International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 17 (2017) pp. 6338-6346
© Research India Publications. http://www.ripublication.com

A study on Deep Machine Learning Algorithms for diagnosis of diseases

Dinu A.J.*, Ganesan R[1], Felix Joseph[2] and Balaji V[3]

**Research Scholar, Noorul Islam University, Kumaracoil, Thuckalay, Tamil Nadu, India.*

[1]Professor, Department of Electronics and Instrumentation Engineering, Noorul Islam University, India.

[2]Department of Electrical and Computer Engineering, Bule Hora University, Ethiopia.

[3]Faculty of Electrical and Computer Engineering, Jimma Institute of Technology, Jimma University, Ethiopia.

**Orcid ID: 0000-0002-0065-8668*

Abstract

Consider that we are living in a place that is far away from a hospital or do not have sufficient money to cover up the hospital bill or do not have enough time to take off work. In such cases, the disease diagnosis through sophisticated machines would be lifesaving. Scientists had developed numerous artificially intelligent diagnosis algorithms for detecting various diseases like Rheumatoid Arthritis, Cancer, Lung Diseases, Heart Diseases, Diabetic Retinopathy, Hepatitis Disease, Alzheimer's disease, Liver Disease, Dengue Disease and Parkinson Disease. Deep learning uses large artificial neural networks layers having interconnected nodes which can rearrange themselves as and when new information comes in. This technique allows the computers to self-learn on their own without the need for human programming. This paper focuses on recent developments in machine learning which have made significant impacts in the detection and diagnosis of various diseases.

Keywords: Machine Learning, Artificial Intelligence, Computer Aided Diagnosis, Artificial Neural Network

INTRODUCTION

Computer Aided Diagnosis is a rapidly growing dynamic area of research in medical industry. The recent researchers in machine learning machine learning promise the improved accuracy of perception and diagnosis of disease. Here the computers are enabled to think by developing intelligence by learning. There are many types of Machine Learning Techniques and which are used to classify the data sets [1, 2]. They are Supervised, Unsupervised Semi-Supervised, Reinforcement, Evolutionary learning, and Deep learning algorithms [3].

Supervised learning- It offers a training set of examples with suitable targets and on the basis of this training set, algorithms respond correctly to all feasible inputs. Learning from examples is another name of Supervised Learning [4]. Classification and regression are the types of Supervised Learning.

Unsupervised learning- Unsupervised learning technique tries to find out the similarities between the input data and based on these similarities, unsupervised learning technique classifies the data. This is also known as density estimation [5]. Unsupervised learning contains clustering which makes clusters on the basis of similarity.

Semi-supervised learning- Semi-supervised learning technique is a class of supervised learning techniques. This learning also used unlabelled data for training purpose (generally a minimum amount of labelled data with a huge amount of unlabelled data) [6]. Semi-supervised learning lies between unsupervised learning (unlabelled-data) and supervised learning (labelled-data).

Reinforcement learning- This learning is supported by behaviourist psychology. An algorithm is informed when the answer is wrong but does not inform that how to correct it. It has to explore and test various possibilities until it finds the right answer [7]. It is also known as learning with a critic. It does not recommend improvements.

Evolutionary Learning- This biological evolution learning can be considered as a learning process like how biological organisms are adapted to make progress in their survival rates and the chance of having offspring's [8]. By using the idea of fitness, to check how accurate the solution is, we can use this model in a computer.

Deep learning- In this technique the back propagation jointly learns all of the model parameters to optimise the output of the task [9]. It uses the deep graph with various processing layer, made up of many linear and nonlinear transformation.

VARIOUS MACHINE LEARNING TECHNIQUES FOR DETECTION AND DIAGNOSIS OF DISEASES

Automatic and continuous assessment of biomarkers enables a quantification of disease progression during medical treatment [10, 11]. The increase in reliability and sensitivity in medical treatments would help to speed up the development of effective disease controlling. This also helps to reduce the number of patients necessary for clinical trials. This paper provides the comparative analysis of different machine learning algorithms for diagnosis of different diseases such as Rheumatoid Arthritis, Cancer, Lung Diseases, Heart Diseases, Diabetic Retinopathy, Hepatitis Disease, Alzheimer's disease, Liver Disease, Dengue Disease and Parkinson Disease.

