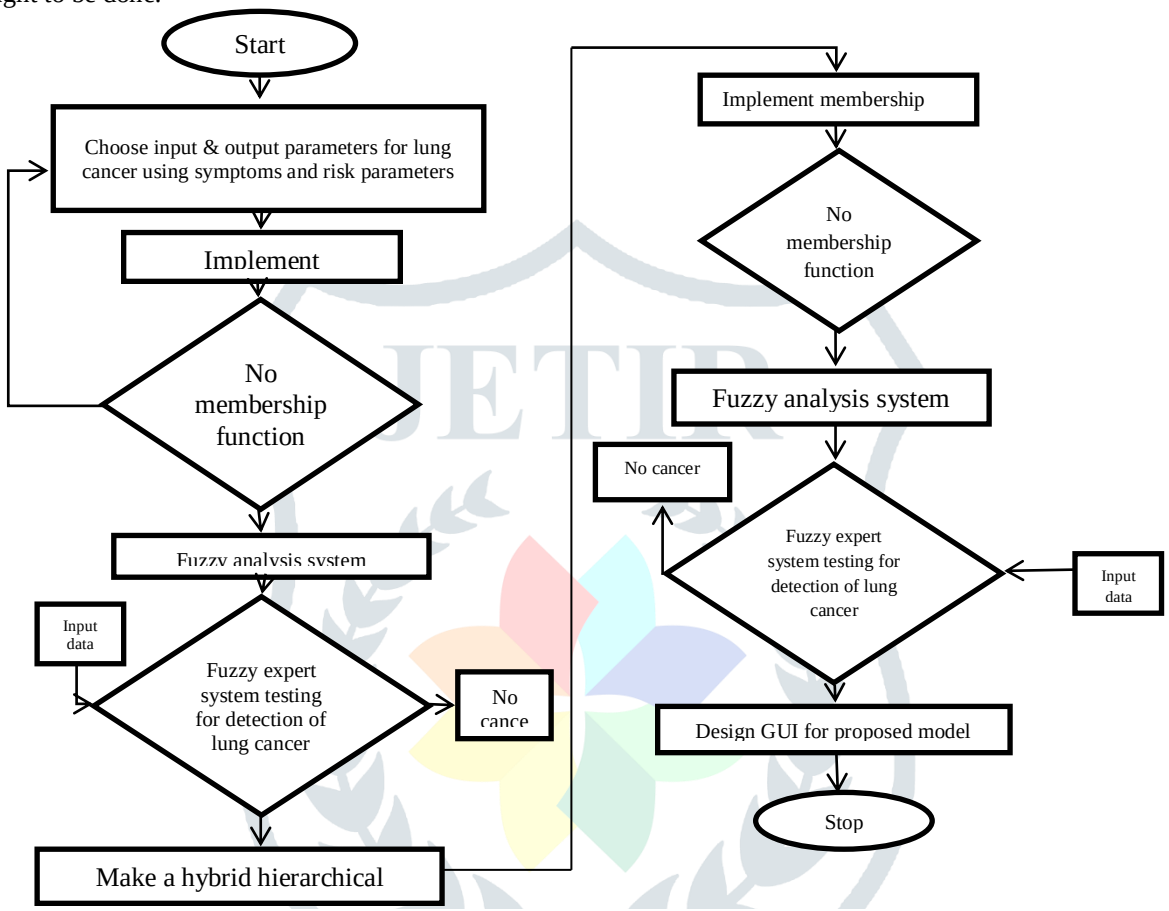


Fig. 2: Research Methodology

When doing literature review, opt for input and output parameters of lung cancer by exploitation symptoms and risk parameters and fuzzy implementation ought to be done. Doing this section, we tend to collect data to outline membership functions. The membership functions area unit well outlined then fuzzy IF-ELSE rules area unit made, if not then move to previous step. When fuzzy rules area unit made then testing is completed if testing of cancer is correct than visit next step is otherwise stop process. Create a hybrid stratified (hierarchical) system by exploitation symptoms and risk parameters fuzzy system. Doing this section, we tend to collect data to outline membership functions. When fuzzy rules area unit made then testing is completed. If testing of cancer is correct than next step is create associate output on screen so stop.

