i-SPiKE 2023

INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

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Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality . I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH

WELCOME MESSAGE (i-SPiKE 2023 CHAIR)

We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPiKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPiKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail
Chair
3rdInternational Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023)

CNN-BASED MODEL ON POTENTIAL DYSLEXIA DETECTION BASED ON AUTOMATED HANDWRITING FEATURES EXTRACTION

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ABSTRACT
Children with dyslexia have additional difficulties in their academic performance and overall well-being. However, dyslexia is still challenging to identify quickly, slowing support and early intervention. This innovation provides a method for dyslexia identification by developing an automated system in response to this drawback. This study aims to build an automated method for potentially detecting dyslexia using automated handwriting image extraction using transfer learning Convolutional Neural Networks (CNN) by tuning the hyperparameter suited to handwriting images. The Residual network, a pretrained CNN architecture, is implemented to extract significant features automatically from handwriting images and classify them as predictive of potential dyslexia or not. The results showed impressive accuracy in classifying the handwriting images, with a testing accuracy of 90.38%. Higher accuracy percentages achieved in both the training and testing stages highlight the promise of the proposed automated dyslexia diagnosis system. Early detection of dyslexia allows for more immediate support and interventions, which leads to better educational outcomes and emotional well-being for impacted children. Furthermore, by expediting the screening process and ensuring that resources are adequately directed, the suggested automated approach can ease the load on educators and healthcare personnel. The development of an automated method for dyslexia detection based on CNN-based handwriting feature extraction represents a promising step forward in the field. The excellent accuracy rates demonstrate the proposed system's potential to improve the lives of children with dyslexia and build a more inclusive and supportive learning environment. With its high accuracy rates, the approach offers promise as an efficient tool for theearly identification of dyslexia in children, allowing for

earlier intervention and targeted educational support. This research has the potential to affect both society and the education sector.

Keywords: Dyslexia Detection, Directed Acyclic Graph, Convolutional Neural Network, Deep Learning, Handwriting Analysis

INTRODUCTION

Numerous people worldwide are affected by dyslexia, a unique learning disability impacting the acquisition of reading, writing, and spelling skills. Individuals with dyslexia, who struggle with decoding and word recognition, encounter major obstacles throughout their academic and professional careers. The symptoms of potential dyslexia can vary by examining the handwriting features that commonly show reversal letters, corrected writing, improper letter form, inconsistent letter size, incomplete writing, etc (Snowling et al., 2020). Reading and writing impairments can lead to low self-esteem, academic underachievement, and constrained career opportunities (Anuradha, 2022). In addition, the emotional and psychological toll of living with learning disabilities frequently results in emotions of frustration and loneliness. Early detection is crucial so that parents and schools can initiate early intervention.

Traditional dyslexia screening methods rely mostly on manual evaluation by educators or healthcare practitioners. Despite the availability of these techniques, they are limited by subjectivity, time-consuming procedures, and the possibility of misdiagnosis. Therefore, there is an urgent need for a more effective and objective method of dyslexia screening. Currently, much research is focused on enhancing screening using machine learning techniques, such as deep learning, supervised learning, and Convolutional Neural Networks (CNNs). Recent advances in machine learning, namely the application of convolutional neural networks (CNNs), have demonstrated significant potential in numerous image identification applications (V, 2022). Technology growth has prompted researchers to investigate the application of machine learning algorithms to detect dyslexia using handwriting samples. By using the power of machine learning, it is possible to create an automated dyslexia screening system that is both efficient and accurate, allowing for early discovery and intervention. This research project aims to develop an automated dyslexia detection system based on handwriting analysis using CNNs. By harnessing the capabilitiesof machine learning, we aim to create a robust and objective screening tool that can accurately identify potential dyslexia in individuals, facilitating timely support and intervention strategies. This automated approach has the potential to revolutionize dyslexia screening, enhancing the prospects for affected individuals and promoting a more inclusive learning environment.

SYSTEM OVERVIEW

This study has developed an automatic detection system based on handwriting images. The images of handwriting by schoolchildren are collected as input for the system. The handwriting images consisted of several sentences written by schoolchildren randomly aged seven to twelve from Persatuan Dyslexia Malaysia (PDM) and Kementerian Pelajaran Malaysia (KPM) Primary School. Figure 1 depicts some of the images that were used in this research.

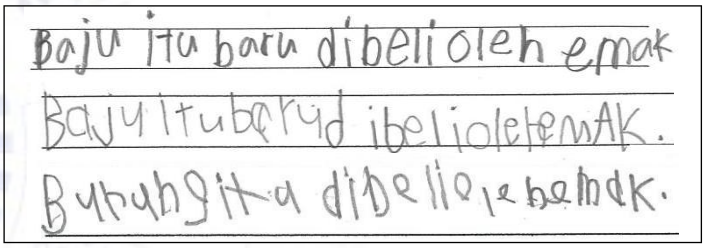

Figure 1. Example of handwriting images

Using a CNN architecture, the system has been developed to extract features from handwriting images of input and classify them at the output layer. Figure 2 shows the residualnetwork's basic layer that implemented the skip connection shortcut in the extraction network. The network layer is composed of convolutional layers, batch normalization layers, and ReLu layers that integrate to extract significant image patterns and features. The extraction features information is used to distinguish between potential dyslexia or normal at output class.