A. AUTOMATIC JOINT DETECTION IN RHEUMATOID ARTHRITIS

The measurement of Joint Space Width (JSW) in hand x-ray images of patients suffering from Rheumatoid Arthritis (RA) is a time consuming task for radiologists. Manual assessment lacks accuracy and is observer-dependent, which hinders an accurate evaluation of joint degeneration in early diagnosis and follow-up studies. Automatic analysis of the JSW is crucial with regard to standardization, sensitivity, and reproducibility. In this work an approach is proposed for the automatic quantification of radiographic changes in rheumatoid arthritis by measuring two indicators for disease progression. Based on a hand radiograph, bone positions and contour delineations are determined by the algorithm. Subsequently, joint space widths are measured and erosions on the contours of bones are detected. The work aims at a quantitative assessment of RA progression that is more sensitive and reproducible than manual approaches currently in use.

Yinghe Huo [12] presented a system for Automatic quantification of radiographic finger joint space width of patients with early rheumatoid arthritis. Around 99% of joint locations are detected with an error less than than 3 mm with respect to the manually indicated gold standard. The joint margins are detected by combining the intensity values and spatially constrained intensity derivatives, which are refined by an active contour model. Around 96% of the joints are successfully delineated.

A.B Suma [13] proposed a cost-effective and safer technique for the diagnosis of RA. The study focuses on the application of non-invasive, radiation-free, cost economic technique namely thermography in the diagnosis of early stage RA. The main aim is to compare various segmentation algorithms, namely manual, colour and k-means image segmentation and to find out the best suitable segmentation algorithm for thermal images. The hot spot region is extracted using three different image segmentation algorithms and compared with the normal thermograph to determine the effective segmentation algorithm in the detection of early stage RA. The accuracy obtained by the work is 93%.

Georg Langs [14] developed a system for Automatic Quantification of Joint Space Narrowing and Erosions in Rheumatoid Arthritis. In this method, Bone contours are delineated by active shape models comprised of statistical models of bone shape and local texture. These models are refined by snakes which increase the accuracy and allow for a fitting of pathological deviations from the training population. The method then measures joint space widths and detects erosions on the bone contour. Joint space widths are measured with a coefficient of variation of 2%–8% for repeated measurements and erosion detection exhibits an area under the receiver operating characteristic (ROC) curve of 0.89.The accuracy is around 92%.

Table 1: Machine Learning Techniques used for the automatic joint detection in Rheumatoid Arthritis

Machine Learning Techniques	Author	Year	Disease	Accuracy
Joint Localization, Active shape models	Yinghe Huo	2017	Rheumatoid Arthritis	96%
Manual, Colour and K-means image segmentation	A. B. Suma	2016	Rheumatoid Arthritis	93%
Joint Localization, Contour delineation, ASM driven snakes	Georg Langs	2009	Rheumatoid Arthritis	92%

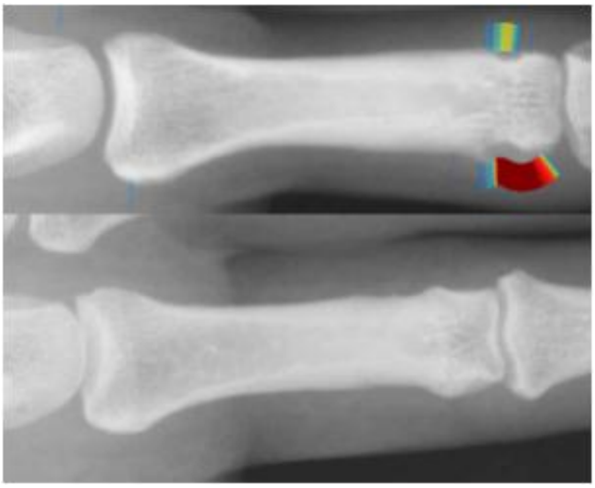

Figure 1: Automatic erosion detection result in Rheumatoid Arthritis after analysis

B. DEEP LEARNING IN DETECTION OF CANCER

A patient's biological tissue samples from pathologist's reports are often considered as the gold standard for review in the diagnosis of many diseases. Cancerous tumours mass is one of the major types of breast cancer. When cancerous masses are embedded in and camouflaged by varying densities of parenchymal tissue structures, they are very difficult to be visually detected on mammograms.

