A Research Based on Medical Image Processing in Various Healthcare Industries

Ramya M., Nandhini P., Nisha R., Suganya P.

Abstract: ***The Survey is based on the Medical Image Processing in various Healthcare Industries to overcome the risk of diseases. Some of the healthcare applications are Early Diagnostics, Patient Health Record, Lung Cancer, Alzheimer's disease, Parkinson's disease, Fish Disease, Retinal Disease, and Brain Tumor. The impact of medical image processing plays a vital role in healthcare industry for the diagnosis of disease. It will be helpful for the doctor to effectively analyse disease in a short span of time. Medical Image processing is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues. In this research paper, Analysis of various healthcare applications was discussed.***

Keyword: Early Diagnostic, Lung Cancer, Alzheimer's Disease, Parkinson's Disease, Fish Disease, Retinal Disease, Brain Tumor.

I. INTRODUCTION

In the past few years health administration or healthcare administration is the field relating to leadership, management, and administration of hospitals, hospital networks, and health care systems. Healthcare industry today generates large amounts of complex data about patients, hospitals resources, disease diagnosis, electronic patient records, medical devices etc. The large amount of data is a key resource to be processed and analyzed for knowledge extraction that enables support for cost-savings and decision making.

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. Although imaging of removed organs and tissues can be performed for medical reasons, such procedures are usually considered part of pathology instead of medical imaging.

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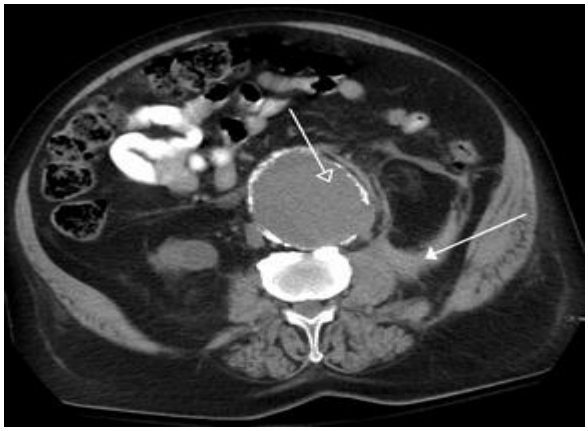

Figure 1: Medical Diagnostics

As a discipline and in its widest sense, it is part of biological imaging and incorporates radiology which uses the imaging technologies of X-ray radiography, magnetic resonance imaging, medical ultrasonography or ultrasound, endoscopy, elastography, tactile imaging, thermography, medical photography and nuclear medicine functional imaging techniques as positron emission tomography (PET) and Single-photon emission computed tomography (SPECT).

Measurement and recording techniques which are not primarily designed to produce images, such as electro encephalography (EEG), magneto encephalography (MEG), electro cardiography (ECG), and others represent other technologies which produce data susceptible to representation as a parameter graph *vs.* time or maps which contain data about the measurement locations. In a limited comparison, these technologies can be considered as forms of medical imaging in another discipline.

Medical imaging is often perceived to designate the set of techniques that noninvasively produce images of the internal aspect of the body. In this restricted sense, medical imaging can be seen as the solution of mathematical inverse problems. This means that cause (the properties of living tissue) is inferred from effect (the observed signal). In the case of medical ultrasonography, the probe consists of ultrasonic pressure waves and echoes that go inside the tissue to show the internal structure. In the case of projectional radiography, the probe uses X-ray radiation, which is absorbed at different rates by different tissue types such as bone, muscle, and fat. The term non-invasive is used to denote a procedure where no instrument is introduced into a patient's body which is the case for most imaging techniques used. The healthcare industry (also called the medical industry or health economy) is an aggregation and integration of sectors within the economic system

That provides goods and services to treat patients with curative, preventive, rehabilitative, and palliative care. It includes the generation and commercialization of goods and services lending themselves to maintaining and re-establishing health. The modern healthcare industry is divided into many sectors and depends on interdisciplinary teams of trained professionals and paraprofessionals to meet health needs of individuals and populations.