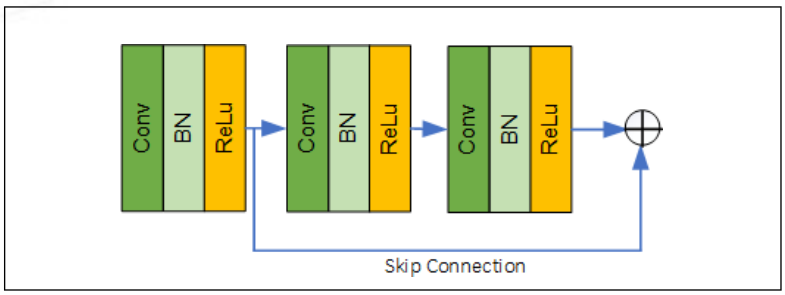

Figure 2. Residual Network

The overall figure of network architecture is illustrated in Figure 3. The overall network has been divided into two parts: extraction network and classification network. Residual network architecture has been explained in Figure 2 as an extraction layer network in that all information was extracted from the handwriting features for each image. The residual network (ResNet) has been implemented by tuning some layers and hyperparameters to be suited to handwriting images. The layer construction is modified according to the size of the image, and the output class is changed to binary classification. All extracted features are then used in classification with fully connected layers, and the softmax function is implemented to produce the classification output of either potential dyslexia or normal handwriting.

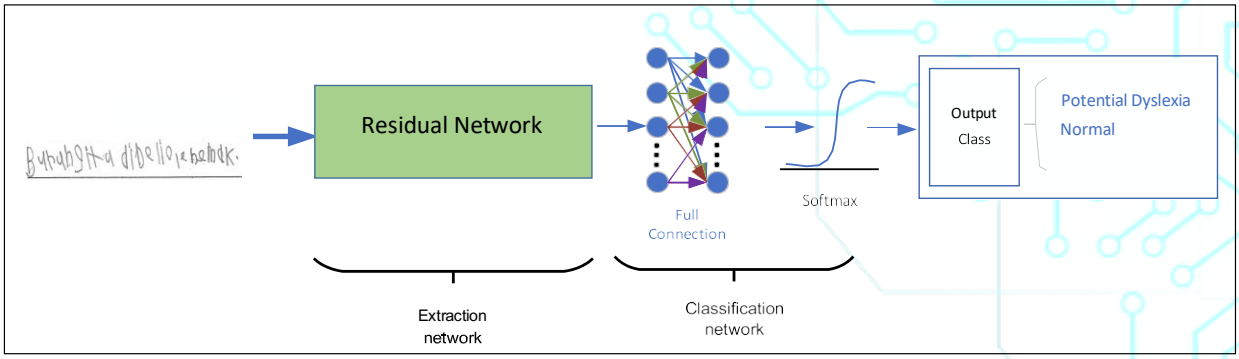

Figure 3. Overall network architecture

RESULT

Figure 4 presents a confusion matrix for the classification performance based on residual network extraction. In this confusion matrix, a binary classification distinguishes between "Potential Dyslexia" and "Normal." The matrix presents the model's performance on a test dataset, where the samples are 26 images for each class.

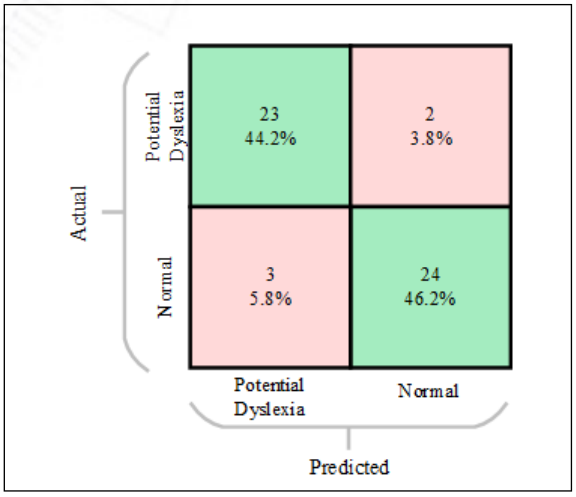

Figure 4. Testing Confusion Matrix

Based on Figure 4, below describes the confusion matrix,

1. True Positive (TP): There are 23 samples that truly belong to the "Potential Dyslexia" class, and the model correctly predicted them as "Dyslexia." These are the correct positive predictions.
2. False Negative (FN): There are two samples that actually belong to the "Potential Dyslexia" class, but the model incorrectly predicted them as "Normal." These misclassified samples should have been identified as "Potential Dyslexia."
3. False Positive (FP): There are three samples that do not belong to the "Potential Dyslexia" class, but the model incorrectly predicted them as "Potential Dyslexia." These misclassified samples should have been identified as "Normal."
4. True Negative (TN): There are 24 samples that truly belong to the "Normal" class, and the model correctly predicted them as "Normal." These are the correct negative predictions.

The overall accuracy of the model is 90.38%, which measures the percentage of correct predictions out of the total number of samples.

CONCLUSION

Finally, the confusion matrix and assessment metrics findings show that the automateddyslexia detection model based on handwriting analysis using CNN is effective. The model's overall accuracy of 90.38% demonstrates its ability to identify between children who may have dyslexia and those who do not. These encouraging findings have the potential tosignificantly

improve dyslexia screening methods, facilitate early detection, and providetimely treatments and targeted support to those in need. However, it is essential to note that this work is based on a single dataset. More validation on various and larger datasets is required to confirm the model's generalizability and dependability across other populations and handwriting styles. Overall, this automated extraction method has successfully automatedthe detection of dyslexia symptoms from handwriting images, which can aid in the identification of potential dyslexia cases and enable early intervention.

ACKNOWLEDGEMENTS

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