Smita Jhajharia proposed a neural network based breast cancer prognosis model with principal component analysis (PCA) processed features. Here a multivariate statistical approach has been coupled with an artificial intelligence based learning technique to implement a prediction model [15]. Principal components analysis pre-processes the data and extracts features in the most relevant form for training an artificial neural network .The ANN learns the patterns in the data for classification of new instances. The accuracy from experimental analysis is found to be 96%

Zheng L proposed an algorithm that combines several artificial intelligent techniques with the discrete wavelet transform (DWT) for detection of masses in mammograms. The AI techniques include fractal dimension analysis, multiresolution Markov random field, dogs-and-rabbits algorithm [16]. The fractal dimension analysis serves as a pre-processor to determine the approximate locations of the regions suspicious for cancer in the mammogram. The dogs-and-rabbits clustering algorithm is used to initiate the segmentation at the LL subband of a three-level DWT decomposition of the mammogram. A tree-type classification strategy is applied at the end to determine whether a given region is suspicious for cancer. The verification results show that the proposed algorithm has a sensitivity of 97.3% and the number of false positives per image is 3.92.

Table 2: Machine learning techniques used for the detection of cancer

Machine Learning Techniques	Author	Year	Disease	Accuracy
PCA,ANN	Smita Jhajharia	2016	Cancer	96%
Fractal dimension analysis ,DWT, Markov random process, Dogs-and-Rabbits algorithm	Zheng L	2014	Cancer	97.3%

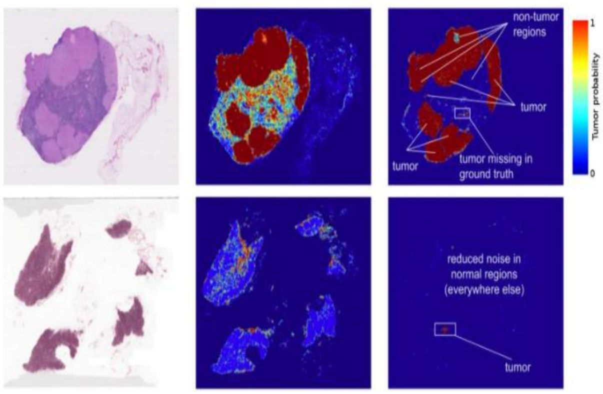

Figure 2: Deep learning diagnosis of tumor

C. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN DETECTION OF LUNG DISEASES

Artificial Intelligence (AI) is used to improve the accuracy of the diagnosis in lung diseases. Machine learning utilises algorithms that can learn from and perform predictive data analysis.

Juan Wang proposed a deep learning algorithm for detecting Cardiovascular Diseases. A 12-layer convolutional neural network to discriminate BAC (Breast arterial calcifications) from non-BAC and apply a pixel wise, patch-based procedure for BAC detection. The performance of the system is assessed using both free-response receiver operating characteristic (FROC) analysis and calcium mass quantification analysis [17]. The FROC analysis shows that the deep learning approach achieves a level of detection similar to the human experts. The calcium mass quantification analysis shows that the inferred calcium mass is close to the ground truth, with a linear regression between them yielding a coefficient of determination of 96.24%.

Shubhangi Khobragade proposed an algorithm for automatic detection of major lung diseases. The lung segmentation, lung feature extraction and its classification is made using artificial neural network technique for the detection of lung diseases such as TB; lung cancer and pneumonia [18]. The intensity based method and discontinuity based method is used to detect lung boundaries. Statistical and geometrical features are extracted. Image classification is carried out using feed forward and back propagation algorithms. The accuracy is found to be 86%.

Table 3: Machine Learning Techniques used for the automatic detection of lung diseases

Machine Learning Techniques	Author	Year	Disease	Accuracy
FROC,ANN	Juan Wang	2017	Lung Disease	96.24%
Feed forward and Back propagation Neural Network	Shubhangi Khobragade	2017	Lung Disease	86%

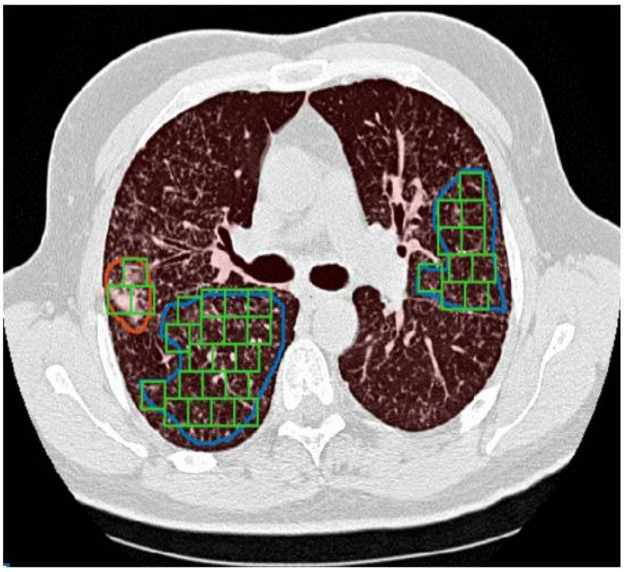

Figure 3: Example of generating image patches through the annotations of a CT slice. The lung field is displayed with transparent red. The polygons are the ground truth areas with considered pathologies. The patches have 100% overlap with the lung, at least 80% overlap with the ground truth and 0% overlap with each other.

