

EARLY DETECTION OF DYSGRAPHIA USING CONVOLUTIONAL NEURAL NETWORKS

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Abstract - Handwriting is a complex ability to get and it demands lot of preparation and effort to be learnt. Children having dysgraphia exhibit troubles to write. This can cause tension and can otherwise impact instruction, drawing and sketching. It requires the close connection and arrangement of psychomotor and biomechanical processes. Dysgraphia is a difficulty in writing that straightforwardly impacts a student's talent to perform capably. Although dysgraphia is exactly elucidated as "distressing novel," it too influences a person's capability to envision and draw lines and shapes. There may lie a number of students that would benefit from proper understanding of this disorder by educators. This record of what happened is created to comprehend the condition of dysgraphia.

Key Words: Dysgraphia, Handwriting, CNN

1. INTRODUCTION

Handwriting is an essential ability, because children give up to 60% of their opportunity at school writing. Appropriately neat and robotic script is necessary for the purchase of added bigger-order skills to a degree of orthography and story arrangement. Handwriting is a complex concerning feelings and intuition-engine task, as it involves consideration, concerning feelings and intuition, semantic and fine motor abilities.

Among dysgraphia, kids or women have a harder time preparing and executing the literature of sentences, conversation, and even individual reports. It's not that you don't have the skill to state, spell, or recognize letters and conversation. Alternatively, your intelligence has questions dispose of dispute and writing. Dysgraphia may be very discouraging and arduous for the character. Concerned body would feel different from possible choices and this can influence their pride and have a negative effect on their professors. So, discovery of dysgraphia at inception can be honestly beneficial for the youngster and persons and the doctors. If analysis is likely at early stages, former improvement is attainable. So, this model is formed to discover dysgraphia and help teenagers suffering from this disorder.

Dysgraphia, a disorder moving the inscribed verbalization of symbols and dispute, otherwise impacts the academic results of pupils in addition to their overall welfare. The use of automated processes can form dysgraphia experiments convenient to larger populace, through expediting early invasion for those who need it. We are working on a machine intelligence approach to recognize script run-down by dysgraphia. To achieve this aim, we composed a new script dataset incorporating several longhand tasks and elicited a broad range of visage to capture various aspects of manuscript. These were likely a machine intelligence invention to predict whether scrawl is impressed by dysgraphia.

1.1 DYSGRAPHIA

Dysgraphia is a disorder that makes learning difficult. Generally reviewed in modern articles within the circumstances of calligraphy and orthography, dysgraphia exactly translates to troublesome literature. Viewed widely as a script deterioration, dysgraphia also influences a person's strength to draw shapes and to draw lines. The condition shows a neurocognitive disorder guide executive functioning and fine- engine and visual-engine shortfalls. The syndromes of dysgraphia are frequently missed by educators, and undergraduates accompanying the condition are viewed as uninspired or indifferent.

Teachers bear to see the signs and syndromes of dysgraphia and not remove from job a minor as utterly bearing messy manuscript. If a faculty member starts to visualize a trend of indecipherable articles, it is appropriate for the bureaucracy to question whether this child has dysgraphia. Teachers bear note that parts of the document process are most troublesome for the minor. While dysgraphia frequently happens in addition to another disadvantage, many pupils accompanying dysgraphia can exhibit extreme academic realizations in additional issues. Figure 1 shows an instance of the handwriting of a second-grade pupil accompanying dysgraphia, and a usual second grader's scrawl. The traits of dysgraphia are different and juniors can exhibit some individual or more of these traits.

1.2 CHARACTERISTICS OF DYSGRAPHIA

- Tightened fingers
- Unique wrist, frame, paper tilt
- Excessive mistakes
- Confusion of upper and lowercase messages
- Confusion of impressed, easy messages
- Improper postcard size and shapes
- Incomplete flowing notes
- Wrong usage of line and border
- Slow in imitating
- Lack of attention about analyses
- Inverted letters
- Uneven spacing
- Improper letter heights

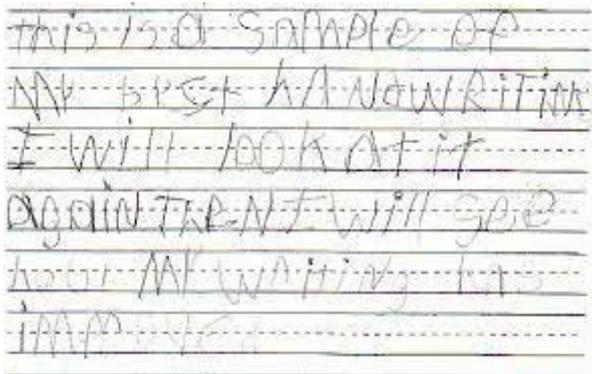


Figure 1: Handwriting of second-grade pupil suffering from dysgraphia

71. This is an example of the Jeps font
 72. This is an example of the Commun font
 73. This is an example of the Tonya2
 74. This is an example of the Mindy font
 75. This is an example of the Edith font
 76. THIS IS AN EXAMPLE OF THE EVERGREEN FONT
 77. THIS IS AN EXAMPLE OF THE WESLEY FON
 78. THIS IS AN EXAMPLE OF THE FAIR FONT

