A Survey on Artificial intelligence in Pathology

Sanjay J
Student, Dept. of computer science and Engineering,
Faculty of Engineering and Technology,
Ramaiah University of Applied Sciences,
Bengaluru, Karnataka, India, 560094
Sanjaysj314@gmail.com

Vishal B S
Student, Dept. of computer science and Engineering,
Faculty of Engineering and Technology,
Ramaiah University of Applied Sciences,
Bengaluru, Karnataka, India, 560094
Vishalsadanand3@gmail.com

Dr Jyothi A P
Assistant Professor, Dept. of Computer Science and Engineering,
Faculty of Engineering and Technology,
Ramaiah University of Applied Sciences,
Bengaluru, Karnataka, India.
jyothiarcotprashant@gmail.com

ABSTRACT

Pathology procedures include necroscopy, radiography, urinalysis, microscopic study of tissues, hematological assays, and anatomical pathology. Artificial intelligence is making an impact in the field of pathology; the developed approaches allow the computer to perform previously performed by humans. In this section, we offer a basic and implemented guidance for artificial intelligence approaches used in pathology, such as deep learning, NLP, digital image analysis, and next generation sequencing.

Some of the major works include pathological voice classification using deep learning, the process of remote diagnosis using tele pathology to improve cancer pathology expertization, electronic medical records were used for storing patients pathology information as this process was lengthy and took time to access or retrieve information, and in-house development frameworks were developed to extract pathology data points. To eliminate scanner, focus inaccuracy, a no reference focus quality evaluation measure for digital pathology is being developed, as is a telepathology system incorporating an effective algorithm to show realistically.

In contrast to traditional approaches in which pathologists had to manually evaluate photos for disease detection, AI has benefited in automating these activities. In this work, we explored several proposed ai strategies that are accessible and applied in the pathology department for improved, advanced, and accurate findings.

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Keywords—pathology, artificial intelligence, telepathology, deep learning, natural language processing, image processing.

I. INTRODUCTION

Pathology is a medical area that studies the nature of illness by analyzing functional changes in cells, tissues, organs, and so on. AI is a discipline that combines datasets and computers to solve problems using subfields such as machine learning, deep learning, image processing, and so on. These discipline domains are a mix of artificial intelligence algorithms with the goal of developing an expertized system that predicts and classifies depending on the input supplied.

Modern technology and its growing uses in the health-care profession are currently expanding and becoming more widely available. The diagnosis of patients using pathology is a practical practice in the health care industry. Diagnosis using laboratories led to the transition to digital pathology, for which the infrastructure was provided by the tools and their use became a reality to deploy using AI. The goal of AI in pathology is to create image-analysis technologies that may be used for diagnostic assistance or unique insights into disease biology. Currently, the program is provided for diagnostic support and is expanding its wings for a variety of applications such as tumor identification, mutating status, and automated tumor grading.

AI in pathology has many application trends, such as AI & DL architecture pathology classification, NLP models for pathology, creating conceptual based application tools in pathology, and so on, all of which lead to improved patient care and satisfaction, earlier diagnosis, and more patient-centric treatments.

II. LITRATURE SURVEY

Paper Reference Number	Positive Impact	Criticism
[1]	THIS PROPOSED TECHINQUE IS COMPETATIONALLY NOT ITENSIVE FOR INPUT SIGNAL WHICH ARE NOT PRE-PROCESSED AND IT TOOK 208MINUTES APPORX.3.46HRS	INITIAL WAIT TIME IS MORE
[2]	ACURACY IS 97% AND SPECIFICITY ON AN AVERAGE WAS 99.4	COST IS COMPARITIVELY HIGH WITH OTHER TRADITIONAL METHODS
[5]	THE SELF DEVELOPED SOLUTION WHICH WAS USED TO MEET THE REQUIREMENTS OF THE CLINICAL INVESTIGATORS DISCOVERING IN KNOWLEDGE FROM UNSTRUCTURED DATA WAS SUCCESSFUL	ATYPICAL PATTERNS SPACES AND PUNCTUATIONS ARE THE MAJOR DRAW BACKS IN THIS STUDY
[11]	SINCE IT USES PROGRAMMING LANGUAGE (C++) WHICH LED IN OUTPERFORMING JAVA BASED PLATFORMS.	REQUIRES HIGHH GPU/CPU
[8]	THIS MODEL HAD HIGHER ACURACY SINGAL THE EEG SIGNALS WERE PREPROCESSED AND THE SIGNALS WERE FED TO THE CNN MODEL USING THEIR SPATIO-TEMPORAL REPRESENTATIONS	DIFFERENT FUSION STRATEGIES ARE YET TO DISCOVERED, THEREFORE THE LIMITATIONS FOR APPLICATIONS IS MORE.

