Thyroid Cancer Detection for Myanmar: Review and Recommendation

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ABSTRACT

Thyroid cancer is common cancer nowadays in most of the people irrespective of country, gender and regions, and so as in Myanmar. This paper brings significant work on thyroid cancer detection using image processing and segmentation methods so that appropriate work can be carried out for the benefit of people of Myanmar. The critical study of important papers gives challenges in existing work on cancer detection using several methods but there is not robust method for thyroid cancer detection. So, we attempt to suggest a robust set of methods for addressing this problem for Myanmar since there is very limited work on detection of cancer in the country.

KEYWORDS: Thyroid cancer, detection, image processing, segmentation, computer-aided diagnosis (CAD), cancerous tissues, benign and malignant

1. INTRODUCTION AND BACKGROUND

In the field of medical science and applications, there are many challenges such as diagnosis of a disease with correct detection and analysis of symptoms, for example in cancer detection it is very difficult to detect exact portion of cancerous area in an image. Patel et al (2014) in their book discussed in details about CAD system for analysis and better diagnosis of various types of diseases such as breast cancer, lung cancer, thyroid cancer etc. [1]. There have been numerous research contributions in the field of medical image analysis using some CAD system even used in assessment of cognitive ability of human brain in [2] (Sinha et al. (2018)).


Therefore, we can see that lot of work has been done in the field of cancer detection of various types such as breast cancer, lung cancer, brain tumor cancer etc. However, the work on thyroid is not much reported. This chapter presents significant contributions in the area of thyroid cancer detection.

2. THYROID CANCER AND CAD

Thyroid cancer can be detected using a CAD system whose typical flow diagram can be seen in Fig. 1 which includes various stages of image processing tasks used for pre-processing, segmentation, post processing etc. The preprocessing is applied to remove any noise signal from ultrasound images, then subjected to segmentation method for extracting regions of interest where cancer is likely to be affected. Feature extraction of segmented areas will help in classifying and detecting of cancer nodules inside the image.
The detection of cancer was done on the basis of malignant
Suitable image de-noising as preprocessing method
CNR (contrast to noise ratio) should be also included.
results with clinical data.
Pre-processing of thyroid images [35]. One more similar work [36] is
Luying et al. (2018) implemented and obtained experimental
detection is implemented with good accuracy and sensitivity.
more number of malignant tissues were detected and therefore the cancer
detection is implemented with good accuracy and sensitivity.
This paper has compared clinical analysis with the results
obtained by radiologists. It has been observed that the
results are matching between clinical practice and
radiologists' observation and diagnosis. However, the images
which are considered in this paper are only static images,
and not the moving images. The research needs to be
modified for video images or real time images of patients
suffering from thyroid. Moreover, time complexity and
number of stages have not been appropriately explained
and calculated in the work [26].

Gopinath et al. (2013) employed support vector machine
(SVM) for thyroid cancer analysis and texture features were
used in this work. Statistical parameters were used to
evaluate the performance of the method operated on
morphological operations and their results. The accuracy
classification could be further improved from 96% [27].
Priti et al. (2016) used [28] artificial neural network (ANN);
Malathi et al. (2017) implemented hybrid system using
neural network as well as fuzzy logic, as neuro-fuzzy system
to detect thyroid abnormalities [29]; Sathy Priya et al.
(2018) suggested another hybrid method based on SVM
for cancer detection of thyroid patients [30]. In all such works,
there is no any robust method that can be used for all types
of images having any difficulties in the image.

Mossoud et al. (2018) designed a CAD system for thyroid
cancer detection using hill climbing method of soft
computing techniques by which sensitivity, accuracy and
other parameters were calculated. But, real time clinical data
and validation of result were not done [31]. Polepogu et al.
(2016) implemented a CAD for the disease and machine
learning approach was used but the area and other values
were not determined therefore improvement could be further obtained [32].
If the area of malignant nodule is calculated, it would be good work. Sonali et al. (2012)
used segmentation tools with the help of MATLAB and compared
for different modalities of images such as CT, MRI, ultrasound. Further improvement is possible by using
adaptive tools for segmentation of thyroid images [33].
Estrivous et al. (2010) studied thyroid nodule detection for
moving ultrasound images that can be applied for real time
data [34]. Yu Yan et al. (2019) used fractal dimension
differentiation for comparing malignant and benign nodules
of thyroid images [35]. One more similar work [36] is
reported in David et al. (2019).

There are several others focusing on thyroid cancer but
analysis of methods and performance evaluation were not
done properly. The major problem which is reported based
on literature survey on this topic is that the research on
thyroid cancer detection using CAD system has to be done
extensively by the native researchers in Myanmar so that the
people of Myanmar can get benefit. Moreover, collaboration
with some cancer research center, or diagnostic center and
at least a practicing physician can be involved for obtaining
better results and appropriate validation of CAD based
results with clinical data.