The healthcare industry is one of the world's largest and fastest-growing industries. Consuming over 10 percent of gross domestic product (GDP) of most developed nations, health care can form an enormous part of a country's economy. Health is given by numerous different legitimate elements. Current evaluations put US healthcare spending at around 15% of GDP, which is the most astounding on the planet. The United States spends the most noteworthy level of health care costs on pharmaceuticals on the planet. In the United States, around 85% of residents have health protection, either through their manager or bought exclusively.

This research will show the result of diagnosis of disease followed by healthcare industry to prevent the disease early in medical image processing .And purpose the new future research directions to improve the healthcare to cure the disease and patents health condition in healthcare industry.

II. LITERATURE SURVEY

A. Content-Based Image Retrieval System for Differential Diagnosis of Lung Cancer

Ashis Kumar Dhara and Chanukya Krishna Chama (2012) [1] presents a CBIR system is to retrieve similar nodules from large chest CT image database for a given query nodule. Lung cancer is a disease with significant prevalence in several countries around the world. Pulmonary nodules are potential manifestation of lung cancer.

This tool can also be used for differential diagnosis of lung diseases. The performance of CBIR can be enhanced by improving the knowledge base through collecting more feedback from expert radiologists.

Algorithm/Techniques:

- CBIR system is used to retrieve the similar nodules from database.
- Pulmonary nodules.

B. Automated Diagnosis of Alzheimer's Disease using Pet Images: A Study of Alternative Procedures for Feature Extraction And Selection

Pedro Miguel and Maravilha Morgado (2012) [2] presents a ALZHEIMER's disease is a neurological disorder that mostly affects people over 65 years old and whose incidence rate grows exponentially with age. It is a progressive disorder meaning that it worsens over time, affecting memory, cognitive and physical capabilities and eventually leading to death. A new method based on data acquired by the Eye Track technology during the inspection of PET images by an expert physician was proposed. The aim of this method is to model the behaviour of the gaze over time and use the model to select the features that the expert found most interesting. The current work studied several approaches to the automatic classification of AD based on FDG-PET images. This fact indicates that better performances might be achieved if it was possible to consider connections between features at lower computational costs.

Algorithm/Techniques:

- PET images are used for disease diagnosis.
- The extraction and
- Selection of features.

C. A Novel Feature Selection in The Case of Brain Pet Image Classification

Imene Garali and Mouloud Adel (2013) [3] presents a Positron Emission Tomography (PET) imaging is of importance for diagnosing neurodegenerative diseases like Alzheimer Disease (AD). Computer aided diagnosis methods could process and analyze quantitatively these images, in order to better characterize and extract meaningful information for medical diagnosis. Brain images are first segmented into Regions of Interest (ROI) using an atlas. To define a Separation Power Factor (SPF) associated to each region. This factor quantifies the ability of each region to separate AD from Healthy Control (HC) brain images. Ranking selected regions according to their SPF and inputting them to a Support Vector Machine (SVM) classifier, yields better classification accuracy rate than when inputting the same number of ranked regions extracted from four others classical feature selection methods.

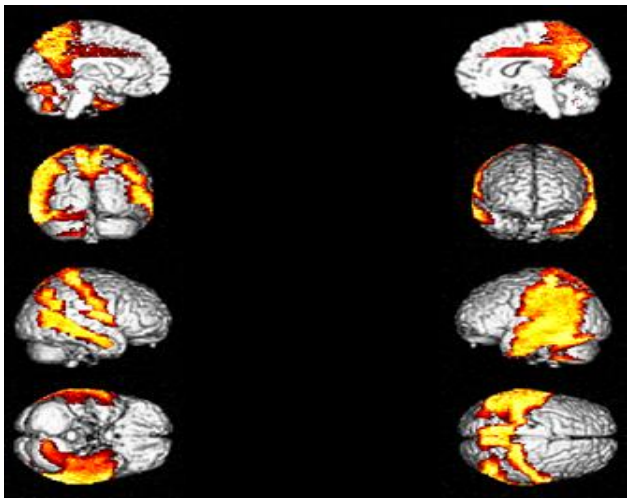

Figure 2: ROIs Selected Are Presented on 3D Brain Image

Algorithm/Techniques:

- A novel computer-aided diagnosis technique for brain PET images classification in the case of AD.
- A Separation Power Factor (SPF) associate to each region.
- Regions of Interest (ROI).

