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Identification of Dysgraphia: A Comparative Review

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Abstract

Dysgraphia is a common learning disability in children worldwide. It is characterized as a disturbance or difficulty in the production of written language presented through visual graphics. Almost 10–20% of school going children do face this issue. The child's functional limitation in creating correct formation of letters or words, insufficient speed and legibility of written text is considered as Developmental Dysgrphia Disorder. Also the term developmental dysgraphia refers to the fact that a child is unable to get writing skills, in spite of the sufficient opportunities to learn in the absence of any neurological disorder. Because of dysgraphia children may have serious issues in their day to day life. It is proposed by various researchers that there might be serious consequences in a child's academic, social and emotional behaviour because of handwriting difficulties. It is

therefore required to detect it in the earlier phase.

There are various scales which are developed to assess the handwriting quality. The Objective of this paper is to present various methods available for automatic detection of dysgraphia. We also presented a comparative study of existing research work for early detection of dysgraphia based on some already available measures.

Keywords

Dysgraphia **Handwriting quality**

Developmental dysgraphia

References

1. Feder, K.P., Majnemer, A.: Children's handwriting

evaluation tools and their psychometric properties. Phys. Occup. Therapy Pediatrics **23**(3), 65–84 (2003)

2. Feder, K.P., Majnemer, A.: Handwriting development, competency, and intervention. Dev. Med. Child Neurol. **49**(4), 312–317 (2007)

3. Hamstra-Bletz, L., Blöte, A.W.: A longitudinal study on dysgraphic handwriting in primary school. J. Learn. Disabil. **26**(10), 689–699 (1993)

4. Mekyska, J., Faundez-Zanuy, M., Mzourek, Z., Galaz, Z., Smekal, Z., Rosenblum, S.: Identification and rating of developmental dysgraphia by handwriting analysis. IEEE Trans. Human-Mach. Syst. **47**(2), 235–248 (2016)

5. Asselborn, T., Gargot, T., Kidziński, Ł, Johal, W., Cohen, D., Jolly, C., Dillenbourg, P.: Automated human-level diagnosis of dysgraphia using a consumer tablet. NPJ Dig. Med. **1**(1), 1–9 (2018)

6. Yogarajah, P., Bhushan, B.: Deep learning approach to automated detection of dyslexia-dysgraphia. In: The 25th IEEE International Conference on Pattern Recognition (2020)

7. Mavrea, T., Malegiannaki, A.C., Apteslis, N., Kosmidi, M.H.: Comparison of intellectual profiles among children with different types of neurodevelopmental disorders and typically developing children. ENCEPHALOS **57**, 35–43 (2020)

8. Rosenblum, S., Dror, G.: Identifying developmental

dysgraphia characteristics utilizing handwriting classification methods. IEEE Trans. Human-Mach. Syst. **47**(2), 293–298 (2016)

9. Döhla, D., Willmes, K., Heim, S.: Cognitive profiles of developmental dysgraphia. Front. Psychol. **9**, 2006 (2018)

10. Gargot, T., et al.: Acquisition of handwriting in children with and without dysgraphia: a computational approach. PLoS One **15**(9), e0237575 (2020)

11. D'Antrassi, P., Perrone, I., Cuzzocrea, A., Accardo, A.: A composite methodology for supporting early-detection of handwriting dysgraphia via big data analysis techniques. In: De Pietro, G., Gallo, L., Howlett, R.J., Jain, L.C. (eds.) KES-IIMSS 2017. SIST, vol. 76, pp. 241–253. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-59480-4_25

12. Treatment of handwriting problems in beginning writers: Transfer from handwriting to composition. J. Educ. Psychol. **89**(4), 652–666 (1997)

13. Rosenblum, S., Weiss, P., Parush, S.: Product and process evaluation of handwriting difficulties. Educ. Psychol. Rev. **15**, 41–81 (2003)

14. Pagliarini, E.: Childrens first handwriting productions show a rhythmic structure. Sci. Rep. **7**(1), 1–10 (2017)

15. Schneck, C., Amundson, S.: Prewriting and

handwriting skills. Occup. Therapy Child., 555–582 (2010)

16. Medwell, J., Wray, D.: Handwriting automaticity: the search for performance thresholds. Lang. Educ. **28**, 34–51 (2021). http://eprints.nottingham.ac.uk/id/eprint/45306

17. Rosenblum, S.: Relationships between handwriting features and executive control among children with developmental dysgraphia. Am. J. Occup. Therapy **70** (2015)

18. Asselborn, T., et al.: Bringing letters to life: handwriting with haptic-enabled tangible robots. In: Proceedings of the 17th ACM Conference on Interaction Design and Children, IDC 2018, p. 219230. Association for Computing Machinery, New York (2018). https://doi.org/10.1145/3202185.3202747

19. Zolna, K., Asselborn, T., Jolly, C., Casteran, L., Johal, W., Dillenbourg, P., et al.: The dynamics of handwriting improves the automated diagnosis of dysgraphia. arXiv preprint arXiv:1906.07576 (2019)

20. Dimauro, G., Bevilacqua, V., Colizzi, L., Di Pierro, D.: Testgraphia, a software system for the early diagnosis of dysgraphia. IEEE Access **8**, 19564–19575 (2020)

21. Mahrishi, M., Morwal, S., Muzaffar, A.W., Bhatia, S., Dadheech, P., Rahmani, M.K.I.: Video index point detection and extraction framework using custom

yolov4 darknet object detection model. IEEE Access **9**, 143378–143391 (2021)

22. Asselborn, T., et al.: Reply: limitations in the creation of an automatic diagnosis tool for dysgraphia. npj Dig. Med. **2**, 1–2 (2019)

23. Asselborn, T., Chapatte, M., Dillenbourg, P.: Extending the spectrum of dysgraphia: a data driven strategy to estimate handwriting quality. Sci. Rep. **10**(1), 1–11 (2020)

24. Drotár, P., Dobeš, M.: Dysgraphia detection through machine learning. Sci. Rep. **10**(1), 1–11 (2020)

25. Zvoncak, V., Mekyska, J., Safarova, K., Smekal, Z., Brezany, P.: New approach of dysgraphic handwriting analysis based on the tunable q-factor wavelet transform. In: 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), pp. 289–294. IEEE (2019)

26. Van Waelvelde, H., Hellinckx, T., Peersman, W., Smits-Engelsman, B.C.: Sos: a screening instrument to identify children with handwriting impairments. Phys. Occup. Therapy Pediat. **32**(3), 306–319 (2012)

27. Rosenblum, S.: Development, reliability, and validity of the handwriting proficiency screening questionnaire (HPSQ). Am. J. Occup. Therapy **62**(3), 298–307 (2008)

28. Barnett, A., Henderson, S., Scheib, B., Schulz, J.: Development and standardization of a new handwriting speed test: the detailed assessment of speed of handwriting. BJEP Monograph Ser. II, Number 6 - Teach. Learn. Writ. **1**, 137–157 (2009)

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