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DG CURE:

Model For Detection of Dysgraphia

Ms.Muneebah Mohyiddeen
Assistant Professor of Computer Science and Engineering
Universal Engineering College
Kerala, India
muneebah@uec.ac.in

Sana T.H
Department of Computer Science and Engineering
Universal Engineering College
Kerala, India
unt19cs045@uec.ac.in

Anoodh Hussain
Department of Computer Science and Engineering
Universal Engineering College
Kerala, India
unt19cs010@uec.ac.in

Nandana P Narayanan
Department of Computer Science and Engineering
Universal Engineering College
Kerala, India
nandanapn674@gmail.com

Sneha Soman
Department of Computer Science and Engineering
Universal Engineering College
Kerala, India
sneharjadeja8@gmail.com

Abstract— Learning disability is a condition that includes a direct impact on the brain and there's no remedy or any distinguished restorative medicines. Children with learning disability have inconvenience with learning compared to their individual peers and quite regularly fall back academically since a larger part of them go undiscovered. Dysgraphia, which is known as a writing disorder, is a particular disorder of writing with respect to the propagation of in sequential order and numerical signs. Since the causes of dysgraphia are obscure, the early detection of dysgraphia is exceptionally vital. This paper points to analyze children with Dysgraphia, classify them based on type and give them with corresponding treatments. This can be fundamentally done by examining the writing dynamics of children. Deep learning techniques are used in the screening process of these specific learning disabilities. Trained convolutional neural networks are used to detect and extract various properties of handwriting and outputs from the convolutional neural network are fed into the models used for screening the disabilities.

Keywords: Dysgraphia ; Image pre-processing; CNN.

I. INTRODUCTION

Writing is a complex frame of dialect generation extending from the thought of conceptualization to execution by hand, namely handwriting. Writing by hand is one of the useful daily activities for school-age youngsters to support them adequately in their academic preparation. But many children are facing struggle with some sort of writing difficulties, that is dysgraphia. Dysgraphia could be a learning disability characterized by problem of writing. It could be a neurological disorder that can impact children or grown-up. Dysgraphia may be a specific learning issue that affects not only visuals but also backwards writing and syntactic norms, making it difficult to replicate both in sequential order and number signs. In addition to writing words that are difficult to read, people with dysgraphia frequently use the improper words to convey their ideas. Dysgraphia may frequently manifest as unreadable handwriting, however not all individuals with messy writing are dysgraphic. Some frequent dysgraphia characteristics include inaccurate spelling, capitalization, mixing print and cursive letters, difficulty duplicating words, modest composing, and a firm grip on the pen or pencil while writing. The untidy handwriting of students with dysgraphia may sometimes lead to accusations of laziness against them. This could have an effect on one's self-esteem and result in unease, a need for assurance, and unfavorable attitudes towards school. Dysgraphia comes in a variety of forms, including dyslexia dysgraphia, motor dysgraphia, and spatial dysgraphia. Early discovery of dysgraphia can progress the issues related with writing fine motor abilities. Here we use deep learning is used to detect the dysgraphia using handwriting. A number of previously known and new features are extracted and trained the learning model to identify handwriting affected by dysgraphia and also mention the type of dysgraphia that is affected. It provide remedies to affected ones based on the type of dysgraphia which is affected

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II.PREVIOUS WORK

Graphomotor difficulties refer to the impaired ability to produce written work and are often seen in individuals with learning disabilities such as dysgraphia. The authors of this paper [1] use various fractional order derivative techniques to analyze the handwriting of children with and without graphomotor difficulties. Fractional order derivatives are mathematical operators that extend the concept of differentiation to non-integer orders. The authors compare the effectiveness of different fractional order derivatives approaches in analyzing features such as curvature, speed, and pressure in the handwriting samples. The results of the study indicate that fractional order derivatives can be effective in distinguishing between individuals with and without graphomotor difficulties. The authors conclude that these techniques could potentially be used as a diagnostic tool for assessing graphomotor difficulties. This research paper highlights the potential of using mathematical tools such as fractional order derivatives in the assessment of learning disabilities and provides insights into the development of diagnostic tools for identifying graphomotor difficulties.