4. COMPARISON AND RECOMMENDATION

This piece of study reported several contributions on
thyroid cancer detection using various types of methods.
There is research on thyroid by limited number of
researchers and very less amount of work has been done for
Myanmar context. So, we recommend the following:
- Much focused research on thyroid cancer is needed
- Suitable image de-noising as preprocessing method
  needs to be developed
- Databases for real time images of patients suffering from
  thyroid, need to be created
- A framework of segmentation methods can be
  implemented for better and improved results for
  classification
- Robust method of classification needs to be found and
  implemented over real time data
- Neuro-fuzzy system as a hybrid method to be used
- The features play important role in assessment of
  performance and therefore robust set of statistical
  features such as area, size, SNR (signal to noise ratio),
  CNR (contrast to noise ratio) should be also included.

Based on extensive research survey, we compared few
important papers in terms of methods; the year of
contribution and their major findings. This is reported in a
Table 1. The comparative study includes major research on
thyroid cancer from 2012 to 2019 which means that our
focus is to find out the latest impact of thyroid cancer
detection so that we can make plan for future research
required in this important field of medical science. Fractal
method was used that involved important statistical
parameters. Support vector machine methods are also used.
and few other features are calculated for classification of cancer. Hill climbing method and artificial neural network (ANN) based methods were used that also involved some parameters as sensitivity, specificity, accuracy etc.

Luying et al. (2017) researched on thyroid with great impact using deep learning that employs convolutional neural network (CNN) where additional parameters such as NPV (negative predictive value) and PPV (positive predictive value). In neuro-fuzzy based hybrid method, all these good parameters were estimated in addition to time required for detection (see Malathi et. al., 2017).

This comparative analysis has included all scope of CAD based research on thyroid cancer but exact cancer stage has not been calculated in any paper. So, the research on breast cancer carried out in several contributions from [1] to [24] are based on involvement of real time data, a radiologist and validation of results that includes opinion of radiologists also. In the breast cancer detection, cancer stage determination was achieved particular. Therefore, the recommendation for implementing thyroid research in Myanmar is as follows:

- Using gray level clustering and adaptive threshold based methods in adaptive manner
- Employing deep neural network so that exact classification can provide the cancer stage also.

### TABLE1.1: Comparative analysis of existing research work on thyroid cancer detection.

<table>
<thead>
<tr>
<th>Contributor</th>
<th>Method used</th>
<th>Major findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yu Yan et al. (2019)</td>
<td>Fractal Dimension</td>
<td>Specificity-86.9%; Sensitivity-64.9%; Accuracy- 98%</td>
</tr>
<tr>
<td>Sathya Priya et al. (2018)</td>
<td>ILBP-SVM</td>
<td>Accuracy, Precision, Recall, F-measure were suggested but not calculated for data used</td>
</tr>
<tr>
<td>Massoud et al. (2018)</td>
<td>Hill Climbing</td>
<td>Specificity-99.7%; Sensitivity-80%; Accuracy- 98.96%; F Score-83.4%</td>
</tr>
<tr>
<td>Jagadeesh et al. (2017)</td>
<td>ANN</td>
<td>The data over which ANN used is limited</td>
</tr>
<tr>
<td>Luying et al. (2017)</td>
<td>CNN</td>
<td>Specificity-48.5%; Sensitivity-96.7%; Accuracy- 82.2%; PPV-81.3%; NPV-86.2%</td>
</tr>
<tr>
<td>Priti et al. (2016)</td>
<td>ANN</td>
<td>Accuracy-70%</td>
</tr>
<tr>
<td>Gopinath et al. (2013)</td>
<td>Support Vector Machine (SVM)</td>
<td>Specificity-100%; Sensitivity-95%; Accuracy- 96.7%</td>
</tr>
<tr>
<td>Eystratios et al. (2010)</td>
<td>SVM and k-Nearest Neighbors</td>
<td>Accuracy-95%</td>
</tr>
</tbody>
</table>

### 5. CONCLUSIONS

This paper presents careful study about main research work on thyroid and other cancer detection in order to find out which method works well. Other cancer determination methods were also studied because suitable CAD system can be suggested for thyroid cancer detection for people of Myanmar. Numerous papers on thyroid suggests that deep neural network (CNN) and neuro-fuzzy methods are optimal methods and these concepts can be implemented with gray level clustering and adaptive thresholding method so that exact cancer determination can be obtained. This research may prove an important work for contribution towards the society and people of Myanmar. Future work suggests implementing the methods which are recommended on real time database created in Myanmar with the help of a radiologist and a hospital.

### REFERENCES


Polepogu Rajesh and Kunduru Umamaheswari, Thyroid Disorder Detection Using Image Segmentation