D. Automated Medical Image Segmentation Techniques

Neeraj Sharma and Lalit M. Aggarwal (2010) [4] presents an accurate segmentation of medical images is a key step in contouring during radiotherapy planning.

Computed topography (CT) and Magnetic resonance (MR) imaging are the most widely used radiographic techniques in diagnosis, clinical studies and treatment planning. The approaches for image segmentation discussed in this review can be ranked on the basis of applicability, suitability, performance, and computational cost. The performance can be improved by integrating them with artificial intelligence techniques. In such situations it is better to use unsupervised methods such as fuzzy-c means algorithm. A variety of different neural network-based algorithms are also available for texture-based segmentation and classification having good accuracy. Finally, it is desired from medical image segmentation and classification algorithms that they must have the following features:

a) Accuracy,
b) Reliability,
c) Repeatability,
d) Robustness and
e) Least dependency on the operator.

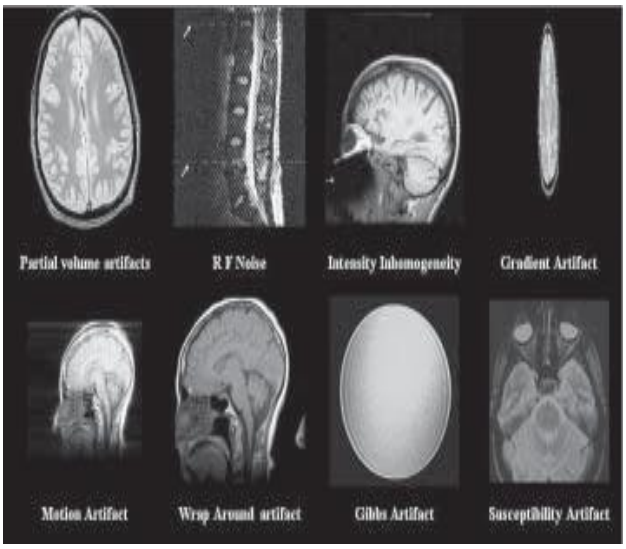

Figure 3: Artifacts in MR Imaging

Algorithm/Techniques:

- Fuzzy-C means algorithm
- Neural network-based algorithms give segmentation and classification.

E. Parkinsons Disease Diagnosis using Image Processing Techniques A Survey

A.Valli and Dr.G.Wiselin Jiji (2014) [5] presents a Computer Aided Diagnosis (CAD) can be embedded into a real time application for the early diagnosis of Parkinson's disease (PD). Dopamine nerve terminals can be reduced in the brain parts such as Substantia nigra, Striatum and other brain structures. This reduction which will lead to Parkinson's disease. Dopamine Reduction gets automatically diagnosed by CAD and PD/normal patients can be found. For this, machine learning system (MLS)/CAD can be trained with the help of Artificial Neural Networks (ANN). Therefore accurate diagnosis of PD and number of wrong decisions gets reduced with the help of CAD and diagnosis algorithms. Extracting features and selecting appropriate features will yields good classification results.

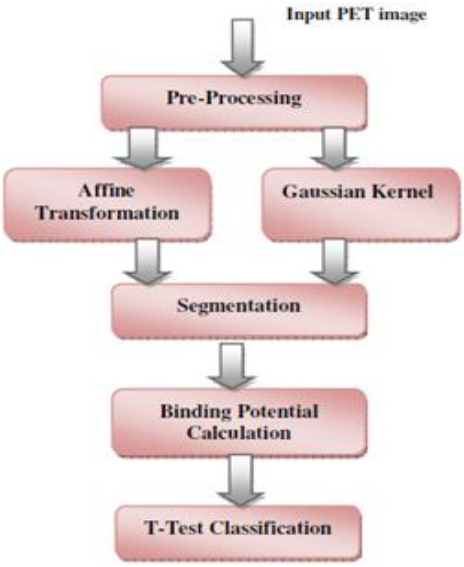

Figure 4: Flow Chart of Whole Processing

Algorithm/Techniques:

- Classification algorithms are used to distinguish between normal and PD.
- Automatically diagnosed by using a Computer Aided Diagnosis (CAD) technique.