The authors of this paper [2] propose a new method that uses a combination of speed, pressure, and angle parameters to characterize graphomotor difficulties. The study involves analyzing the handwriting of 122 children between the ages of 6 and 11, with and without graphomotor difficulties. The results of the analysis show that the proposed parametrization method is effective in distinguishing between individuals with and without graphomotor difficulties. Moreover, the authors demonstrate that the new parametrization method can be used to track changes in graphomotor difficulties over time, which can be useful for monitoring progress and evaluating the effectiveness of interventions. This research paper highlights the potential of using advanced parametrization techniques in the assessment of graphomotor difficulties in school-aged children. The proposed method provides a quantitative and objective way of characterizing graphomotor difficulties, which can be useful for diagnosis, monitoring, and treatment evaluation.

This paper [3] presents a novel approach for diagnosing Parkinson's disease (PD) based on handwriting analysis. PD is a progressive neurodegenerative disorder that affects movement, including handwriting. The authors of this paper propose using spectral and cepstral features extracted from handwriting signals to diagnose PD. The study involves analyzing the handwriting of 41 individuals, including 18 with PD and 23 healthy controls. The authors extracted spectral and cepstral features from the handwriting signals and used machine learning algorithms to classify the samples as PD or healthy controls. The results of the analysis show that the proposed approach is effective in diagnosing PD based on handwriting analysis. The spectral and cepstral features extracted from the handwriting signals were able to capture differences between individuals with PD and healthy controls. Moreover, the authors demonstrated that the proposed approach can be used to track changes in PD symptoms over time. This could be useful in monitoring the progression of the disease and evaluating the effectiveness of treatments. Overall, this research paper highlights the potential of using spectral and cepstral handwriting features in the diagnosis of PD. The proposed approach provides a non-invasive and objective way of diagnosing PD based on handwriting analysis, which could lead to earlier diagnosis and more effective treatments.

This paper [4] is about a new mobile, web-based software for addressing dysgraphia, a learning disability that affects handwriting ability. The software is designed to provide interactive feedback to users as they write on a touchscreen device. The feedback is based on various parameters, such as speed, pressure, and stroke direction, and is intended to help users improve their handwriting skills.T he study involves testing the software on a group of children with dysgraphia. The participants used the software for several sessions, and their progress was monitored using various measures, such as the number of errors, the time taken to complete a task, and the quality of handwriting. The results of the study show that the software was effective in helping children with dysgraphia improve their handwriting skills. The interactive feedback provided by the software helped the participants make fewer errors, complete tasks more quickly, and produce better quality handwriting. This research paper highlights the potential of using mobile, web-based software with interactive feedback to address dysgraphia. The proposed software provides a user-friendly and engaging way of improving handwriting skills, which could lead to improved academic performance and better quality of life for individuals with dysgraphia.

The author of this project [5] proposes a novel method for diagnosing Parkinson's Disease (PD) using offline handwriting samples. The proposed method uses multiple fine-tuned Convolutional Neural Networks (CNNs) to extract features from the handwriting samples, which are then used to classify the samples as either belonging to individuals with PD or healthy controls. The CNNs are fine-tuned using transfer learning, which involves using a pre-trained model and adapting it to the specific task at hand. The study involves testing the proposed method on a dataset consisting of handwriting samples from individuals with PD and healthy controls. The results show that the proposed method outperforms existing methods for PD diagnosis from handwriting samples, achieving an accuracy of 92.46%.Moreover, the authors also demonstrate that the proposed method is robust to different types of handwriting samples, including cursive and print. This suggests that the method could be used to diagnose PD from a wide range of handwriting samples. This research highlights the potential of using multiple fine-tuned CNNs for diagnosing PD from offline handwriting samples. The proposed method provides a highly accurate and robust way of diagnosing PD, which could have significant implications for early diagnosis and treatment of the disease.

