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International Journal of Advanced Research in Computer Science Engineering and Information Technology

Volume: 6, Issue: 3,Special Issue: 2 ,Apr,2023 ,ISSN_NO: 2321-3337

A PROPOSED BASED DISEASE MODEL TO MACHINE LEARNING IN DIAGNOSTICS

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Abstract - Despite 60 years of research into necrotizing enter colitis (NEC), our understanding of the disease has not improved enough to achieve better outcomes. Even though NEC has remained the leading cause of death and poor outcomes in preterm infants, there remain vital questions on how to define, differentiate and detect the condition. Numerous international groups have recently highlighted NEC as a research priority and called for broader engagement of the scientific community to move the field forward. The three foremost barriers at present are lack of suitable definition(s), lack of clean datasets and consequently a lack of scope to gain sufficient insights from data. This research paper proposes a new direction of travel to advance neonatal gastro-intestinal monitoring and strengthen our efforts to gain better insights from global databases. An integrated machine learning based model is recommended to produce a comprehensive disease model to manage the complexity of this multivariate disease. This intelligent disease model would be used in the daily neonatal settings to help aggregate data to support clinical decision making, better capture the complexity of each patient to enrich global datasets to create bigger and better data. This paper reviews current machine learning and CAD technologies in neonatology and suggests an innovative approach for an NEC disease model.

INDEX TERMS: Abdominal x-ray, AI, diagnosis, multimodal, necrotizing enterocolitis, surgery.

1. INTRODUCTION

NEC is one of the most devastating gastrointestinal emergencies in the neonatal care unit [1]. Usually, there are no clinical warning signs for acute NEC. It is estimated that up to 50% of patients need surgical intervention, 46.5% of patients do not survive after surgery, and 20% to 50% of the survivors develop long-term sequelae, such as recurrence intestinal stenosis, short bowel syndrome, slowed growth,and neurodevelopmental disorders [2]. NEC consists of group of complex multivariable diseases that are dif_cult to describe, detect, and diagnose [3], [4]. Numerous international groups have recently highlighted NEC as a research priority and have made efforts to move the _eld forward[1], [5]. Despite the intense research performed in this The associate editor coordinating the review of this manuscript and approving it for publication was Shadi Alawneh . _eld, an effective method for the rapid diagnosis and the prediction of surgical indications of NEC has not been found.

In 2020, Hooven *et al.* [7] predicted NEC using microbiome data, achieving a precision-recall AUC value of only 0.7 .Shi *et al.* [4] showed that the prediction and diagnosis of NEC were satisfactory in the Era of Metabolomics and Proteomics despite the small quantity of training data [4]. Additionally, van Druten *et al.* [2], [3], [8] diagnosed NEC based on abdominal X-rays with arti_cial intelligence, but the results were not expected through a single medical examination. Multimodal models represent attempts to effectively simplify the complexity of multiple-factor diagnosis [9]. This study aims to establish a new multimodal AI system for NEC patients. Combined with feature engineering, a multimodal AI system was constructed via machine learning (ML) and deep learning (DL) models in series. The system was evaluatedwith a dataset derived from 2,245 NEC patients from51050

Received February 18, 2022, accepted March 9, 2022, date of publication March 29, 2022, date of current version JUNE 8, 2022 *Digital Object Identifier 10.1109/ACCESS.2022.3069191*

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Guangzhou Women and Children's Medical Center, China, collected from 2011 to 2020. Then, we carried out a series of experimental studies. The diagnosis of NEC is heavily dependent on abdominal radiography (AR) [10]. Therefore, in the _rst stage, 4,535 ARs of 1,823 suspected NEC patients were collected and divided into a training dataset, a validation dataset, and an internal test dataset. Then, three DL models were made computationally effective with the training and validating ARs. We selected the best model, SENet-154, by comparing the AUC value, sensitivity, speci_city, precision and accuracy of the three models in the internal test dataset.