D. AUTOMATIC DETECTION OF HEART DISEASES

Machine learning algorithms can be used to help improve the accuracy of the diagnosis in heart diseases.

Otoom et, al proposed an algorithm for detection and analysis of Coronary artery disease. Performance analysis is carried out using three algorithms Bayes Net, Support vector machine, and Functional Trees FT [19]. Bayes Net attained 85.5% of correctness, SVM provides 85.1% accuracy and FT classify 84.5% correctly.

Vembandasamy et al. [20] put forward an algorithm, to diagnose heart disease by using Naive Bayes algorithm. Naive Bayes offers 86.42% of accuracy.

Chaurasia and Pal [21] proposed an algorithm for heart disease detection. Naive Bayes provides 85.31% accuracy. J48 gives 84.35% of correctness. 85.03% of accuracy is achieved by Bagging.

Parthiban and Srivatsa [22] developed a machine learning algorithm for diagnosis of heart disease by using the methods of machine learning. By using Naive Bayes Algorithm 74% of accuracy is obtained. SVM provide the highest accuracy of 94.60.

Tan et al. [23] proposed hybrid technique in which two machine-learning algorithms named Genetic Algorithm (G.A) and Support Vector Machine (SVM) are joined effectively by using wrapper approach. After applying GA and SVM hybrid approach, 84.07% accuracy is attained for detection of heart disease.

Table 4: Machine Learning Techniques used for the automatic detection of heart diseases

Machine Learning Techniques	Author	Year	Disease	Accuracy
Bayes Net SVM FT	Otoom	2015	Heart Disease	85.50% 85.10% 84.50%
Naive Bayes	Vembandasamy	2015	Heart Disease	86.42%
Naïve Bayes J48 Bagging	Chaurasia Pal	2013	Heart Disease	85.31% 84.35% 85.03%
SVM Naive Bayes	Parthiban and Srivatsa	2012	Heart Disease	94.60% 74.00%
GA,SVM	Tan	2009	Heart Disease	84.07%

E. AUTOMATIC DIAGNOSIS OF DIABETIC RETINOPATHY

DME is one of the largest causes of visual loss in diabetes. There are various machine learning algorithms that can be used to improve the accuracy of diagnosis of diabetic retinopathy.

Iyer has performed a work to predict diabetes disease by using decision tree and Naive Bayes. J48 shows 76.95% accuracy by using Cross Validation and Percentage Split Respectively [24]. Naive Bayes presents 79.56% correctness by using PS. Algorithms show the highest accuracy by utilizing percentage split test.

Sen and Dash developed Meta-learning algorithms for diabetes disease diagnosis. CART, Adaboost, Logiboost, and grading learning algorithms are used to predict that patient has diabetes [25]. From experimental results CART offers 78.64% accuracy. The Adaboost obtains 77.86% exactness. Logiboost offers the correctness of 77.47%. Also Misclassification Rate of 21.35%, which is smaller as compared to other techniques.

R. Catherine Silvia introduced a feature extraction technique. This technique is used to capture the global characteristics of the fundus images and separate the normal from DME images. Diabetic macular edema detection is carried out via supervised learning. Disease severity is assessed using a rotational asymmetry metric by examining the symmetry of macular region [26].A microaneurysm is identified using Circular Hough Transform. The detection performance has specificity between 74% and 90%.

Table 5: Machine Learning Techniques used for the automatic diagnosis of diabetic retinopathy

Machine Learning Techniques	Author	Year	Disease	Accuracy
Naïve Bayes J48	Iyer	2015	Diabetes Disease	79.56% 76.95%
CART Adaboost Logiboost Grading	Sen and Dash	2014	Diabetes Disease	78.64% 77.86% 77.47% 66.40%
Hough, Supervised learning	R. Catherine Silvia	2013	Diabetes Disease	74%

F. AUTOMATIC DIAGNOSIS OF HEPATITIS DISEASE

Hepatitis B is a potentially life-threatening infection which affects the liver.It is caused by the hepatitis B virus. The information details range from clinical symptoms to various types of biochemical data. Information in the data received is analyzed and evaluated during the diagnostic process. Artificial intelligence methods which include computer-aided diagnosis and artificial neural networks can be employed for the diagnosis. These adaptive learning algorithms can evaluate various types of medical data and integrate them into categorized outputs.