Figure 2: Student with good handwriting

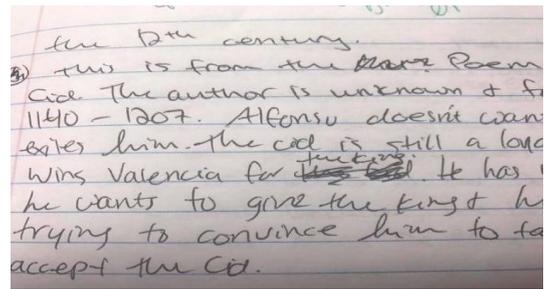


Figure 3: Student with bad handwriting

2. METHODOLOGY

2.1 DATASET AUGMENTATION METHOD

Data augmentation is a bunch of methods to falsely build how much information by creating new data of interest from existing information. This incorporates rolling out little improvements to information or utilizing profound learning models to create new data of interest.

Data augmentation is valuable to further develop execution and results of AI models by shaping new and various guides to prepare datasets. On the off chance that the dataset in an AI model is rich and adequate, the model performs better and all the more precisely. One of the means into an information model is cleaning information which is essential for high exactness models. Nonetheless, in the event that cleaning decreases the representability of information, the model can't give great expectations to certifiable data sources. Information increase methods empower AI models to be stronger by making varieties that the model might find in reality.

2.2 CNN

CNNs are used to distinguish designs in a picture. This is achieved by tangling over an idea and anticipated designs. The organization can find lines and corners in a dwarfed bunch front level of CNNs. We can then move these examples underneath and begin to perceive more perplexing characteristics as we adopt a more profound strategy. This trademark ensures that CNNs are exceptionally dynamic at recognizing objects in portrayals. The projected game plan utilizes CNNs to find dysgraphia composing from dysgraphia pictures portrayals.

The first layer is convolution layer. Pictures are convolved using channels or bits. Channels are small units that are applied across the data using a sliding window. It includes taking component wise result of the channels in data and afterward add these particular properties for each sliding activity. The result of a convolution is that it has a 3-dimensional channel with variety and would be a 2d lattice.

The second layer is activation layer, it applies Rectified Linear Unit, in this layer, rectifier is applied to increment non-linearity in CNN.

The third layer is pooling layer, which includes inspection of elements. It is applied for each layer. It utilizes 2X2 max channel that has a step of 2. A channel would return maximum worth in highlights inside locale. Illustration of maximum pooling is when there are 26X26X32 volumes, presently utilizing maximum pool layer that has 2X2 channels and with on leg on each side, the volume is then decreased to 13X13X32 element map.

The fourth layer is the completely connected layer, it includes flattening. It changes the whole pooled highlight map lattice into solitary segment which is later taken care by brain network for handling. With these completely associated layers, highlights are consolidated together to create a model. SoftMax or sigmoid is used to group the result.

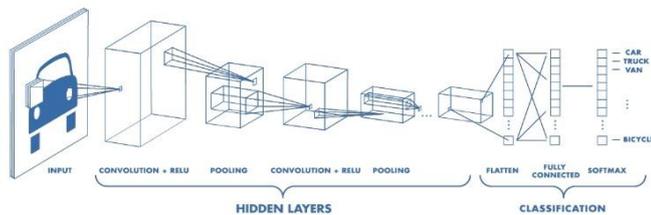


Fig 4: Architecture of a CNN Model

2.3. GRAPHICAL USER INTERFACE

We have built an application which will be available to everyone and the parents can check whether their children's handwriting is dysgraphia or not.

3. LITERATURE SURVEY

In accordance with the paper Labelling Developmental Dysgraphia Traits Applying Script Classification Designs (2017) [1], Dysgraphia is a commotion or trouble as a result of written language having connection with the mechanical details of the letter. The difficulties manifest as incompetent acting of longhand among youth the one argues least an average intellect level and the one destitute existed identified as bearing some understandable neurological or concerning feelings and intuition-engine questions. The prevalence of scrawl troubles with elementary school scholars ranges from 10% to 34%. Dysgraphia can have deep associations for the individual in conditions of compromised self-figure and accomplishment in school. The aim concerning this study was to cultivate and test a mathematical model for changing between dysgraphia and able calligraphy to establish their performance traits. This study attracted labelling and typifying dysgraphia among Israelite literature teenagers. The SVM classifier shows accurate

prophecies for 89 exhausted 99 calligraphy products, which leads to a veracity of 89.9%.

