International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 04, 2019
ISSN: 1475-7192

Detection of Malignant Lung Tumors Using Convolutional Neural Networks

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ABSTRACT— *Cancer is amongst the leading reasons of untimely demise in human beings. Detection of nodules present in lung in earlier stages of cancer can help in bringing down the mortality rate of this disease. Hence, the most pressing priority in the field of cancer treatment is the need of new methodologies that can aid in detecting the disease in its earlier stages. In this project, convolutional neural network is put to use for the purpose of detecting cancerous nodules in the lungs. Using this system, not only lung cancer can be detected in a person but also the chances of a person acquiring lung cancer can be estimated. In every phase of this system, the given image is enhanced and segmented separately. For the purpose of image enhancement, the image is resized, contrasts are enhanced and the colour space is converted from one form to another. This step is followed by segmentation and classification. For the purpose of classification, a binary CNN classifier is deployed. This methodology can provide greater precision for both diagnostic and predictive purposes.*

Keywords-- *Convolutional neural networks, image segmentation, binary classifier, multi-stage classification*

I. INTRODUCTION

Lung cancer is a disease in which the cells of the lungs divide and grow uncontrollably. Initially, the symptoms for this disease might include coughing, shortness of breath and loss of appetite. As the cells continue to grow, tumours are formed that damage the normal functions of the lungs. Mortality rate for lung cancer has increased drastically in the recent years.

Using the standard methods for predicting lung cancer might not always provide accurate results. Hence the need of the hour is to find techniques that can help in swifter detection and prediction of this disease. Earlier diagnosis can increase the chances of survival in a person.

In order to improve the precision of existing methods, CNN algorithm is used. The techniques that are used for the purpose of image enhancement are as follows:

- Conversion to grayscale image
- Sharpening of the details in the given image
- Reduction of noise by making use of medians
- Smoothing of the image
- Changing of the image into binary format

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Received: 22 Aug 2019 | Revised: 13 Sep 2019 | Accepted: 15 Nov 2019

- Extraction of red, green, blue values For colour space transformation from one form to another, the red, green, blue values of the inputted image are taken out before changing the given image to a grayscale image. The CT scan is sharpened in order to increase the accuracy of prediction.

II. MODULE DESCRIPTION

1.) The first module is the data collection module that performs one of the most important tasks in building a machine learning model. This module collects information pertaining to the given task based on some targeted variables to analyse and generate some valuable outcome. However, some of the data may be noisy, i.e. may contain inaccurate values, incomplete values or incorrect values. Hence, it is must to process the data before analysing it and generating the final result. In this project data pre-processing is carried out by resizing the image and removing noise from the given image.

2.) After data pre-processing, data segmentation module is responsible for performing various tasks that include:

- Data transformation may include smoothing, aggregation, generalization, transformation which improves the quality of the data.
- Data selection includes some methods or functions which allow us to select the useful data for our system.

Here segmentation is carried out by using K-means clustering and Otsu Binarization.

3.) The final module is responsible for training the dataset and displaying the final result. The output produced shows whether a given person has lung cancer or not. In case, the person does not have cancer then the module predicts the probability of the person getting lung cancer later.

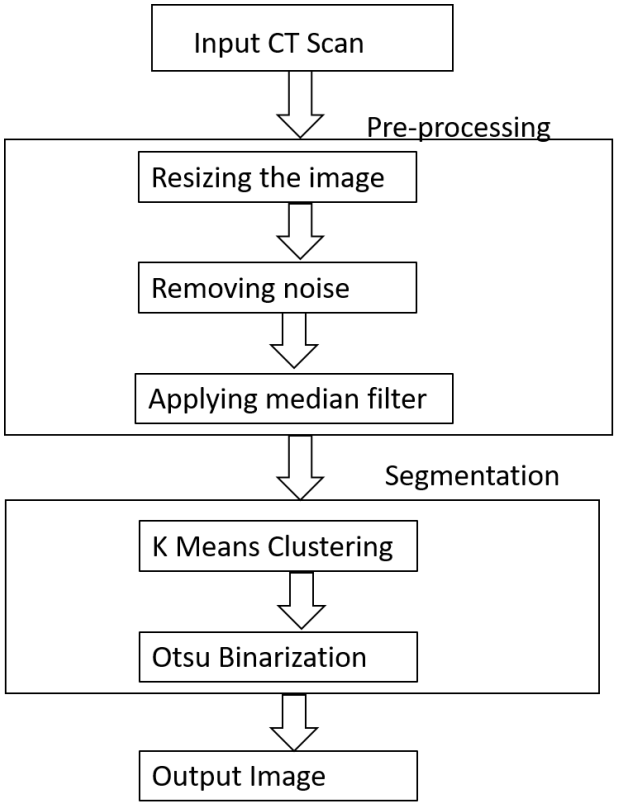

Figure 1: Architecture Diagram

III. LITERATURE SURVEY

[1] Moffy Vas et al., " Lung cancer detection system using lung CT image processing", 2017 International Conference on Computing, Communication, Control
and Automation (ICCUBEA), August 2017

This paper puts forward a novel method for the purpose of lung cancer detection by making use of computer tomography scan. In this method, an unprocessed CT image is taken as the input which then undergoes pre-processing, segmentation and feature extraction to obtain the output image that can help in swifter detection of cancer in a potential patient.