The paper deals with a new method for identifying and rating

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developmental dysgraphia based on the analysis of handwriting samples. The proposed method [6] involves extracting a set of features from the handwriting samples using digital signal processing techniques, including time and frequency-domain analyses. The features are then used to train a machine learning model, which can classify the samples as either dysgraphic or non-dysgraphic and provide a rating of the severity of dysgraphia. The study involves testing the proposed method on a dataset of 170 handwriting samples from children with and without dysgraphia. The results show that the proposed method is highly accurate in identifying and rating dysgraphia, achieving an overall accuracy of 93.5%.Moreover, the authors demonstrate that the proposed method is effective in identifying specific types of dysgraphia, including dyslexic dysgraphia, which is characterized by difficulties with spelling and grammar. This research paper highlights the potential of using digital signal processing and machine learning techniques for identifying and rating developmental dysgraphia based on the analysis of handwriting samples. The proposed method provides an objective and quantitative way of diagnosing and evaluating dysgraphia, which could have significant implications for the early detection and treatment of the condition.

By utilizing progressed machine learning methods this system [7]aims at pedicting Parkinson's infection in an progressed way. Parkinson's infection (PD) is one of the major open wellbeing issues within the world. Individuals are for the most part recognizable with the motor side effects of Parkinson's infection be that as it may an expanding amount of research is being done to foresee the Parkinson's illness from non-motor side effects that go before the motor ones. Non-motor indications considered are Rapid Eye Development (REM) sleep Behaviour Disorder (RBD) and olfactory loss. Creating machine learning models that can offer assistance us in anticipating the malady can play a crucial part in early prediction.here they expand a work which utilized the non-motor highlights such as RBD and olfactory loss. At the side this the extended work also uses critical biomarkers. And attempted to demonstrate this classifier utilizing different machine learning models that have not been utilized before.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%.

This system[8] points at Parkinson's infection determination using a combined deep learning approach.Parkinson's disease is one of the most prevalent central nervous system neurodegenerative illnesses, particularly within the elderly population.Deep learning is an improvement of Machine learning and has presently demonstrated efficiency to analyze and analyze unstructured datasets and, consequently to provide the most excellent care for patients. In this paper, an early determination strategy combining LeNet and Long Short Term Memory (LSTM) has been proposed for Parkinson's malady. The 102 spiral drawings are passed as input to the LeNet design. By comparing with the ordinary picture, these drawings are classified as Healthy and Parkinson's. The output layer of the LeNet is associated to LSTM engineering. The pictures classified as Parkinson's are at that point passed as input to the LSTM design.. The LSTM architecture is used to classify these Parkinson images based on a severity level of the person as "Safe but to be treated soon" and "Immediate hospitalization required". The performance metric used is accuracy.deep learning techniques have exhibited a remarkable performance in the medical field and when applied for Parkinson's disease, a promising accuracy could be acquired. In this regard, an early diagnosis system using LeNet and Long Short Term Memory (LSTM) deep learning techniques is proposed in this paper. The output acquired using this system would help in understanding at which severity level a person with Parkinson's is and can help take the required next step

The This system[9]detect Dysgraphia by assessing digitized handwriting utilizing Random Forest classification strategy The paper deals with the issue of disabled hand-writing, especially dysgraphia, and the acknowledgment and the handling of qualities extraction. A few machine learning strategies, such as random forest, support vector machine and versatile boosting were utilized for this purpose. There has been 52 extracted handwriting qualities (e.g. speed, acceleration,jerk, length, write lifts, etc.) from 78 handwriting tests. As it were subjects matured 10–13 (comprehensive 10 and 13) were included. Vital component examination was at that point utilized in arrange to imagine traits from handwriting, in two-dimensional space.Random forest is a machine learning calculation for classification and regression assignments. It is the foremost utilized calculation based on decision trees . It makes different decision trees and combines them together for more exact and stable prediction.The random forest method adds randomness to the model.Instead of searching for the most important feature when splitting a node, it searches for the best feature among random subsets of features. This results in a wide variety which generally leads to a better model. The advantages are that the decision trees are independent of each other and thus can be created in parallel.In this research, this method is used for prediction.Support Vector Machine (SVM) analyzes the data used for classification, regression and outliers detection. The aim of this algorithm is to find an optimal hyperplane which divides two classes of training data in a dimensional space and classifies the data points .The goal is to find a plane with the maximum distance between the data points of both classes. SVC is also used in this research in order to achieve better prediction. The main advantage of this paper was it had a great accuracy.