In accordance with the paper Dysgraphia detection through machine intelligence (2020) [2], a new script dataset was composed that consisted of various writing activities and a wide range of faces were extracted to get various facets of scrawl. Those were given to a machine intelligence treasure to envision if the manuscript was affected by dysgraphia. Before they distinguished several machine intelligence algorithms and erect high-quality results were achieved apiece adjusting pushing (Adaptive Boosting) algorithm. Finally, it proved that machine intelligence may be used to identify dysgraphia accompanying nearly eighty percent accuracy, while handling a heterogeneous set of matters. Cases with some harm or physical dislike to draft were expelled. Speed, jerk, acceleration, pressure, azimuth and peak were culled in form of heading of calligraphy sample. Classifier confirmation was conducted utilizing layered having ten of something cross validation, and all processes were recurring for ten periods. Categorization accuracy, feeling, and particularity over the ten duplications were averaged. Results showed it is likely to select youngsters with disorder with accuracy of 79.5% on a sample of kids of various ages using the AdaptiveBoosting and utilizing the RF and SVM algorithms. The accuracy score of the added models were high, 72.3% for RF classifier and 72.5% for SVM.

In accordance with paper, TestGraphia, a Spreadsheet Whole for the Early Diagnosis of Dysgraphia (2020) [3], this study plans an judgment agreement for BHK test by including writing face to a degree book size, impartial abandoned border, skewed lines, lacking scope 'tween words, sharp angles, defective links middle from two points reports, collision 'between two postcards, uneven height of letters, contradictory crest 'tween letters accompanying and outside enlargement, atypical messages, uncertain notes, traced memos, doubtful path. These facial characteristics should be deliberate by doctors and forms to pronounce dysgraphia. Certain countenance is approximately arithmetic-based, while additional physiognomy demands a doctor's interpretation and few visages may be automated.

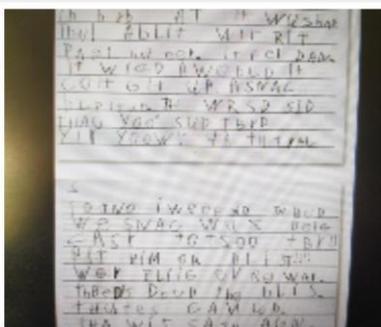
In accordance with the paper, [4], it uses a reduced version of loop affecting animate nerve organs networks accompanying keras using tensor flow backend, a Scanning in of documents model was erected utilizing CNN. Accuracy of 86.14% is computed utilizing veracity principles of 85.12% and 87.18% from the data and the experiments. 5-Fold cross validation approach was second-hand. In every trial, the veracity profit was calculated every round and last veracity utilizing the mean principles of all rounds were calculated.

In another study, Towards Detecting Dyslexia in Babies' Handwriting Utilizing Affecting animate nerve organs Networks (2019) [5], an akin approach was second-hand using CNN in addition to keras and TensorFlow outside Scanning in of documents which managed to a veracity of 55.7%. So, scanning in of documents using CNN is favourable.

In accordance with the paper, Concept Classification utilizing SVM and CNN (2020) [6], SVM model that second-hand a very narrow dataset realized an accuracy of 93% and even though SVM is a very powerful method, achieving aforementioned an extreme veracity was still an anomaly. Utilizing dossier improving, the size of the dataset was in addition to increase and was acted on SVM repeatedly, it achieved a veracity of 82%. On favourably executing CNN, it achieved a veracity of 93.57% on the unchanging dataset. So, it decides that using CNN over an abundant improved dataset of countenances is better than using SVM because it determines larger veracity.

3. RESULT

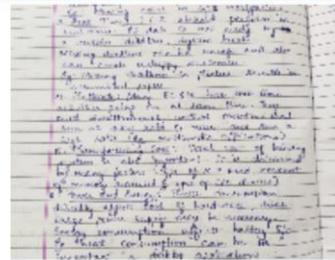
Dysgraphia categorization in the period of being young helps to treat the offspring effectively and increases self-confidence of the offspring. Few existent plans involved in the dysgraphia categorization established machine intelligence methods and have the restraint of overfitting problems. The existent means have the restraints of lower effectiveness in categorization and non-discrimination discussion is not thought-out in the model. We achieved a total accuracy of 78.9% overall which can help in the detection of dysgraphia.



Classified as:
Dysgraphic

Confidences:
Bad: 0.0%
Dysgraphic: 99.9%
Good: 0.0%

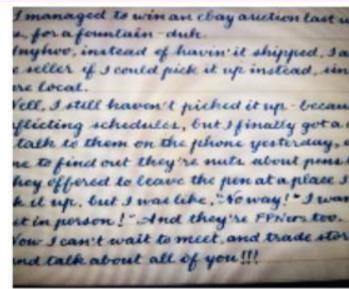
Fig 5: Dysgraphic image detection



Classified as:
Bad

Confidences:
Bad: 94.7%
Dysgraphic: 1.0%
Good: 4.3%

Fig 6: Bad Image detection



Classified as:
Good

Confidences:
Bad: 0.2%
Dysgraphic: 0.0%
Good: 99.8%

Fig 7: Good image detection

4. CONCLUSIONS

Clearly dysgraphia is a hindrance for learning and improving in education. There is medication that help to destroy those obstacles using technology, guidance, and support. CNN architecture is put forward for bad, dysgraphic and good handwriting detection with an objective of high classification accuracy.

A genuine dataset was collected for the training and testing process which went smoothly. A training strategy comprised training model on the desirable patterns.

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