[2] V. Krishnaiah et al., "Diagnosis of lung cancer prediction system using data mining classification techniques", International Journal of Computer Science and Information Technologies, Vol. 4, issue
1, pp. 39-45, December 2013

This paper introduces the use of classification based techniques such as rule based classification to recognize whether lung cancer is present in a given image or not. Bayesian Network classifier is put to use for the purpose of diagnosis. IF-THEN rules are used in order to increase the correctness of the prediction.

[3] C. Anita et al., "Lung cancer detection on CT images by using image processing", International Conference on Computing Sciences, September 2012

Image processing is put to use in order to ascertain whether lung cancer is present in the given CT-image or not. MATLAB has been used for the purpose of classification. Various methodologies have been utilized such as feature extraction and image sharpening in order to increase the accuracy percentage.

[4] K. Murphy et al., "A large-scale evaluation of automatic pulmonary nodule detection in chest CT using local image features and k-nearest-neighbour classification," Medical Image Analysis, vol. 13, issue 5, pp. 757–770, 2009

K-nearest-neighbour algorithm is used twice in order to reduce the possibilities of error in detection. Nodules in lungs are detected by using a feature known as shape index. The proposed system was trained using three databases. The final results show a more accurate detection of lung cancer in a given image.

[5] M. Temesguen et al., "A new computationally efficient CAD system for pulmonary nodule detection in CT imagery." Medical image analysis Vol. 14,
issue 3, pp. 390-406, June 2010

This paper proposes a CAD system that is used for detecting the presence of nodules in CT images. A lung segmentation algorithm is devised that makes use of two distinct classifiers. This paper explores the future possibilities of a CAD system being put to use for detecting cancer.

[6] Y. Xujiong et al., "Shape-based computer aided detection of lung nodules in thoracic CT images " IEEE Transactions, June 2009

This paper introduces a novel method that can help in detecting both solid nodules and part solid and nonsolid nodules present in lungs. The entire process is segmented into a number of steps that start with making use of a fuzzy threshold method and end with using a support vector machine based classifier for detecting cancer nodules. Rate of computation is incredibly fast in this method which can help in clinical advancements.

[7] J. J. Dignam, L. Huang et al., “Estimating cancer statistic and other-cause mortality in clinical trial and population-based cancer registry cohorts.” Wiley Inter Science Vol. 115, issue 22, August 2009

The estimation of relative survival is done by the authors by utilizing the data obtained from Cancer Cooperative Groups. It was noted that relative survival was able to correctly predict BCSS in patients.

[8] Milena Bojic et al., "Automatic detection of abnormalities in lung radiographs caused by planocellular lung cancer", 1st Middle East Conference on Biomedical Engineering, February

2011

An automatic algorithm is presented in this paper that can help in the earlier diagnosis of lung. Segmentation of different sections of a given image is done followed by determining the similarity coefficients and determining the value that is maximum. It was noted that the results obtained can help in improving the already available methods.

[9] Alamgir Hossan et al., “Multi-Stage Lung Cancer Detection and Prediction Using Multi-class SVM Classifier”, 2018 International Conference on Computer, Communication, Chemical, Material and Electronic Engineering (IC4ME2), February 2018

Diagnosis of cancer in its earliest stages can be a challenging task. This paper presents a new methodology for the prediction of lung cancer that makes use of support vector machine(SVM). Various image processing techniques are applied to the given scan which eventually results in a more accurate prediction.

[10] Stephen Lam et al., “Smoking Status Effects on the Early Detection of Early Lung Cancer in HighRisk Smokers Using an Electronic Nose”, IEEE Transactions on Biomedical Engineering, March

2015

This paper suggests a method for determining the possibility of a person getting lung cancer by studying the percentage of volatile organic compounds in exhaled breath. It was noted that the presence of VOC can help in predicting whether ex-smokers are at a risk of getting lung cancer or not.

IV. CONCLUSION

The proposed system aims to build a computerized framework that can aid in swifter detection of cancerous nodules in lungs. The usage of convolutional neural networks for the purpose of classification helped in increasing the rate of accuracy. Thus, this methodology provides increased accuracy in detecting the presence of nodules in the lungs.

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Received: 22 Aug 2019 | Revised: 13 Sep 2019 | Accepted: 15 Nov 2019

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