[9]	USING FUSION TECHNIQUE, IT ACHIEVED THE HIGHEST ACURACY AND OUTPERFORMED OTHER RELATED SYSTEM	THE FUSION METHOD IS EXPENSIVE AND TIME CONSUMING

III. ADOPTION OF ARTIFICIAL INTELLIGENCE IN PATHOLOGY

A. Deep learning architecture pathology classification in a voice signal:

The current proposal shows and framework with hybrid learning architecture for the recognition and classification of pathologies in a voice(speech) signal via continuous signal and prediction processes that are filtered to improve accuracy. A spoken data set was picked, and it was collected in the form of a waveform data base with text in a text format for information. The proposed work flow was the only the complicated nature of pathogens' voices witnesses only the most useful signal section to be recovered, the performance completely connected and convolution model of deep learning model are studied.

The second step created three-time frequencies, one with time frequency pictures and the other two with time frequencies derived from the bump and morse wave let. This suggested model employs a novel guessing, training, and dual optimization for prediction. Two deep learning models are investigated to see if they can be trained to reliably differentiate diseased speech signals from background signals. procedure followed are

1.Extraction and learning of features

2.obtaining the denoised signal

Transformation of time and frequency

The signal-to-noise ratio is divided into three variations here: continuous wavelet transforms (cwt)Morse, amor, and nump wavelets. The wavelet employs a variety of resolutions for distinct locations where the input signal may be divided into a time scaled domain. This planned effort was effective in defining two kinds of dysphonia: hypokinetic dysphonia and reflux laryngitis. When compared to other approaches for varied pathologic input voice, the mean accuracy was high.

B. TELEPATHOLGY:

To overcome the scarcity of pathologies caused by a lack of pathology competence, which may result in incorrect illness diagnosis. This incorrect diagnosis may force individuals to undertake unnecessary surgery and therapies, or perhaps miss out on necessary treatments. My misdiagnosis was caused by a lack of additional cancer expertise and technology to improve, as well as the load.

So, in this case, we employ tele-pathology, which is the use of information technology and digital pathology for remote diagnosis; this technology aids in overcoming resource constraints. Telepathy is the remote inspection of a whole slide image (WSI) that has previously been digitalized by a large number of pathologists from across the world to analyse virtual slides. This tele pathology saves time and optimises but has the disadvantage of being expensive because to the high cost of full slide digital scanners.

They demonstrate a tele pathology technology equipment in action. This technique employs

1. high-performance, portable, low-cost customised WSI technology.
2. Application of virtual microscopy
3. Creation of automatic picture analysis strategies.

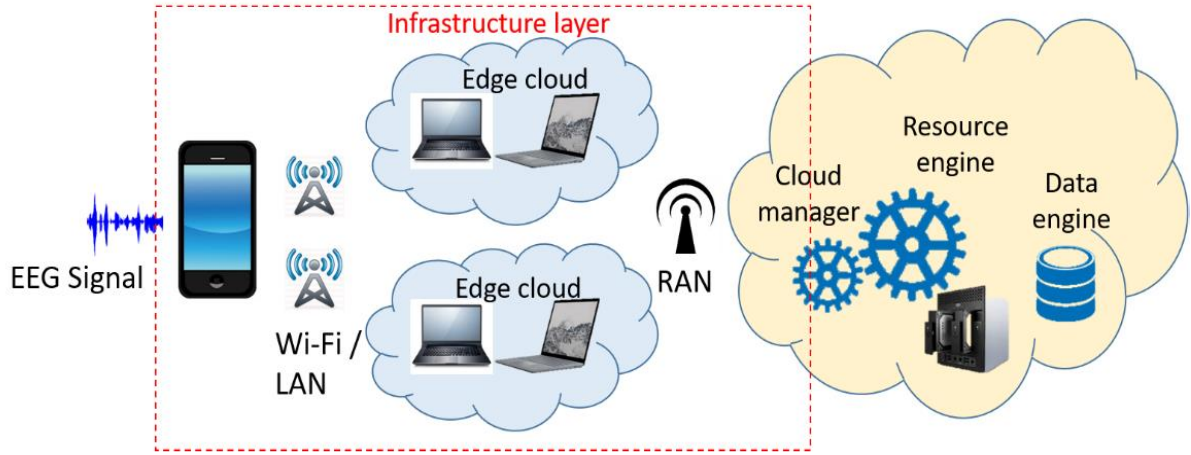
This technique is beneficial. To assist the pathologist network in a certain disease. In their work, they include automated ways for quantifying observation.1

C.ELECTROENCEPHALOGRAM PATHLOGY DETECTION BASED ON DEEP LEARNING:

EEG signals are often used to record brain impulses and can be used to determine whether or not a person has disease. CNN receives the processed spatio-temporal representation of the raw EEG as an input.

