Future Generation Computer Systems 89 (2018) 539–547

Contents lists available at ScienceDirect

Future Generation Computer Systems

journal homepage: www.elsevier.com/locate/fgcs

A real time computer aided object detection of nasopharyngeal carcinoma using genetic algorithm and artificial neural network based on Haar feature fear

Mazin Abed Mohammed [a,b,*], Mohd Khanapi Abd Ghani [a], N. Arunkumar [c], Raed Ibraheem Hamed [d], Mohamad Khir Abdullah [e], M.A. Burhanuddin [a]

[a] Biomedical Computing and Engineering Technologies (BIOCORE) Applied Research Group, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, Malaysia
[b] Planning and Follow Up Department, University Headquarter, University of Anbar, Anbar, Iraq
[c] School of EEE, Sastra University, Thanjavur, India
[d] Department of IT, College of Science and Technology, University of Human Development, Sulaymaniyah KRG, Iraq
[e] Department of Otorinolaringologi, Hospital Pakar Sultanah Fatimah Muar, Johor, Malaysia

HIGHLIGHTS

- NPC tumour detection from endoscopic image with machine learning methods.
- To outline and assess a novel method based on machine learning approaches for detecting and identifying NPC.
- The proposed approach was validated by comparing the number of NPC cases by the ENT doctors.

ARTICLE INFO

Article history:
Received 3 June 2018
Received in revised form 4 July 2018
Accepted 12 July 2018
Available online 18 July 2018

Keywords:
Nasopharyngeal carcinoma
Machine learning approaches
Computer-aided object detection
Trainable segmentation
Haar feature
Artificial neural networks
Genetic algorithm
Endoscopic images

ABSTRACT

Nasopharyngeal carcinoma (NPC) is a serious disease with diverse prognoses and the diffusive development of the tumors further complicates the diagnosis. However, in most cases, surgery is performed by resecting the tumor that decides the life expectancy of a patient. Certainly, the graphical portrayal is a fundamental factor to distinguish and examine an NPC tumor; and, the exact nasopharyngeal carcinoma perception remains an important errand. It is crucial to improve the extent of resection for the irregular tissues while sparing the normal ones. There are several methods to envision the nasopharyngeal carcinoma, but the main problem with these strategies is the inability to imagine the border points of the nasopharyngeal tumor accurately in detail. In addition, the inability to separate the normal tissues from the undesirable ones prompts the assessment and calculation of a wrong tumor measure. NPC diagnosis is a difficult and challenging process owing to the possible shapes and regions of tumors and intensity of the images. The pathological identification of the nasopharyngeal carcinoma and comparing typical and anomalous tissues require a set of scientific strategies for the extraction of features. The aim of this paper was to outline and assess a novel method using machine learning approaches based on genetic algorithm for NPC feature selection and artificial neural networks for an automated NPC detection of the NPC tissues from endoscopic images. The proposed approach was validated by comparing the number of NPC identified through this technique against the manual checking by the ENT specialists. The classifier lists a high precision of 96.22%, the sensitivity of 95.35%, and specificity of 94.55%. Additionally, the feature chosen process makes the Artificial Neural Networks classifier straightforward and more efficient.

1. Introduction

The medical images provide useful and detailed knowledge with respect to normal and abnormal nasopharyngeal cases. Presently, MRI, endoscopy and CT images the most widely recognized test for diagnosing and affirming the existence of NPC tumor. Essentially, nasopharyngeal endoscopy images involve both normal and abnormal image cases. Despite extensive research, the detection and classification process of nasopharyngeal endoscopy image abnormality remains challenging. The reasons are due to

* Corresponding author at: Biomedical Computing and Engineering Technologies (BIOCORE) Applied Research Group, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, Malaysia.

E-mail addresses: mazin_top_86@yahoo.com (M.A. Mohammed), khanapi@utem.edu.my (M.K. Abd Ghani), arun.nura@gmail.com (N. Arunkumar), raed.alfalahy@uhd.edu.iq (R.I. Hamed), mdkhirmd@hotmail.com (M.K. Abdullah), burhanuddin@utem.edu.my (M.A. Burhanuddin).

https://doi.org/10.1016/j.future.2018.07.022
0167-739X/

variation of possible complex locations, size, shapes, and image intensities for various kinds of nasopharyngeal tumors [1,2].

Radiologists analyze the nasopharyngeal endoscopy case by visual inspection to detect and identify the existence of tumor or abnormal case [3]. These diagnoses are based on the shape, location, and image intensity of various kinds of nasopharyngeal tumors. Clinically, Clinically, the radiology specialist the nasopharyngeal image slice by slice visually for cancer detection and identification. Such exertion is work serious, costly and regularly incorrect, particularly including a substantial number of image cases [4]. Moreover, the sensitivity of the human eye and mind to clarify such images decreases with the growing of number of cases, especially when just few regions include data of the influenced NPC region [5]. In this manner, a robust and solid instrument should be created to computerize the tumor localization with the goal that exact detection and division of the strange abnormal is doable.