F. New Feature Selection Method on Lung

R.Nithya and H.Umamageswari (2016) [6] presents a new feature selection method based on Fisher criterion and genetic optimization, called FIG for short, to tackle the CISL recognition problem. The effectiveness of the proposed classification scheme was verified using nine categories of CISL images from CT scan. The combination of different image features exploits the complementary strengths of these different feature extractors. The effectiveness of the proposed classification scheme was verified using a breast cancer biopsy image dataset and a 3D OCT retinal image set. The benchmark images used in this work were cropped from the original biopsy scans and only cover the important areas of the scans. Furthermore, it brought slightly better recognition performance and much better computation efficiency than the commonly used genetic feature selection method based on classification accuracy rate.

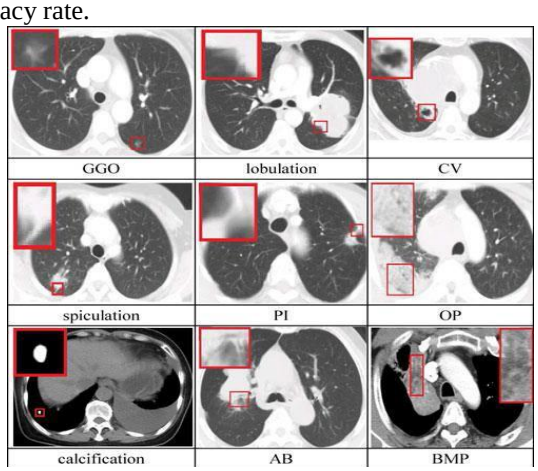

Figure 5: Nine Categories of CISL

Algorithm/Techniques:

- A new feature selection method called FIG.
- Feature selection method based on classification.

G. Fish Disease Diagnosis System Based on Image Processing of Pathogens Microscopic Images

Jeong-Seon Park and Myung-Joo Oh (2007) [7] presents an image processing-based fish disease diagnosis system was developed, allowing for earlier treatment of infected fish to prevent the spread of disease. The system is composed of three steps:

1) Extracting pathogen area from the microscopic images of infected fish tissue by applying various kinds of image processing such as noise reduction, edge detection, morphological operations, background extraction, and object detection.
2) Confirming pathogen and making final diagnosis by feature extraction, correlation matching and statistical pattern matching compared to the registered pathogen database.
3) Sending a message about diagnosed disease and treatment method to the fish farmers on their mobile phones after sorting out appropriate treatment methods by searching drug information database.

The proposed system is more convenient, consistent, and rapid to diagnosis fish disease rather than general diagnosis method.

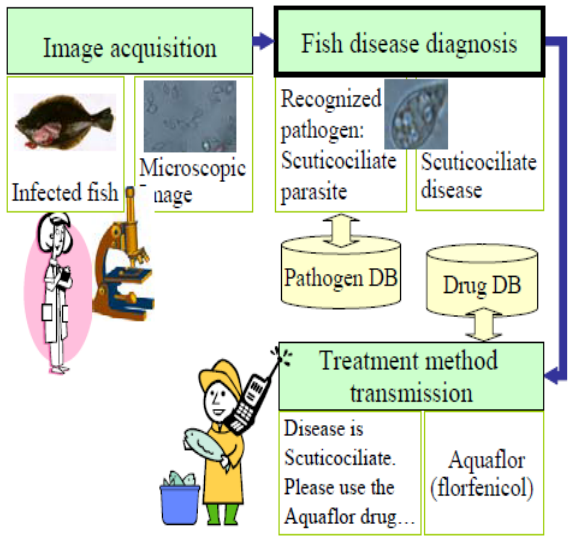

Figure 6: Flow of the Developed Fish Disease Diagnosis System Based on Image Processing