Here, we often deploy cognitive technologies for signal identification and processing.
Similar to how our brain controls our body, different parts of the brain are responsible for carrying out various functions, which results in a variety of signals being sent from various parts of the brain, all of which are picked up by sensors and have a range of frequencies.

The most cutting-edge research and diagnosis method for many disorders and diseases, automated EEG disease diagnosis, has benefited from deep learning technology. This field often makes use of ML, ANN, and DL developments. Based on the data sets that are supplied to the model, it operates.



The image above illustrates how this technology often operates. This method outperforms conventional technologies and has a better degree of precision.

D. **AGILE NATURAL LANGUAGE PROCESSING MODEL FOR KNOWLEDGE EXTRACTION FROM PATHOLOGY.**

This proposal provides a basic overview of electronic medical records. Structured, unstructured, and even simple text formats are all used to store the data. However, pathology deals with data relating to the skin and even cancer or other serious issues connected to it. Knowing how difficult and in some cases impossible it is to extract information from such data, this study uses the NLP, or natural language processing, method. Using NLP, it is possible to extract deserving words and obtain data from the DB or Data Base. But this was a failure since it is a difficult assignment. In order to get precise information, this study demonstrates the in-depth, sophisticated software that was developed specifically for pathology.

The following are the study's objectives:
* Extracting the necessary terms of interest, such as Name, ID, Position, and Pathology Diagnosis, from the pathology database/documents.
*Verify the retrieved information against the system's existing data. The primary structure was True/False.

E. **FOCUS QUALITY ASSESMENT OF DIGITAL PATHOLOGY'S SLIDE IMAGING.**

The need for automatic quality control is one of the biggest obstacles to the introduction of digital pathology systems for clinical usage. Despite the fact that occasionally scanners provide erroneous results. And When scanning at 20X picture resolution, the scanned image will be very huge. In order for digital pathology to be really useful, it is crucial to create computational techniques that can solve the picture quality problem rapidly and precisely. This study suggests a focus feature designed particularly for digital pathology images that utilises a sum of visual systems. Then, it is used to adjust high-frequency picture information by the patch level optics and quality of digital pathology images. This study demonstrates through a number of studies that the strategy is both more computationally effective and correlates with z-level data more favourably than previous ways.

*From an application standpoint, the comparison between various approaches and procedures is necessary.
*The initial PSF, which was assumed in this investigation, is unaffected by the focus being positive or negative.

IV. CONCLUSION

The process of remote diagnosis using telepathology to improve cancer pathology expertization is one of the major works, and electronic medical records were used to store patients' pathology information as this process was time-consuming and difficult to access or retrieve information. In-house development frameworks were also created to extract pathology data points. A no reference focus quality evaluation measure for digital pathology is being developed to remove scanner focus inaccuracy, and a telepathology system combining an efficient algorithm to show realistic.

AI has aided in automating these tasks, as opposed to conventional methods where pathologists had to manually assess photographs for illness identification. In this study, we looked at a number of suggested AI techniques that can be used in the pathology division to produce better, more cutting-edge, and accurate results.

V.RESULT

Feature extraction and learning, acquiring the customised, high-performance, portable, and inexpensive WSI technology, the use of virtual microscopy developing techniques for automatic image analysis.

This method has advantages. to support the pathology community in a certain disease. They incorporate automated techniques for quantifying observation in their work. removing the relevant terms of interest from the pathology database/documents, such as Name, ID, Position, and Pathology Diagnosis. Compare the information you've retrieved to the data the system already has. True/False was used as the main framework. Comparing different methods and techniques is necessary from an application perspective. Positive or negative attention has no impact on the initial PSF, which was assumed for this experiment.

VI. REFERENCES

[1] K. Wahengbam, M. P. Singh, K. Nongmeikapam and A. D. Singh, "A Group Decision Optimization Analogy-Based Deep Learning Architecture for Multiclass Pathology Classification in a Voice Signal," in IEEE Sensors Journal, vol. 21, no. 6, pp. 8100-8116, 15 March15, 2021, doi: 10.1109/JSEN.2021.3049277.

[2] J. R. Orozco-Arroyave *et al.*, “Characterization methods for the detection of multiple voice disorders: Neurological, functional, and laryngeal diseases,”*IEEE J. Biomed. Health Informat.*, vol. 19, no. 6, pp. 1820–1828,Nov. 2015, doi: 10.1109/JBHI.2015.2467375.

[3] C. Alvarez, G. Corredor, D. Giraldo and E. Romero, "Tele-Pathology: A Use Case In Colombia," 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019), 2019, pp. 1417-1421, doi: 10.1109/ISBI.2019.8759227.