IV. IMPLEMENTATION OF FUZZY METHOD FOR THE EARLY DETECTION OF LUNG CANCER

In a hierarchical scheduling system, a number of individual components are integrated into a single system running on one execution platform as shown in figure 5.1 [21]. Hierarchical fuzzy logic systems are increasingly applied to solve complex problems. Decomposition and conversion of systems into hierarchical fuzzy logic systems reduces the number of fuzzy rules and improves the learning speed for such systems [22].

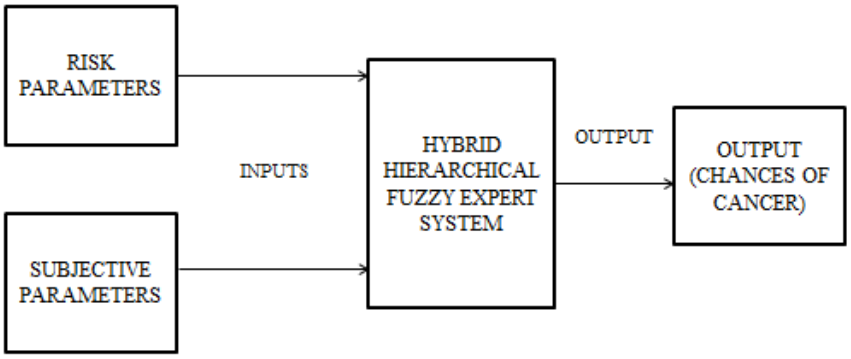
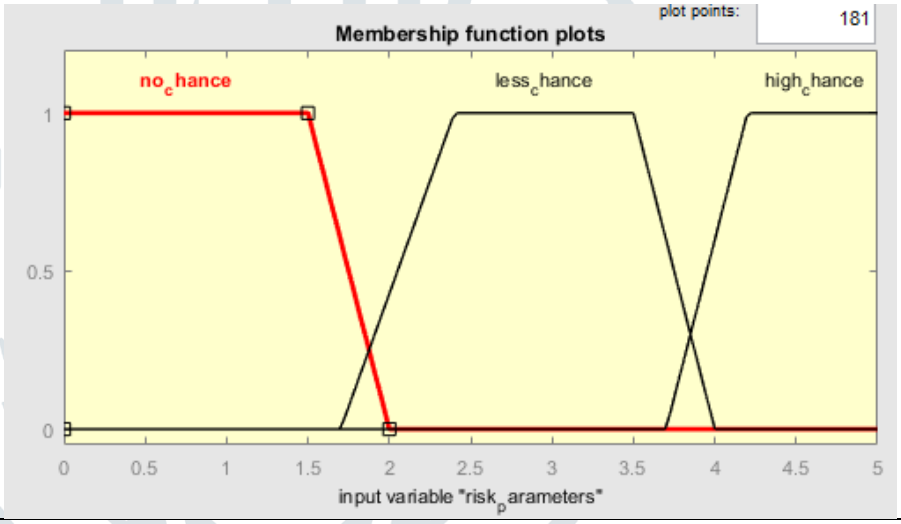
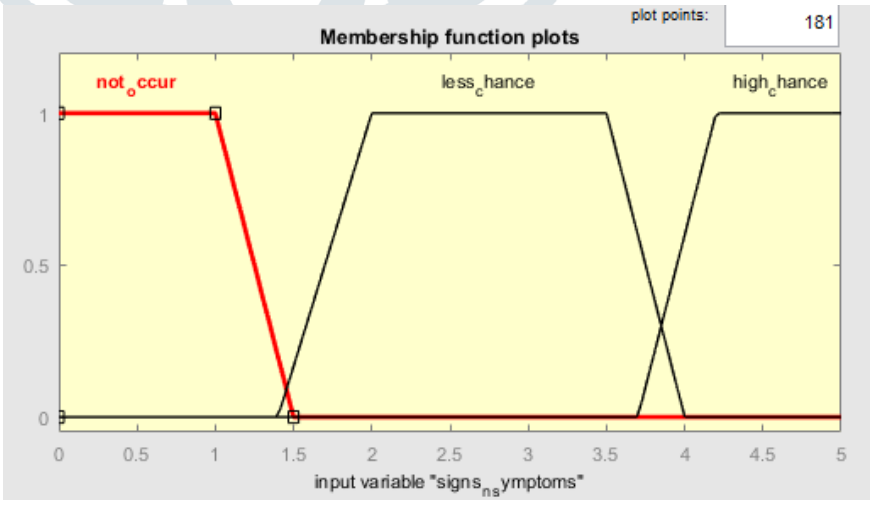