DYS-I-CAN[10] is an help for the Dyslexic to progress their skills using Mobile Application.This paper depicts a mobile application that makes a difference the dyslexic clients influenced with reading, composing difficulties in real world. This example will appear the content such as letter sets and numbers around them and perused it loudly. Moreover the utilization of a machine learning approach to boost the

DOI:

effectiveness of the instruction in a dyslexic child is needed.Dyslexia – A Learning disability could be a therapeutic learning disorder which includes challenges in perusing, word unscrambling, comprehension, memory, composing, spelling, and talking. Individuals analyzed with learning inability shows need of self-esteem, energetic and uneasiness as they are not able to blend with the society. The calculation utilized here is neural machine translation algorithm.models.here point is to translate given sentences from English to Tamil. Neural Machine Translation (NMT) is similar to the encoder decoder structure which accepts any input and converts it to the respected output. NMT model is to take a sentence in one language as input and return that sentence translated into a distinct language as output. Steps involved NMT is the encoder decoder structure. A sequence to sequence model lies behind numerous systems which is appreciated in everyday lives. For instance, seq2seq model powers applications like Google Translate, voice-enabled devices and online chatbots.It is highly essential to know the difficulties of the dyslexic students and to attempt the learning disorders through advancement of Technology. The major challenge of dyslexic students is character Identification or recognition which is very important for various activities such as spell, read and write. It is very important for any individual to recognize, memorize, learn repeatedly.According to this paperThe performance of the dyslexic student can beevaluated using the scores that will be generated at the end of the levels. This app can be used for dyslexic children between the age 3 to 12

Here the system[11] points at Recognizing Dyscalculia Utilizing Machine Learning.Dyscalculia is one of the Specific learning Disorders (SLD) with a specific disability in Mathematics. Early detection of Dyscalculia is one of these tedious, time expending tasks. Detection of Dyscalculia is carried out by conducting different tests where each person test has got to be conducted and assessed physically. The demonstrate makes a difference to rearrange the location and assessment handle for the doctors.The test utilized is the 'Woodcock-Johnson IV' test. The information required is the answers to the 'Woodcock-Johnson IV' test. There are 3 sorts of inputs - correct, incorrect and not attempted. The dataset is shaped in this way, with a 0 for not attempted , 1 for correct and -1 for incorrect answer.The demonstrate uses Random Forest Algorithm which was found to provide most extreme accuracy. The algorithm is at that point prepared on the dataset obtained.

The Segmentation of Bangla Unconstrained Handwritten Text propose a strong scheme to segment unconstrained handwritten Bangla writings into lines, words and characters[12]. For line division, at to begin with, we isolate the text into vertical stripes. Stripe width of a report is computed by statistical analysis of the text height within the document. Another we decide horizontal histogram of these stripes and the relationship of the negligible values of the histograms is utilized to segment text lines. Based on vertical projection profile lines are segmented into words. Division of characters from handwritten word is exceptionally tricky as the characters are rarely vertically separable. The framework uses a concept based on water reservoir rule for the purpose.At to begin with, distinguish disconnected and connected characters in a word. Another touching characters of the word are segmented based on the reservoir base area points and structural feature of the component.