Ba-Alwi and Hintaya put forward a comparative analysis of various data mining algorithms that are used for hepatitis disease diagnosis are Naive Bayes, FT Tree, K-Star, J48, LMT, and NN [27]. From the analysis results, Naive Bayes is considered as the best classification algorithm which gives the accuracy of 96.52%.

Sathyadevi employed C4.5, ID3 and CART algorithms for diagnosing the disease of hepatitis. In this analysis, CART has offered great performance as it shows the highest classification accuracy of 83.2% [28]. ID3 Algorithm offers 64.8% of accuracy. 71.4% is attained by the C4.5 algorithm.

Table 6: Machine Learning Techniques used for the automatic diagnosis of hepatitis disease

Machine Learning Techniques	Author	Year	Disease	Accuracy
Naive Bayes FT K Star J48 LMT NN	Ba-Alwi and Hintaya	2013	Hepatitis Disease	96.52% 87.10% 83.47% 83% 83.6% 70.41%
C4.5 ID3 CART	Sathyadevi	2011	Hepatitis Disease	71.4% 64.8% 83.2%

G. AUTOMATIC DIAGNOSIS OF ALZHEIMER'S DISEASE

In Alzheimer disease, death of brain cells are occurs so there is many causes happened such as memory loss, poor in calculations etc.

Ruben Armananzas proposed a Voxel-Based Diagnosis of Alzheimer's Disease Using Classifier Ensembles [29]. The images were first preprocessed using the statistical parametric mapping toolbox to output individual maps of statistically activated voxels. A fast filter was applied afterwards to select voxels commonly activated across demented and nondemented groups. Four feature ranking selection techniques were embedded into a wrapper scheme using an inner–outer loop for the selection of relevant voxels. The classification accuracy of the proposed method is 97.14%.

Baiying Lei proposed a novel discriminative sparse learning method with relational regularization to jointly predict the clinical score and classify AD disease stages using multimodal features [30]. A discriminative learning technique is applied to expand the class specific difference and include geometric information for effective feature selection. The classification accuracy of the proposed method is 94.68%.

Tong Tong proposed A Novel Grading Biomarker for the Prediction of Conversion from Mild Cognitive Impairment to Alzheimer's disease [31]. Using the Alzheimer's disease Neuroimaging Initiative (ADNI) dataset, the proposed global grading biomarker achieved an area under the receiver operating characteristic curve (AUC) in the range of 79-81% for the prediction of MCI-to-AD conversion within three years in tenfold cross validations. The classification AUC further increases to 84-92% when age and cognitive measures are combined with the proposed grading biomarker.

Priyanka Thakare developed Alzheimer Disease Detection AI system [32]. In this work using wavelet transform four features are extracted and classification is done by support vector machine. It gives an accuracy of 94%.

Jun Zhang proposed a landmark-based feature extraction method based on based on a shape-constrained regression-forest algorithm [33]. The AD classification accuracy is 83.7%.

Table 7: Machine Learning Techniques used for the automatic diagnosis of Alzheimer’s disease

Machine Learning Techniques	Author	Year	Disease	Accuracy
Statistical parametric mapping, Stochastic searches	Ruben Armananzas	2017	Alzheimer disease	97.14%
Discriminative sparse learning, Relational regularization	Baiying Lei	2017	Alzheimer disease	94.68%
Sparse Representation techniques	Tong Tong	2016	Alzheimer disease	92%
DWT,SVM	Priyanka Thakare	2016	Alzheimer disease	94%
Nonlinear registration ,Shape-constrained regression-forest algorithm	Jun Zhang	2016	Alzheimer disease	83.7%

H. *MACHINE LEARNING TECHNIQUES FOR LIVER DISEASE*

Various intelligent techniques are to classify the liver patients. Recent techniques are as follows

Vijayarani and Dhayanand predict the liver disease by using Support vector machine and Naive bayes Classification algorithms [34]. Naive bayes shows 61.28% accuracy and 79.66% accuracy is attained in by SVM.

Rajeswari, P. put forward an analysis of liver disorder by using Data Mining Algorithm [35]. Naive Bayes provide 96.52% Correctness. 97.10% accuracy is achieved by using FT tree. K star algorithm classify the instances about 83.47% accurately.