In the second stage, the SENet-154 model was trained and

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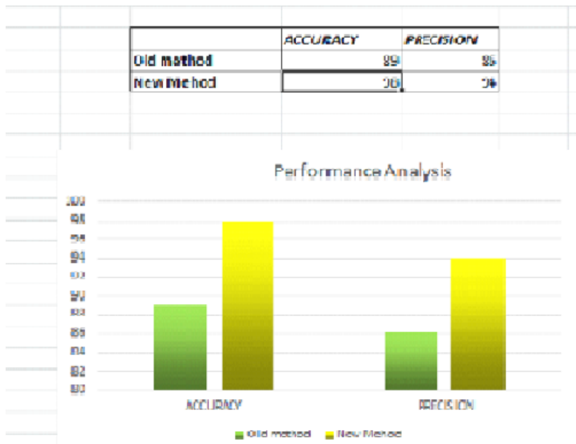
validated with the clinical data of 827 suspected NEC patients and 379 con_rmed NEC patients obtained one week before surgery, respectively. The radiomics signatures of the ARs were obtained by transferring the learning and _ne-tuning the model parameters, and then the top-performing significant features were selected by mRMR. In the third stage, the light gradient boosting machine (LightGBM) classi_er was used to predict the diagnosis and surgical eligibility of NEC in combination with the radiomics signature and clinical parameters **(**Fig. 2**)**. The model captured valuable information from ARs that cannot be detected by the human eye. Afterward, thermographic images were generated, which improved the value of the diagnosis and prediction of surgical eligibility for NEC. Diagnostic value: AUC 0.9337 (95% CI: 0.9028, 0.9646), sensitivity 0.9427 (95% CI: (0.9138, 0.9716)), speci_city 0.8246 (95% CI: (0.7774, 0.8718)), precision 0.9476 % CI: (0.9199, 0.9753)), accuracy 0.9157 (95% CI: (0.8812, 0.9502)). Surgery-predictive value: AUC 0.9413 (95% CI: 0.8998, 0.9828), sensitivity 0.8500 (95% CI: 0.7869, 0.9131), speci_city 0.9535 (95% CI: 0.9163, 0.9907), precision 0.9714 (95% CI: 0.9419, 1.0000), accuracy 0.8861 (95% CI: 0.8300, 0.9422). Our multimodal AI system was comparable to experienced clinicians in diagnosing and predicting the surgery eligibility for NEC. This study can be used as an auxiliary means for the clinical diagnosis and surgical eligibility prediction of NEC.

2.PERFORMANCE EVALUATION:



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3.Methods:

3.1 IMAGE ACQUISITION PHASE The first step is to acquire images. To produce classification model, the computer needs to learn by example. The computer needs to view many images to recognize an object. Other types of data, such as time series data, can also be used to train deep learning models. In the context of the work surveyed in this paper, the relevant data required to detect NEC disease will be images. Images that could be used include chest X-ray, CT scan image. The output of this step is images that will later be used to train the model.

3.2 DATA PRE-PROCESSING Image pre-processing is a very common and beneficial technique in the deep learning process and it not only could enlarge the quantity of the original dataset but also enrich the information implicit in the dataset. As previously mentioned, we utilized an effective image enhancement method named to improve the quality of images before they were inputted into the CNN model. Which denotes mapping from the initial narrow pixel levels to a wider extent and improves image enhancement, has been widely used in image processing. The NEC images technique means to convert the gray levels of an image by using cumulative effort function globally, yet always brings about the problem that elaboration information in images is damaged, leading to awful image quality. This popular image contrast enhancement method could enhance image contrast effectively in many aspects, like X-rays.

3.3 IMAGE SEGMENTATION Image Segmentation is an important step in domain of computer vision based on emerging applications including medical imaging. The image segmentation is a step of processing which is used threshold method to segment the CT and X-ray image gray level to binary image. Segmentation means partitioning the digital images into multiple parts of segments or objects. Segmentation is a process of grouping the pixels that have similar attributes. Is used to locate the objects and boundaries in images. Basically, the segmentation process performed to extract important features from the image for further analysis.

3.4 FEATURE EXTRACTION In this module, we are performing some more operation on segmented image. In this module we will perform feature extraction operation to get all detailed information about NEC image. Feature Extraction and reduction has been playing a vital role for disease region into their relevant categories in the field of computer vision and machine learning. The major issue behind feature extraction is to compute the most active or robust features for classification, which produced an efficient performance. The Feature extraction is used related to dimensionality reduction.