H. Congenital Heart Disease (CHD) Discrimination In Fetal Echocardiogram Based On 3d Feature Fusion

Liqun Ji and Yun Gu (2018) [8] presents an automatic diagnosis for fetal echocardiography plays an important part in diagnostic aid in the discrimination of congenital heart disease (CHD). It proposed a new system for automatic discrimination of CHD applying 4D original echocardiogram, which avoids the challenging work of searching standard views and also extracted the features of 3D static structure and 3D motion via 3D SIFT and 3D Histogram of Optical Flow (HOF) from the original 4D (3D+T) echocardiogram data, respectively. Bag of Words (BoW) method was employed to construct the quantized feature. Both static and motion features were fused to form the final image representation. One-Class SVM classifier was utilized to discriminate CHD due to the lack of CHD data and the significant difference in all the CHD cases. Experiments on the real data demonstrate the improved discrimination accuracy due to the fused feature.

Algorithm/Techniques:

- Bag of Words (BoW) method.
- Support Vector Machine (SVM) classifier.

I. Automatic Diabetic Retinopathy Detection using FCM

Lokesh Gowda J and K V Viswanatha (2018) [9] presents a diabetes is a chronic disease that occurs due to the pancreas does not able to make insulin. Nowadays diabetic retinopathy is a common eye disease in diabetic patients. Diabetic Retinopathy (DR) is the leading cause of blindness in the working-age population. Early detection of diabetic retinopathy protects patients from losing their vision. The risk of severe vision loss can be significantly reduced by timely diagnosis and treatment. It directly uses Shape, Color and Domain Knowledge of Diabetic Retinopathy. The proposed method uses the color intensity and domain knowledge is used to extract the abnormal region. The simulation results of the proposed classifier obtained the accuracy of 99.01%, sensitivity of 98.38%.

Algorithm/Techniques:

The Fuzzy C-Means Clustering Method has been applied to identify the exact region of the Diabetic Retinopathy.

J. A Study on Retinal Disease Classification and Filteration

Parul and Neetu Sharma (2015) [10] presents a disease recognition and classification approaches are specific to human organ and image type. One of such disease class includes detection of retinal disease such as glaucoma detection or diabetic detection. It has defined a study on disease recognition approaches such as SVM, DCT, HMM and PCA approaches. It also defined the image processing operations applied to filter the medical image and to perform disease area segmentation. The presented work is about the detection of retinal Glaucoma disease in optical retinal images.

To perform this detection a two stage approach is presented,

1) The extraction of ROI will be done using intelligent segmentation algorithm.
2) The curvature analysis approach will be used to identify the blood vessel and cup. The work is about to identify the retinal disease more accurately.