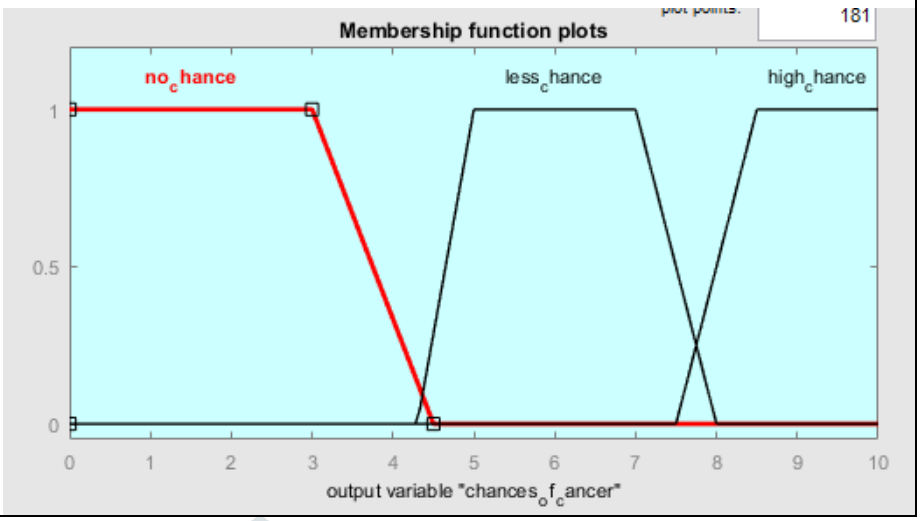
Fig. 3: Hierarchical Fuzzy System

4.1. Input Output Parameters

In table 1 shown the membership functions or input/output parameters of risk parameters:

Table 1 Input/Output Membership Functions

Sr. No.	parameters	Membership functions
1	Risk parameter (input)	
2	Subjective parameter (input)	

3	**Chances of cancer (output)**	

4.2 Rule Editor

Rule Editor is for editing the list of rules that defines the performance of the system. It comprises of an outsized editable text field for displaying and writing rules. Rule Editor is in addition has some acquainted with landmarks constant as those inside the FIS (fuzzy Inference system) Editor and Membership perform Editor, along with the menu bar and also the status line as shown in figure 5.3.

Rules = $M^i = 3^2 = 9$ rules

M = Membership functions

I = Input parameters

4.3. Rule Viewer

Rule Viewer to analyze the fuzzy inference system. Use this viewer as a diagnostic to check for instance, the individual membership function shapes implication the results. The Rule Viewer displays the instructions of the complete fuzzy inference process. In addition, there are the now intimate items like status line and the menu bar. In the lower right, there is a text field where you can enter a specific input value. Fig 3.9 displays the rule viewer of the proposed system. It indicates the outcome of entire proposed system is =6.08 which means person is low chances.