Table 8: Machine Learning Techniques used for the automatic diagnosis of Liver disease

Machine Learning Techniques	Author	Year	Disease	Accuracy
SVM Naive Bayes	Vijayarani and Dhayanand	2015	Liver Disease	79.66% 61.28%
Naive Bayes K Star FT tree	Rajeswari and Reena	2010	Liver Disease	96.52% 83.47% 97.10%

I. *MACHINE LEARNING TECHNIQUES FOR DENGUE DISEASE*

Dengue fever is a disease caused by viruses that are transmitted by mosquitoes. Several machine learning techniques are developed for detection of dengue fever.

Fathima and Manimeglai used SVN data mining algorithm for prediction of dengue disease [36]. Accuracy that is achieved by SVM is 90.42%.

Ibrahim proposed an Algorithm of Multilayer feed-forward neural network for prediction of dengue disease [37]. Accuracy obtained by MFNN is 90%.

Table 9: Machine Learning Techniques used for the automatic diagnosis of Dengue disease

Machine Learning Techniques	Author	Year	Disease	Accuracy
SVM	Fathima and Manimeglai	2012	Dengue Disease	90.42%
MFNNN	Ibrahim	2005	Dengue Disease	90%

J. *MACHINE LEARNING TECHNIQUES FOR PARKINSON DISEASE*

Parkinson's disease (PD) is a neuro-degenerative disease which affects a person’s mobility.

Kamal Nayan Reddy Challa, Venkata Sasank Pagolu, Ganapati Panda, Babita Majhi developed automated diagnostic models using Multilayer Perceptron, BayesNet, Random Forest and Boosted Logistic Regression [38]. It has been observed that Boosted Logistic Regression provides the best performance with an impressive accuracy of 97.159 % and the area under the ROC curve was 98.9%.

Sachin Shetty and Y. S. Rao proposed SVM based machine learning approach to identify Parkinson's disease using gait analysis [39]. Gaussian radial basis function kernel based Support vector machine (SVM) classifier achieves overall accuracy of 83.33%, good detection rate for Parkinson’s disease of 75% and low false positive results of 16.67%.

Indrajit Mandal and N. Sairam proposed robust methods of treating Parkinson's disease (PD) includes sparse multinomial logistic regression, rotation forest ensemble with support vector machines and principal components analysis, artificial neural networks, boosting methods [40]. A new ensemble method comprising of the Bayesian network optimised by Tabu search algorithm as classifier and Haar wavelets as projection filter is used for relevant feature selection and ranking. The highest accuracy obtained by linear logistic regression and sparse multinomial logistic regression is 100% and sensitivity, specificity of 0.983 and 0.996, respectively. All the experiments are conducted over 95% and 99% confidence levels and establish the results with corrected t-tests.

Table 10: Machine Learning Techniques used for the automatic diagnosis of Parkinson disease

Machine Learning Techniques	Author	Year	Disease	Accuracy
Boosted Logistic Regression	Kamal Nayan Reddy Challa	2016	Parkinson Disease	97.15%
Gaussian radial basis function kernel based SVM	Sachin Shetty Y. S. Rao	2016	Parkinson Disease	83.33%
Linear LR NN SVM SMO Pegasos AdaBoost Additive L R Ensemble Selection FURIA Multinominal Ridge LR RF Bayesian LR	Indrajit Mandal N. Sairam	2012	Parkinson Disease	96.58% 96.05% 96.58% 95.22% 96.58% 96.41% 96.75% 95.9% 96.41% 95.73% 96.07% 95.9%

CONCLUSION

This paper provides an idea of recent artificial intelligent systems available for detection and diagnosis of different diseases. The system analyzes the relevant medical imagery and associated point data to make an inference that can help the doctor make a decision in a clinical situation. The AI system just works as an interface between clinical image flow and archived image data. The AI system does not require application-specific engineering to apply it. The various disease diagnosis using AI systems can increase the speed of decision making, and it can lower the false-positive rates. From the study it can be clearly observed that different AI algorithms provide enhanced accuracy on detection of various diseases.

REFERENCES

[1] C. K. Shie, C. H. Chuang, C. N. Chou, M. H. Wu, and E. Y. Chang, 2015, "Transfer representation learning for medical image analysis," in IEEE Conf Eng Med Biol, pp. 711–714.

[2] Meherwar Fatima, Maruf Pasha, 2017, "Survey of Machine Learning Algorithms for Disease Diagnostic", Journal of Intelligent Learning Systems and Applications, pp.1-16.

[3] D. Yu, and L. Deng, 2011, "Deep learning and its applications to signal and information processing," IEEE Signal Process. Mag., vol. 28, no. 1, pp. 145-154.