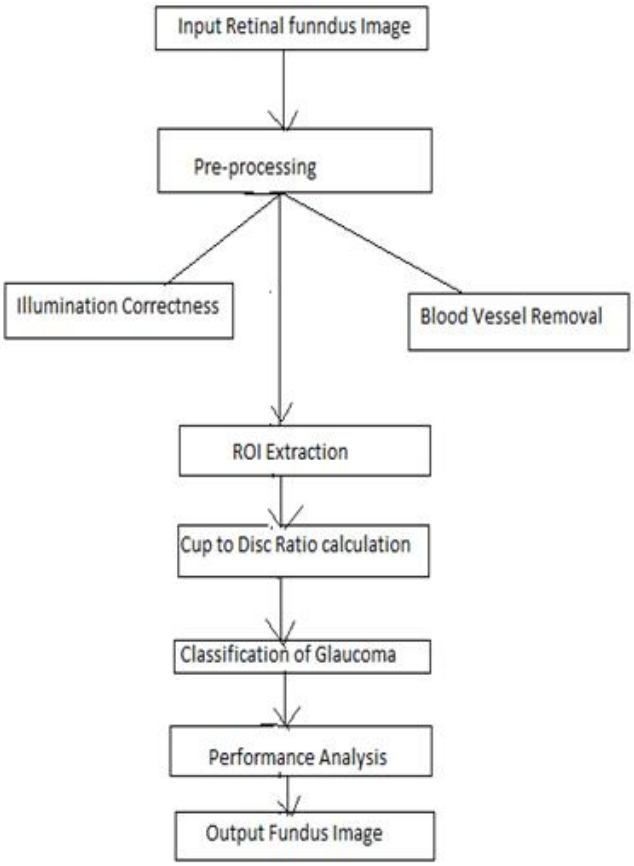

Figure 7: Methodology for Detection of Glaucoma Disease

III. SEGMENTATION OF MRI BRAIN IMAGE USING FUZZY C MEANS FOR BRAIN TUMOR DIAGNOSIS

Sayali D. Gahukar and Dr. S.S. Salankar (2014) [11] presents an segmentation of brain MR images, among them the fuzzy c-mean (FCM) algorithm is widely used in MR images segmentation. Cluster analysis identifies groups of similar objects and therefore helps in discovering distribution of patterns in large data sets. Fuzzy C-means (FCM) is most widely used fuzzy clustering algorithm for real world applications. However accuracy of this algorithm for abnormal brains with edema, tumor, etc is not efficient because of limitation in initialization of this algorithm. The author proposed an ant colony algorithm to improve the efficiency of fuzzy c-means clustering. The proposed algorithm is tested in medical images.

Algorithm/Techniques:

- The ant colony algorithm is used to improve the accuracy.
- The PSNR value of the algorithm increases but at the cost of time.
- Fuzzy c-mean (FCM) algorithm is used in MR images segmentation.

A. Feature Extraction and Classification on Esophageal X-Ray Images of Xinjiang Kazak Nationality

Fang Yang and Murat Hamit (2017) [12] presents an esophageal cancer is one of the fastest rising types of cancers in China. Both sequential forward selection and principal component analysis methods were employed to select the discriminative features for classification. The support vector machine and K-nearest neighbours were applied to classify the esophageal cancer images with respect to their specific types. The classification performance was evaluated in terms of the area under the receiver operating characteristic curve, accuracy, precision, and recall, respectively. Therefore, the proposed computer-aided diagnostic system is promising for the diagnostics of esophageal cancer. The modules of the proposed system include image pre-processing, feature extraction, feature selection, image classification, and performance evaluation.
A two-stage classification process was carried out for classifying the esophageal cancer by type.

1) Classification process, the X-ray images are classified as normal and abnormal.
2) Classification process continues the abnormal images that are classified as fungating and ulcerative type images.

B. Segmentation of The Lung Anatomy for High Resolution Computed Tompgraphy (HRCT) Thorax Images

Norliza Mohd Noor and Omar Mohd Rijal (2013) [13] discussed about the diagnosing interstitial lung disease (ILD) using HRCT Thorax images, the radiologists required to view large volume of images. An automatic segmentation algorithm is proposed to obtain the shape of the heart and lung. To determine the quality of the segmentation, ground truth or manual tracing of the lung and heart boundary done by senior radiologist was compared with the result from the proposed automatic segmentation.
The five segmentation quality measurements that are used to measure the performance of the proposed segmentation algorithm, namely,

1) The volume overlap error rate (VOE),
2) Relative volumetric agreement (RVA),
3) Average symmetric surface distance (ASSD),
4) Root mean square surface distance (RMSD) and
5) Hausdorff distance (HD).

The results showed that the proposed segmentation algorithm produced good quality segmentation for both right and left lung and may be used in the development of computer aided system application.

IV. CONCLUSION

In this research, various challenges were addressed by the authors in the field of healthcare industry. From this survey, still more improvement is needed in diagnosis of disease since it plays an important role in healthcare industry. The proposed method gives better idea to decision makers for improving our health condition by identifying the disease based on previous record of the patient.

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