By using a soft computing approach this system[13]diagnosis learning disability and classify them appropriately. This system is to analyze a child with learning disability. The demonstrate is outlined by executing a soft computing procedure called Learning Vector Quantization. This model classifies a child as learning disabled or non- learning disabled. Once analyzed with learning disability, rule based approach is used assist to classify them into types of learning inability that's dyslexia, dysgraphia and dyscalculia. The model is trained utilizing the parameters of curriculum-based test. The paper proposes a strategy of not as it were identifying learning disability but moreover the type of learning disability

By utilizing handwriting classification strategies this system[14] Identifies developmental Dysgraphia Characteristics In this work, a strategy for automatic identification and characterization of dysgraphia in thirdgrade children is portrayed. The strategy is based on analyzing the child's writing elements by examining the pressure the write applies on the paper as well as the pen's position and orientation by using a standard computerized writing pad. Ninety-nine tests were collected from scholars with dysgraphia and capable writers. A wide extend of highlights covering dynamic properties of the writing and typographic properties were extracted for each member. Machine learning strategies were utilized to discriminating dysgraphic items from proficient items with roughly 90% precision

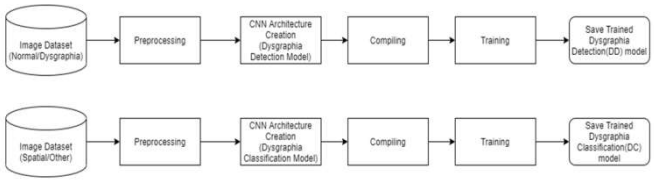
III.PROPOSED SYSTEM

About 30% of the school children face certain kinds of writing disabilities. These disabilities has great significance in their academic success as well as professional career. Thus the early detection of these disorders are really important. The proposed system aims at rapid detection of Dysgraphia. Dysgraphia is a neurological disorder that affects a person's ability to write. It is characterized by difficulties in producing written language, including spelling, handwriting, and organizing thoughts on paper.People with dysgraphia may have trouble with fine motor skills, making it difficult to write legibly and consistently. They may also struggle with letter formation, spacing, and punctuation, and may have difficulty expressing their ideas in writing. Dysgraphia can have a significant impact on a person's academic and social life, as writing is an essential skill in many aspects of daily life. It can cause frustration, embarrassment, and anxiety, as people with dysgraphia may feel self-conscious about their writing abilities.Dysgraphia is often diagnosed in childhood, and early intervention can help children develop strategies to cope with the condition. Treatment for dysgraphia may include occupational therapy to improve fine motor skills, as well as specialized

DOI:

instruction to improve writing skills.It's important to note that dysgraphia is a specific learning disability and not simply a lack of effort or motivation. People with dysgraphia may need additional support and accommodations to succeed academically and in other areas of life.Thus our system classifies healthy children and children with Dysgraphia based on their handwriting. Also the type of Dysgraphia can be identified using the system. Here, we focus mainly on two types namely Spatial and Motor Dysgraphia. Based on the type of Dysgraphia detected the system provide certain remedies based on the type

Training Stage



Prediction Stage

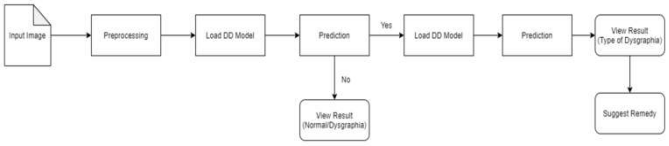


Fig1.1 SystemArchitecture

IV. DESIGN

A. DFD LEVEL-0

Handwritten inputs from children are fed into the model for classification and the model predicts the result.

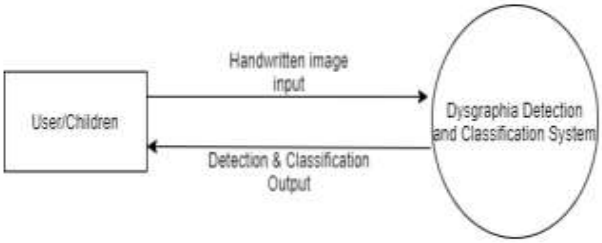


Fig 1.2 dfd-level-0

B. DFD LEVEL-1

Handwritten input undergoes preprocessing which clean up the data. Then preprocessed data is fed into the model for prediction During this phase features are extracted for training the model followed by displaying the result.