3.5 CLASSIFICATIONEVALUATION METRICS In this subsection, several evaluation metrics, are described. According to the outputs of model, four

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indices Necrotic Pneumonia and Necrotizing enterocolitis, are used to analyze and identify the performance of model. The True Positive means that the chest X-ray images, which suffer from pneumonia or enterocolitis, are signed as pneumonia as well by the model. The True Negative means if the chest X-ray images do not show pneumonia or enterocolitis as well as the model predicts. The always used to estimate how much the number of images that are truly pneumonia accounted for in the total number examples, which are classified as training for pneumonia or enterocolitis. That is, the pneumonia or enterocolitis images must be identified in practical clinical diagnoses and it predicts the pneumonia or enterocolitis.

4.PROPOSED SYSTEM

In this project, we identified the significant features of ARs and clinical data that were closely related to the diagnosis and surgical prediction of NEC with feature engineering using artificial intelligence. Then, a multimodal AI system was established with ML and DL models in series. The AI system was tested on a dataset derived from patients from Guangzhou Women and Children's Medical Center and ultimately demonstrated favorable accuracy in diagnosing NEC and predicting surgical NEC. After validation, the multimodal AI system proved to be a useful auxiliary diagnostic tool for helping clinicians improve their efficiency and accuracy.

5.MODULE

5.1 CLASS 1: TRAINING

Image Classification uses Machine Learning algorithms to analyze the presence of items in a picture and to categorize the picture. This particular task forms the basis of Computer Vision and Image Recognition. Machines don't analyze a picture as a whole. They only analyze a picture through pixel patterns or vectors..

Fig. 5.1. Training Module

5.2 CLASS 2:TESTING

Fig. 5.2. Testing Module

5.3 CLASS 3:IMAGE PROCESSING

Machine Learning (ML) has become one of most widely used AI techniques for several companies, institutions and individuals who are in the business of automation. This is because of considerable improvements in the access to data and increases in computational power, which allow practitioners to achieve meaningful results across several areas.Today, when it comes to image data, ML algorithms can interpret images the same way our brains do. These are used almost everywhere, right from face recognition while capturing images on our smartphones, automating tedious manual work, self-driving cars and everything in between.In this blog, we'll be deep-diving into machine learning image processing fundamentals and discuss various technologies that we could leverage to build state-of-the-art algorithms on image data.

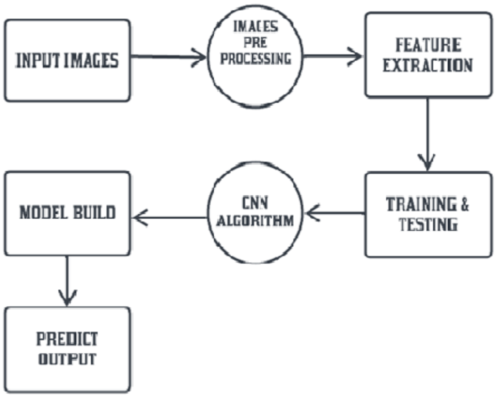

Fig. 5.3. Image Processing Module

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6. N-Tier Architecture:

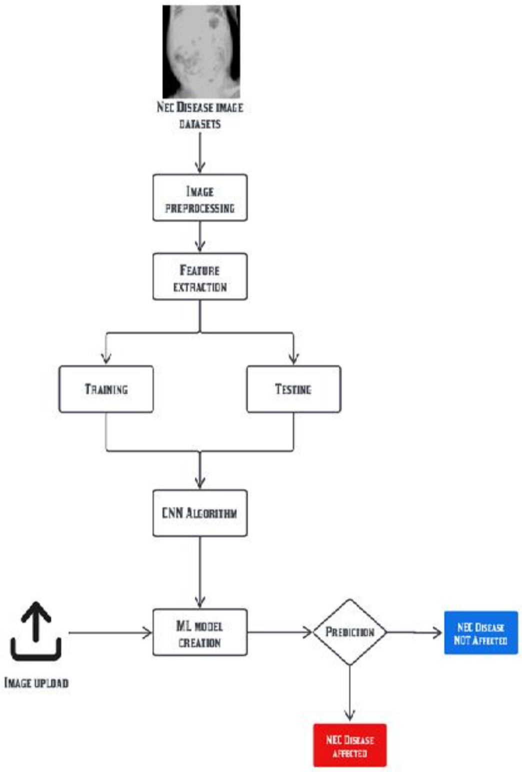

Figure 6.1 N-Tier Architecture

7. EXPERIMENTAL RESULTS

This result discusses about the implementation of the images for various cases are identified and the below Fig. 5.1., Fig. 5.2. and Fig. 5.3 Shows the implementation of images based on the proposed methodology.