[4] V. Kumar, A. K. Abbas, and J. C. Aster, Robbins Basic Pathology,chapter Cell Injury, Cell Death and Adaptations, pp. 1–29, Saunders-Elsevier, 2013.

[5] The Royal College of Pathologists, “Histology,”https://www.rcpath.org/discover-pathology/i-want-a-careerstudying/human-tissue/histopathology-careers.html.

[6] A. Baghal, S. Al-Shukri and A. Kumari, "Agile Natural Language Processing Model for Pathology Knowledge Extraction and Integration with Clinical Enterprise Data Warehouse," 2019 Sixth International Conference on Social Networks Analysis, Management and Security (SNAMS), 2019, pp. 419-422, doi: 10.1109/SNAMS.2019.8931828.

[7] Savova G.K., Masanz J.J., Ogren P.V., Zheng J., Sohn S., Kipper-Schuler K.C., Chute C.G., “Mayo clinical Text Analysis and KnowledgeExtraction System (cTAKES): architecture, component evaluation andapplications,” Journal of American Medical Informatics Association,2010, 17(5):pp.507–513.

[8] M. Alhussein, G. Muhammad and M. S. Hossain, "EEG Pathology Detection Based on Deep Learning," in IEEE Access, vol. 7, pp. 27781-27788, 2019, doi: 10.1109/ACCESS.2019.2901672.

[9] S. U. Amin *et al.*, ``Cognitive smart healthcare for pathology detection and monitoring," *IEEE Access*, vol. 7, pp. 10745_10753, 2019. S. López *et al.*, ``Automated identi_cation of abnormal adult EEGs," in *Proc. IEEE Signal Process. Med. Biol. Symp. (SPMB)*, Philadelphia, PA,USA, 2015, pp. 1_5.

[10] S. López *et al.*, ``Automated identi_cation of abnormal adult EEGs," in *Proc. IEEE Signal Process. Med. Biol. Symp. (SPMB)*, Philadelphia, PA,USA, 2015, pp. 1_5.

[11] A. Pedersen, M. Valla, A. M. Bofin, J. P. De Frutos, I. Reinertsen and E. Smistad, "FastPathology: An Open-Source Platform for Deep Learning-Based Research and Decision Support in Digital Pathology," in IEEE Access, vol. 9, pp. 58216-58229, 2021, doi: 10.1109/ACCESS.2021.3072231.

[12] A. Baidoshvili, A. Bucur, J. van Leeuwen, J. van der Laak, P. Kluin, and P. J. van Diest, ``Evaluating the bene_ts of digital pathology implementation:Time savings in laboratory logistics," *Histopathology*, vol. 73, no. 5,pp. 784_794, Nov. 2018.

[13] M. S. Hosseini, J. A. Z. Brawley-Hayes, Y. Zhang, L. Chan, K. N. Plataniotis and S. Damaskinos, "Focus Quality Assessment of High-Throughput Whole Slide Imaging in Digital Pathology," in IEEE Transactions on Medical Imaging, vol. 39, no. 1, pp. 62-74, Jan. 2020, doi: 10.1109/TMI.2019.2919722.

[14] Victor Sanchez and Miguel Hern´andez-Cabronero, “Graph-based rate control in pathology imaging with lossless region of interest coding,”IEEE Transactions on Medical Imaging, 2018

[15] Siegel R, Miller KD, Jemal A (2018) Cancer statistics. CACancer J Clin 68: 7-30.

[16] Knowles MA, Hurst CD (2015) Molecular biology of bladder cancer: New insights into pathogenesis and clinical diversity. Nat Rev Cancer 15: 25-41.

[17] T. Nakashika, T. Takiguchi and Y. Minami, "Non-Parallel Training in Voice Conversion Using an Adaptive Restricted Boltzmann Machine," in IEEE/ACM Transactions on Audio, Speech, and Language Processing, vol. 24, no. 11, pp. 2032-2045, Nov. 2016, doi: 10.1109/TASLP.2016.2593263.

[18] A. Kain and M. W. Macon, “Spectral voice conversion for text-to-speech synthesis,” in *Proc. IEEE Int. Conf. Acoust., Speech, Signal Process.*,1998, pp. 285–288.

[19] L. M. Oliveira et al., "Tissue optical clearing as a diagnostic tool for tissue pathology differentiation," 2018 International Conference Laser Optics (ICLO), 2018, pp. 508-508, doi: 10.1109/LO.2018.8435385.

[20] E.A. Genina, A.N. Bashkatov, Yu.P. Sinichkin, I.Yu. Yanina, V.V. Tuchin, Optical clearing of biological tissues: prospects of application in medical diagnostics and phototherapy [Review], J. Biomed. Photon. & Eng.,**1**(1), 22-58 (2015).