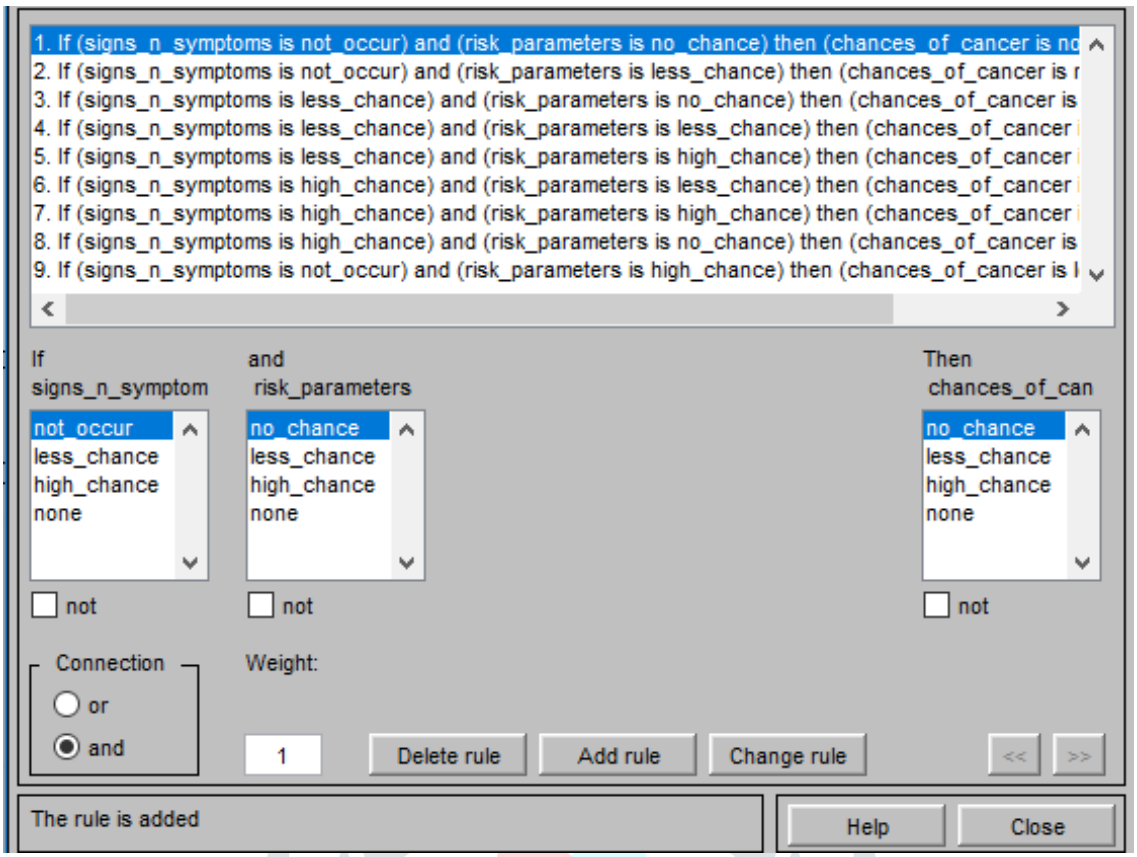


Fig. 4: Rule editor

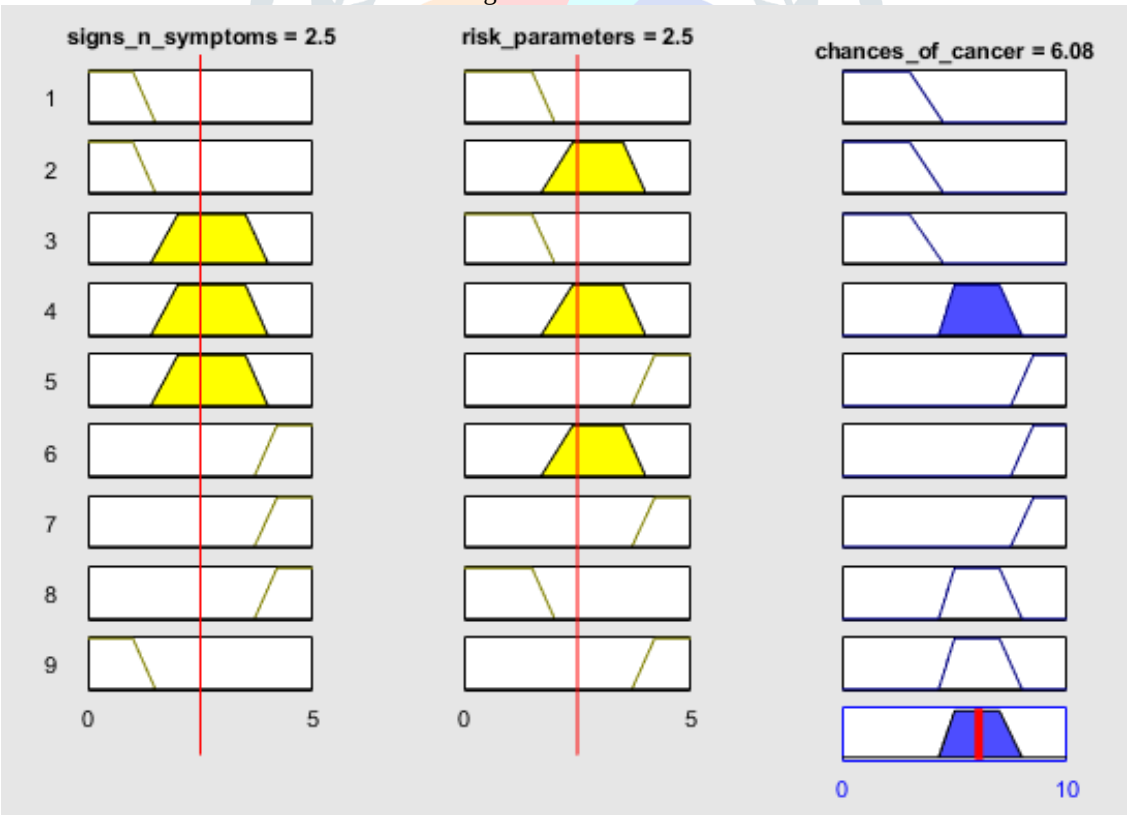


Fig. 5: Rule Viewer

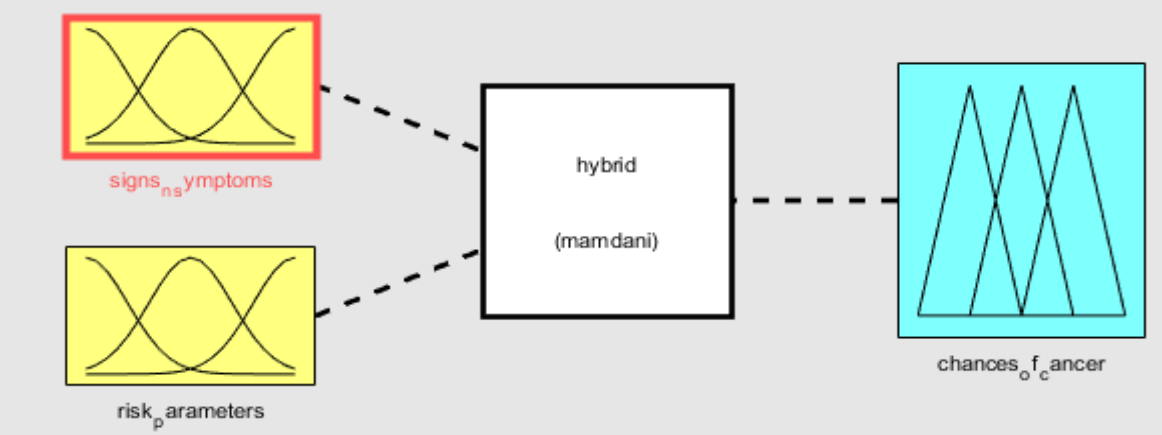


Fig.6: Screen Shot of Fuzzy Inference System

V. CONCLUSION AND FUTURE SCOPE

Lung cancer is one of the dangerous and life taking disease in the world. However, early diagnosis and treatment can save life. Although, it is difficult for doctors to interpret and identify the cancer from CT scan images. It is difficult to detect because it arises and shows symptoms in final stage. However, mortality rate and probability can be reduced by early detection and treatment of the disease. Computer Aided Diagnosis has become supplement and promising tool for early detection of lung cancer. The projected technique will cope with varied inputs which may be much better than to handle uncertainty during diagnosis process. This technique has shown very effective for the automatic detection and classification of chances of cancer. The proposed method achieves best classification rates for symptoms (subjective) parameters and risk parameters. After check the validity of system the accuracy for subjective parameters are 87% and for risk parameters are 91% and with hybrid hierarchical system is 96%.

The future scope of the current research work and is described below as:

1. It can also be extended that system to have a database which can be used for future use and references and also for storing patient's information.
2. The future work is that researchers can increase input attributes based on symptoms to make the system more useful for that particular disease.
3. It can also be extended that system to have a camera which can take images automatically and give an accurate decision.

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REFERENCES

[1] Makajua S., Prasad P., Alsadoona A., Singh A. and Elchouemi A., "Lung Cancer Detection using CT Scan Images", presented in 6th International Conference on Smart Computing and Communications, ICSCC, vol. 3, pp. 7-8, 2017.