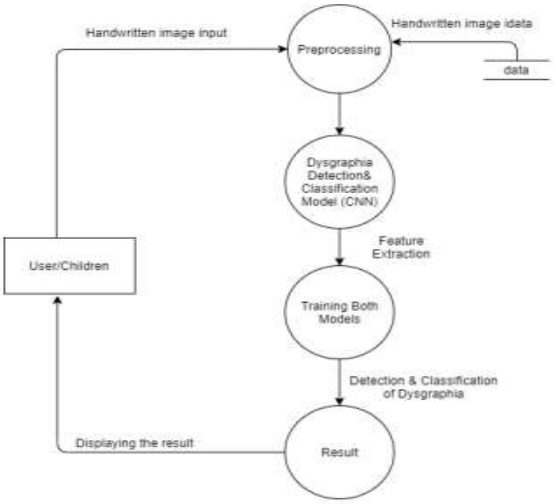


Fig 1.3 dfd level-1

C. DFD LEVEL-2

Initially preprocessing of handwritten input is one in which normalization and resizing take place. Later preprocessed imagesare fed into the model followed by feature extraction and training.Then the model predict and classify the students into healthy or dysgraphic depending up on the taken handwritten sample.

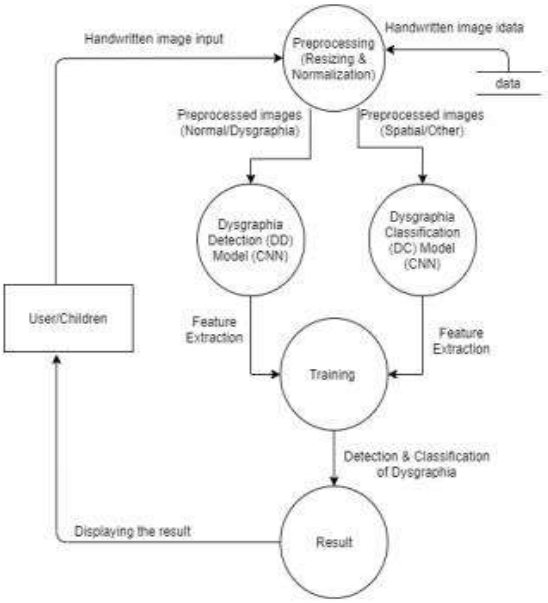


Fig 1.4 dfd level-2

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There are total of four modules for our proposed sytem they are:

A. Image Pre-Processing

Here we performed image resizing for better vision and accuracy and normalization for making convergence faster while training the network. Also created a collection of handwritten datasets by categorizing the collected data's into normal and dysgraphic, again classified the dysgraphic data's into spatial and others.Using this we performed testing and training.

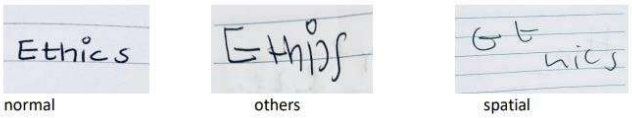

Fig 1.5 pre-processed data samples

B. Dysgraphia Detection Model

Here we created a CNN architecture and compiled it. After compiling it we train the model with collected pre-processed dataset for detecting normal and dysgraphic handwritings.

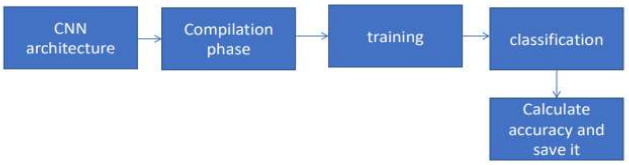

Fig 1.6 Dysgraphia detection

C. Dysgraphia Classification Model

Similar to Dysgraphia detection model, we created a Dysgraphia classification model by making use of CNN architecture, training the model to classify the dysgraphic handwriting into spatial and others.