Fig.7.1. Training

Fig.7.2. Testing

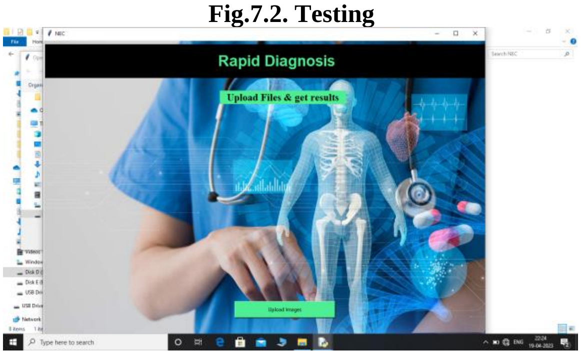

Fig.7.3. Main Interface

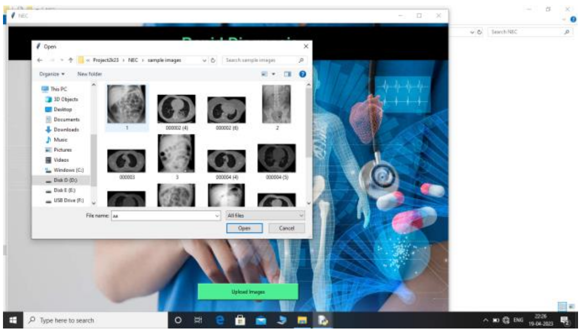

FIG.7.4. DISEASE DIAGONSIS

8.RESULT AND DISCUSSION:

The results generated during the training and the validation of the proposed fine-tuned CNN model trained on the CT images taken from open access from Kaggle. Several preprocessing and data augmentation techniques were applied to enhance this particular dataset's quality and size. For better training, we used a variety of hyper parameters to train our proposed model. For the proposed model, the graph illustrates that the accuracy of the validation and training sets steadily grew in a shorter period with the given hyper parameters as the number of epochs increased until it reached a point of stability. The presence of necrotizing Enterocolitis (NEC) from abdominal X-ray images, we developed an image processing algorithm that utilized

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deep learning techniques. We collected a dataset of abdominal X-ray images from infants, which included images with NEC and 250 images without NEC. We split the dataset into 70% training and 30% testing sets. The developed algorithm was trained using the training set to predict the presence of NEC in abdominal X-ray images. We used a pre-trained convolutional neural network (CNN) as the backbone of the algorithm and fine-tuned it for the task of NEC prediction. The results of our study demonstrate the effectiveness of deep learning techniques in predicting the presence of NEC in abdominal X-ray images. The high accuracy obtained from the testing set indicates that the developed algorithm is capable of accurately identifying the presence of NEC. Firstly, the dataset used in this study was relatively small, which may limit the generalizability of the results. Secondly, the algorithm was only tested on abdominal X-ray images, and its effectiveness on other types of medical images such as CT scans is yet to be determined. Our study demonstrates the potential of image processing and deep learning techniques in predicting the presence of NEC in abdominal X-ray images.

9. CONCLUSION & FUTURE WORK

In this project, we identified the significant features of ARs and clinical data that were closely related to the diagnosis and surgical prediction of NEC with feature engineering using artificial intelligence. Then, a multimodal AI system was established with ML and DL models in series. The AI system was tested on a dataset derived from patients from Guangzhou Women and Children’s Medical Center and ultimately demonstrated favorable accuracy in diagnosing NEC and predicting surgical NEC. After validation, the multimodal AI system proved to be a useful auxiliary diagnostic tool for helping clinicians improve their efficiency and accuracy. Future work should entail the determination of characteristic factors to improve the accuracy of the AI system and supplement a prospective randomized case-control study on the treatment of NEC.

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