[2]Makajua S., Prasad P., Alsadoona A., Singh A. and Elchouemi A., "Lung Cancer Detection using CT Scan Images", presented in 6th International Conference on Smart Computing and Communications, ICSCC, vol. 3, pp. 7-8, 2017.

[3]Cancerresearchuk.org[Online].Available:http://www.cancerresearchuk.org/sites/default/files/styles/cruk_wide_resp_breakpoint_one/public/chromosomediagm.jpg?itok=GUQUIwrv

[4]Healthline.com[Online]. Available: http://www.healthline.com/health/breast-cancer/pictures#Pictures2.

[5]American cancer society [online]. Available: https://www.cancer.org/our-partners.html.

[6]McWilliams A., "Sex and Smoking Status Effects on the Early Detection of Early Lung Cancer in High-Risk mokers using an Electronic Nose" IEEE Transactions on Biomedical Engineering, vol. 15, pp. 018-294, 2015.

[7]Farahani F., Ahmadi A. and Zarandi M., "Hybrid intelligent approach for diagnosis of the lung nodule from CT images using spatial kernelized fuzzy c-means and ensemble learning" Mathematics and Computers in Simulation journal, vol.25, pp. 0378-4754, 2018.

[8]Park S., Lee S., "Intra- and Inter-Fractional Variation Prediction of Lung Tumors Using Fuzzy Deep Learning", IEEE journal of translational engineering in health and medicine, vol. 3, pp. 2168-2372, 2016.

[9]Ohri K., Singh H., Sharma A.," Fuzzy Expert System for diagnosis of Breast Cancer," Presented at IEEE WiSPNET conference,2016.

[10]Https://Static.Aminer.Org/pdf/pdf/000/259/934/An_Expert_Sysytem_Development_Tool_Using_Fuzzy_Logic.Pdf.

[11]Fuzzy Logic Retrieved January 2015, From Zadeh, L. A.: Fuzzy Sets. Information and Control, 8, 2005, Pp. 338-353[Http://En.Wikipedia.Org/Wiki/fuzzy_Logic].

[12]Schuh C., and Bohm S., "Fuzzy sets and their application in Medicine., Medical statics and informatics, core unit of the medical university of Vienna 2010.

[13]Mizutani T, Ando M, "Prognostic value of Lung Cancer Subscale in older patients with advanced non-small cell lung cancer: An integrated analysis of JCOG0207 and JCOG0803/WJOG4307L (JCOG1414A)," Journal of Geriatric Oncology, vol. 4, pp-24-29, 2018.

[14]Kaminetzky M, Milch, H, Shmukler A, "Effectiveness of Lung-RADS in Reducing False-Positive Results in a Diverse, Underserved, Urban Lung Cancer Screening Cohort" Journal of the American College of Radiology, vol. 4, pp. 1-7, 2018.
[15]Haman H, Elizabeth S., "Multilevel Opportunities to Address Lung Cancer Stigma across the Cancer Control Continuum" Journal of Thoracic Oncology Vol. 13, pp. 1062-1075, 2018.
[16]Amanda G., "Understanding Lung Cancer: Presentation, Screening, and Treatment Advances," The Journal for Nurse Practitioners, vol. 6, pp. 1-7, 2017.
[17]Roointan A, Ahmad Mir T, "Early detection of lung cancer biomarkers through biosensor technology: a review" Journal of Pharmaceutical and Biomedical Analysis, vol. 8, pp. 4-10, 2018.
[18]Vogeltanz-Holma N, SchwartzbG.,"Radon and lung cancer: What does the public really know?", Journal of Environmental Radioactivity, vol. 192, pp. 26-31, 2018.
[19]Carr S, Akerley W, Albright L.,"Genetic Contribution to Non-Squamous, Non-Small Cell Lung Cancer in Non-Smokers," Journal of Thoracic Oncology, vol. 9, pp. 239- 246, 2018.
[20]S. M. Metev and V. P. Veiko, Laser Assisted Microtechnology, 2nd ed., R. M. Osgood, Jr., Ed. Berlin, Germany: Springer-Verlag, 1998.
[21]J. Breckling, Ed., The Analysis of Directional Time Series: Applications to Wind Speed and Direction, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61.
[22]S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," IEEE Electron Device Lett., vol. 20, pp. 569–571, Nov. 1999