[4] J. Shi and J. Malik,2000, "Normalized cuts and image segmentation," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 22, no. 8, pp. 888–905.

[5] A. Kumar, J. Kim, W. Cai, and D. Feng, 2013, "Content-based medical image retrieval: a survey of applications to multidimensional and multimodality data," J Digit Imaging, vol. 26, no. 6, pp. 1025–1039.

[6] N. Tajbakhsh, J. Y. Shin, S. R. Gurudu, R. T. Hurst, C. B. Kendall, M. B.Gotway, and J. Liang, 2016, "Convolutional neural networks for medical image analysis: Full training or fine tuning?" IEEE T Med Imaging, vol. 35, no. 5, pp. 1299–1312.

[7] Adriana Albu, Loredana Stanciu, 2016, "Benefits of using artificial intelligence in medical predictions," 1EEE, E-Health and Bioengineering Conference (EHB).

[8] M. Abedini, N. C. F. Codella, J. H. Connell, R. Garnavi, M. Merler,S. Pankanti, J. R. Smith, and T. Syeda-Mahmood, 2015, "A generalized framework for medical image classification and recognition," IBM J Res Dev, vol. 59, no. 2/3, pp. 1:1–1:18.

[9] C. Bishop, 2006, Pattern Recognition and Machine Learning. Springer-Verlag New York.

[10] Erol Gelenbe, Yongha Yin, 2016, "Deep learning with random neural networks", Neural Networks (IJCNN), 2016 International Joint Conference.

[11] Y. LeCun, Y. Bengio, and G. Hinton, 2015 "Deep learning," Nature, vol. 521, no. 7553, pp. 436–444.

[12] Yinghe Huo, Koen L. Vincken, Floris P. Lafeber, and Max A. Viergever, 2016,"Automatic quantification of radiographic finger joint space width of patients with early rheumatoid arthritis", IEEE Journals & Magazines, Volume: 63, Issue: 10, pp. 2177 – 2186..

[13] Georg Langs, Philipp Peloschek, Horst Bischof, and Franz Kainberger, 2009, "Automatic Quantification of Joint Space Narrowing and Erosions in Rheumatoid Arthritis", IEEE Transactions on Medical Imaging, Vol. 28, NO. 1.

[14] A. B. Suma, U. Snekhalatha, T. Rajalakshmi, 2016, "Automated thermal image segmentation of knee rheumatoid arthritis", IEEE International conference on Communication and Signal Processing (ICCSP).

[15] Smita Jhajharia , Harish Kumar Varshney , Seema Verma ,Rajesh Kumar, 2016, " A neural network based breast cancer prognosis model with PCA processed features",

IEEE, International Conference on Advances in Computing, Communications and Informatics (ICACCI)

[16] Zheng L, Chan AK., 2001, "An artificial intelligent algorithm for tumor detection in screening mammogram", IEEE Trans Med Imaging, 20(7):559-67.

[17] Wang J, Ding H, Bidgoli FA, Zhou B, Iribarren C, Molloi S, Baldi P, 2017, "Detecting Cardiovascular Disease from Mammograms With Deep Learning", IEEE Trans Med Imaging, 36(5):1172-1181.

[18] Shubhangi Khobragade , Aditya Tiwari , C.Y. Patil , Vikram Narke , 2017,"Automatic detection of major lung diseases using Chest Radiographs and classification by feed-forward artificial neural network",IEEE,International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES).

[19] Otoom A.F., Abdallah E.E., Kilani Y., Kefaye A. and Ashour M, 2015, "Effective Diagnosis and Monitoring of Heart Disease" International Journal of Software Engineering and Its Applications, 9, 143-156.

[20] Vembandasamy K., Sasipriya R. and Deepa E, 2015, "Heart Diseases Detection Using Naive Bayes Algorithm", IJISET-International Journal of Innovative Science, Engineering & Technology, 2, 441-444.

[21] Chaurasia V. and Pal S, 2013, "Data Mining Approach to Detect Heart Disease", International Journal of Advanced Computer Science and Information Technology (IJACSIT), 2, pp.56-66.

[22] Parthiban, G. and Srivatsa, S.K., 2012, "Applying Machine Learning Methods in Diagnosing Heart Disease for Diabetic Patients". *International Journal of Applied Information Systems*, 3, pp.25-30.

[23] Tan, K.C., Teoh, E.J., Yu, Q. and Goh, K.C., 2009, "A Hybrid Evolutionary Algorithm for Attribute Selection in Data Mining". Journal of Expert System with Applications, 36, pp.8616-8630.