Nasopharyngeal Carcinoma (NPC) is the common well-known tumor in neck and starting at nasopharynx, the superior area of pharynx or throat, where nasal entries and sound-related tubes including the rest of the upper respiratory tract [6]. Nasopharyngeal tumor is altogether different from different malignancies in the head and neck in the event and reasons for conduct and clinical treatment. It is more normal to a substantial degree in some eastern districts of Asia and Africa more than anyplace else, with the viral and nourishing and hereditary variables required in the event. Nasopharynx growth, known as (i) nasopharyngeal disease, (ii) a tumor, or (iii) malignancy emerging from the epithelium of the mucous layer of the nasal pharynx [7]. The three subtypes of nasopharyngeal cancer are good kind of differentiation podded, the type of moderate differentiation is podded, and the type of undifferentiated, which usually contains large numbers of noncancerous lymphocytes (chronic inflammatory cells), which leading to the emergence of epithelial lymphoma. The shape is differentiated as the most common, which is most neatly connected with the Epstein-Barr virus infection of cancer cells. NPC is a prevalent carcinoma in the skull region and collar area, and this prevails in the esophagus area amongst pharynx and nasal cavity. This cancer was frequently detected towards South-eastern Asian countries, predominantly in the south region of Chinese population, Malaysia, Singapore, Taiwan and Vietnam [8]. Generally, NPC self-possessed is cured by chemotherapy and radiotherapy [9]. According to Asian Americans, Native Hawaiians and Pacific Islanders (AANHPIs) the ratio of Incidence and mortality for NPC about 2% to 3% annually from 2003 to 2012. Five-year cause-specific survival is higher for AANHPIs than NHWs (males 66% versus 59%; females 74% versus 58%;) By estimation, in 2012, there were more than 80 000 new cases of NPC and more than 50 000 deaths worldwide [3,10–13].

Regardless of various current strategies and approaches agreeable outcomes on nasopharyngeal tumor detection and segmentation are a long way from being obtained. Therefore, medical procedure and diagnostics remain a debate. Distinctive methodologies and methods are proposed for the all past processing steps. Furthermore, making of another standard is obligatory. The whole Nasopharyngeal tumor identification model for the most part relies on suitable preprocessing strategies regarding precision and reliability factor. A real time computer-aided object detection of nasopharyngeal carcinoma using genetic algorithm and artificial neural network based on Haar feature fear should be presented by taking numerous improvements such as clinically, detection of nasopharyngeal carcinoma images abnormality is difficult, enormous and time-consuming [6,7]. This is because of two fundamental reasons: (1) identification or similarity between normal tissues as (healthy one) and abnormal cells as (cancerous), which is extremely hard to recognize even by human eyes, not to mention the machines and, (2) extensive number of cases required amid the examination — the number differs whose depends on the sort and seriousness of ailments [14,15]. In this way, numerous endeavors are made to computerize the procedure. Nonetheless, its execution is fairly less great and opportunity to get better is still completely open. Moreover, another problem that is begging to be addressed is to localize a tumor or cancerous cell found in the abnormal case, consequently, which is never being of research intrigue up to this point. Consequently, an efficient solution for the above issues not exclusively would equip the specialist with the best in NPC direction, however would likewise guarantee a fruitful usage of ensuing methods, involving segmentation, classification, and volume estimation of tumors in a more accurate way.

The current studies on nasopharyngeal carcinoma detection very few due its realized on all endoscopy NPC image to separate the normal cases (containing only the healthy tissue) from the abnormal cases (containing both of healthy and cancerous tissue). [16] proposed A novel computer-aided approach based on MRI for the early detection and diagnosis of NPC. A local Chan-Vese level-set model, which integrated the maximum interclass-variance method with the ChanVese model, was built to detect foci with unobvious boundaries. In the technique, a neighborhood Chan-Vese show was presented with segmentation area; 26 NPC features were separated from the nasal mucosa area, and after that packed into 8 chief parts; The SVM employed for NPC classification and diagnosis. in the detection of recurrent NPC utilizing 18F-FDG PET/CT pictures by [17], the authors outlined ANNs to mirror the neural limit and procedures for the choice procedure of experienced radiologists. Their outline was made out of a three-layer ANNs with a back-propagation technique utilizing Levenberg–Marquardt method for minimum square bend fitting and 21 validation task by radiological features were utilized as an input of ANNs approach. [18] improved an automated medical diagnosis tool for NPC segmentation technique from MRI images. This technique is just qualified for identify NPC, which makes it a kind of "identification" as opposed to "division" strategy. The NPC detection outcomes acquired utilizing the proposed strategies had a rating of 85% in coordinate percent contrasted and these tissues distinguished by an accomplished radiologist. The match percent for the two proposed strategies did not have noteworthy contrasts. Be that as it may, the calculation cost for the slant technique was around twelve times quicker than the relative flag increment strategy. [6] showed development for this study is incorporates taking automatic factors realizing while proposing NPC tumor segmentation techniques for usage clinical use. the clustering technique, the tool innovate lies in the parts of proposing another spatial weighted metric-based closeness and another approach to take in its parameters by spectral clustering. The weakness is doctors need to draw isolated ROI on various tumor-bearing cuts to detect NPC segmentation for one patient, if tumor is shown on a few cuts. In any case, it is as of now considerably simpler for doctors to draw various ROIs, contrasted and outlining tumor limits deliberately on various cuts. In addition, another challenge lies in the appearance of doctors used the observation of human eyes (human errors) in NPC cases can be missed detailed information. [4] Present a computerized system for automatic identification of NPC, focusing on both the essential tumor what is more, territorial nodal metastasis, on PET/CT. they demonstrated that the proposed system effectively distinguished each of the 53 hyper metabolic injuries bigger than 1 cmin excluded normal physiological uptake in chestnut fat, muscles, bone marrow, cerebrum, and salivary organs.

Detection of the endoscopy NPC image abnormality is realized on all endoscopy NPC image to separate the normal cases (containing only the healthy tissue) from the abnormal cases (containing both of healthy and cancerous tissue). Set of pre-processing steps is executed with the endoscopy images containing non-NPC tissue extraction. Generally, radiologists analyze the endoscopic images via visual screening to identify and detect the existence of