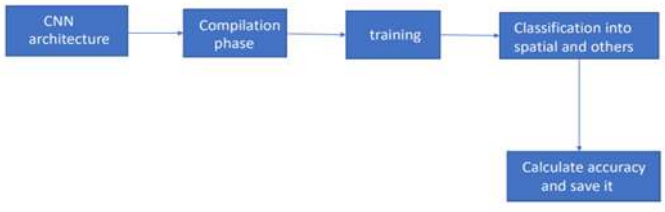

Fig 1.7 Dysgraphia classification

D. Prediction

By using a graphical interface created using python we predict the loaded input images

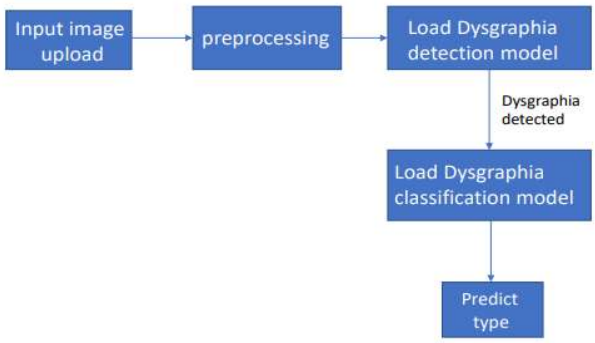

Fig 1.8 Prediction

V.REQUIREMENTS

In case of Hardware Specification, Processor i5 or i7 RAM 8GB(Minimum) ,Hard Disk 500GB or above are Required

In case of Software requirement, Tools we used are Python IDLE, Anaconda, Visual Studio Code. Python Version 3 is required. For the front end Python Tkinter and Back end python is used

VI. EXPERIMENTAL RESULT

The experimental results of the proposed models are discussed here. The deep learning models are built using python with the help of Keras and Tensorflow. The models are trained over 10 epochs. The decision tree model is built using python with the help of sklearn

The performance of various state of the art models for both Dysgraphia recognition and classification is discussed in here. The following figures show the performance comparison of different models.

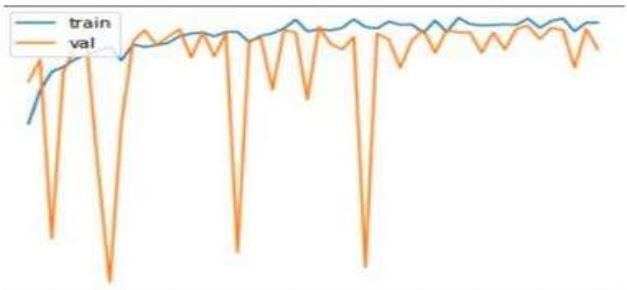

Fig 1.9 Accuracy of Dysgraphia Detector

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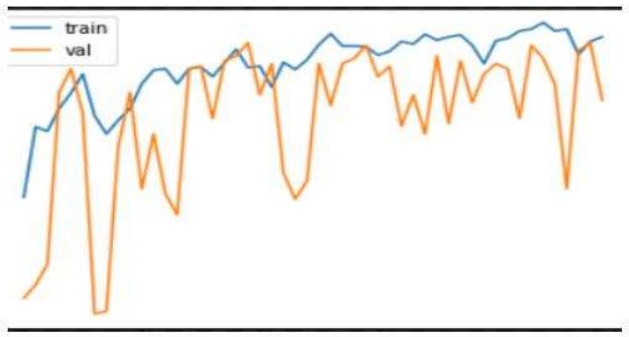

Fig 1.10Accuracy of Dysgraphia Classifier

The proposed models acquired validation accuracy above 90%

VII. CONCLUSION

Our system mainly focus on the early detection of dysgraphia among small children which is basically done by analyzing their writing dynamics, from their handwriting. After detection they are classified according into spatial dysgraphia and other dysgraphia by evaluating various attributes of the handwriting and predict suitable remedies. Early detection of this learning disability helps the children to improve themselves in lots of percepts. Early detection helps to build self-esteem among them, build confidence, helps them to interact with social matters without fear, helps to build a skill which will help them in future and also avoid development of certain behavioural problems. Accuracy depends up on the quantity and quality of dataset used during training. If the number of data increases, accuracy of the model also increases. The output will predict based on the basis of datasets.

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