[24] R. Catherine Silvia, R. Vijayalakshmi, 2013, "Detection of Non-Proliferative Diabetic Retinopathy in fundus images of the human retina", International Conference on Information Communication and Embedded Systems (ICICES).

[25] Iyer A., Jeyalatha S. and Sumbaly R, 2015, "Diagnosis of Diabetes Using Classification Mining Techniques", International Journal of Data Mining & Knowledge Management Process (IJDKP), 5, 1-14.

[26] Sen S.K. and Dash S, 2014, "Application of Meta Learning Algorithms for the Prediction of Diabetes Disease", International Journal of Advance Research in Computer Science and Management Studies, 2, 396-401.

[27] Ba-Alwi F.M. and Hintaya H.M, 2013, "Comparative Study for Analysis the Prognostic in Hepatitis Data: Data Mining Approach", International Journal of Scientific & Engineering Research, 4, 680-685.

[28] Sathyadevi G, 2011, " Application of CART Algorithm in Hepatitis Disease Diagnosis", IEEE International Conference on Recent Trends in Information Technology (ICRTIT), MIT, Anna University, Chennai, 3-5 June 2011, 1283-1287.

[29] Rubén Armañanzas, Martina Iglesias, Dinora A. Morales, Lidia Alonso-Nanclares, 2017, "Voxel-Based Diagnosis of Alzheimer's Disease Using Classifier Ensembles", IEEE Journal of Biomedical and Health Informatics,Volume: 21, Issue: 3,pp.778 – 784.

[30] Baiying Lei, Peng Yang, Tianfu Wang, Siping Chen, Dong Ni, 2017, "Relational-Regularized Discriminative Sparse Learning for Alzheimer's Disease Diagnosis", IEEE Transactions on Cybernetics , Volume: 47, Issue: 4,pp.1102-1113.

[31] Tong Tong , Qinquan Gao , Ricardo Guerrero , Christian Ledig , Liang Chen , Daniel Rueckert , 2017, "A Novel Grading Biomarker for the Prediction of Conversion From Mild Cognitive Impairment to Alzheimer's Disease" IEEE Transactions on Biomedical Engineering , Volume: 64, Issue: 1,pp. 155 – 165.

[32] Priyanka Thakare, V. R. Pawar, 2016,"Alzheimer disease detection and tracking of Alzheimer patient", 2016 International Conference on Inventive Computation Technologies (ICICT), IEEE, Vol 1,pp.1-4.

[33] Jun Zhang, Yue Gao, Yaozong Gao, Brent C. Munsell, Dinggang Shen, 2016, "Detecting Anatomical Landmarks for Fast Alzheimer's Disease Diagnosis", IEEE Transactions on Medical Imaging,, Volume: 35, Issue: 12,pp.2524 – 2533.

[34] Vijayarani, S. and Dhayanand, S., 2015, "Liver Disease Prediction using SVM and Naïve Bayes Algorithms", International Journal of Science

Engineering and Technology Research (IJSETR), Vol.4, pp. 816-820.

[35] Rajeswari, P. and Reena, G.S., 2010, "Analysis of Liver Disorder Using Data Mining Algorithm", Global Journal of Computer Science and Technology", 10, pp.48-52.

[36] Fathima, A.S. and Manimeglai, D., 2012, "Predictive Analysis for the Arbovirus- Dengue using SVM Classification", International Journal of Engineering and Technology, 2, pp.521-527.

[37] Ibrahim, F., Taib, M.N., Abas, W.A.B.W., Guan, C.C. and Sulaiman, S., 2005, "A Novel Dengue Fever (DF) and Dengue Haemorrhagic Fever (DHF) Analysis Using Artificial Neural Network (ANN)", Computer Methods and Programs in Biomedicine, 79, pp.273-281.

[38] Kamal Nayan Reddy Challa, Venkata Sasank Pagolu, Ganapati Panda, Babita Majhi, 2016, "An improved approach for prediction of Parkinson's disease using machine learning techniques", Signal Processing, Communication, Power and Embedded System (SCOPES), 2016 International Conference , IEEE.

[39] Sachin Shetty, Y. S. Rao, 2016, "SVM based machine learning approach to identify Parkinson's disease using gait analysis", Inventive Computation Technologies (ICICT), International Conference.

[40] Indrajit Mandal, N. Sairam, 2012, "New machine-learning algorithms for prediction of Parkinson's disease", International Journal of Systems Science, pp.1-20.