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DETECTION OF LUMBAR POSTURAL DEVIATIONS, THE USE OF ARTIFICIAL NEURAL NETWORKS STRUCTURED IN AI: AN INSTRUMENT FOR PROMOTING THE QUALITY OF LIFE OF MEDICAL PROFESSIONALS

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Abstract: This study portrays the importance of Human Movement Sciences (CMH) and Artificial Intelligence (AI) in detecting postural deviations, such as scoliosis, and their impacts on quality of life. Employing a pre-diagnostic descriptive methodology, the work developed and validated an AI algorithm to identify abnormalities in the lumbar spine using X-ray images. From an initial set of 2897 images, the study expanded the dataset to 579400 images, employing technologies advanced such as: Python®, TensorFlow® e OpenCV®. The Neural Network architecture was rigorously prepared, trained and tested, with the model's effectiveness confirmed by robust metrics. The results highlight the efficiency of AI in diagnostic medicine, highlighting the technology's potential to advance medical diagnosis and open new paths for future clinical innovations focusing on this professional's quality of life.
Key words: artificial intelligence; quality of life; medicine; lumbar deviation

RATIONALE

The theoretical foundation of the study illuminates the importance of Human Movement Sciences (HCM) in understanding and treating conditions that affect human well-being, evidenced by historical progress in health especially in medicine, such as the invention of vaccines, anesthesia and X-ray (FRIEDMAN; FRIEDLAND, 2000). Recently, the area of HCM has stood out as a fertile field for discoveries, especially in the investigation of postural deviations such as scoliosis. This condition, among other postural disorders, has been the focus of intensive studies due to its profound impact on individuals' quality of life, demonstrating the need for accurate diagnoses and effective treatments.

The study of postural deviations is not only crucial to individual well-being, but also contributes significantly to the broader understanding of human health and movement. Scoliosis, for example, is a complex condition with several possible etiologies, affecting individuals of different ages and lifestyles. The attention given to this and similar conditions reflects a broader effort to address health challenges that affect mobility, functionality, and quality of life, highlighting the ongoing contributions and importance of HCM (Wasinpongwanich et al., 2021; Taguchi et al., 2021; Noh, 2021; Negrini et al., 2022; Lenz et al., 2021; Bradko et al., 2021).

Our objective was to create, develop and validate an intelligent algorithm, aimed at evaluating postural deviations of the lumbar spine, through a *Convolutional Neural Network* (CNN) and as secondary objectives, an effective and reliable way to be used to improve working conditions and quality of life for doctors stands out.

METHODOLOGY

This study adopted a pre-diagnostic descriptive approach using Artificial Intelligence (AI) methods to develop and validate an intelligent algorithm for identifying lumbar spine deviations from X-ray images. The dataset consisted of 2897 images, augmented to 579400 through interpolation techniques. Development tools included: Python®, TensorFlow®, OpenCV®, among other essential libraries. The Neural Network architecture was carefully designed and implemented, following a rigorous sequence of data preparation, training and testing (Vilela Júnior, 2015; Ueda, 2022).

RESULTS

The results were validated using a Confusion Matrix, where several metrics were obtained to confirm model validation, including true positives (VP or TP), false positives (FP), true negatives (VN or TN) and false negatives (FN). The results indicated an accuracy of

0.961, precision of 0.986, sensitivity of 0.913 and specificity of 0.991. Additional metrics were considered for a more robust analysis, including the Fowlkes-Mallows Index (FMI), the Matthews Correlation Coefficient (MCC) and the Youden Index (IY), with results of FMI=0.934, MCC=0.894 and IY =0.877 (Zhang et al., 2022; Samina et al., 2022; Wang, Khan and Zhang, 2021; FATIMA et al., 2021).

DISCUSSION

The implementation and validation of the AI algorithm demonstrates a significant advance in the accurate identification of lumbar postural deviations. The accuracy and reliability of the model are corroborated by performance metrics, highlighting its practical applicability in the healthcare sector. This study also recognizes the growing importance and impact of digital technology and AI in healthcare, particularly in HCM. The multidisciplinary approach adopted not only improves diagnostic accuracy but also paves the way for future innovations and clinical applications in a rapidly evolving field. The promising results of this study encourage the continuation of research in the area, seeking to further improve AI techniques for medical diagnosis, as well as ensuring faster, more accurate work for them and with mitigating impacts on their professional activity, thus improving your quality of life.

The multidisciplinary approach proposed and adopted in this study opens doors for future innovations, ensuring that medical workers, physiotherapists, physical education professionals, can perform their functions in an environment with technological support and that can presumably be aids to their physical health and well-being. be general, relieving your workload.

REFERENCES

FRIEDMAN, M., FRIEDLAND, G. W. (2000). Medicine's 10 Greatest Discoveries. Yale University Press.

WASINPONGWANICH, K.; NOPSOPON, T.; PONGPIRUL, K. (2021). Surgical Treatments for Lumbar Spine Diseases: A Systematic Review and Meta-Analysis. medRxiv.

TAGUCHI, T.; NAKANO, S.; NOZAWA, K. (2021). Effectiveness of pregabalin treatment for neuropathic pain in patients with spine diseases: a pooled analysis of two multicenter observational studies in Japan. Journal of Pain Research, 14, 757.

NOH, S. H. (2021). Epidemiology of senile spinal diseases: a study based on the Health Insurance Review & Assessment Service database. Journal of the Korean Medical Association/Taehan Uisa Hyophoe Chi, 64(3).

NEGRINI, S. et al. (2022). The classification of scoliosis braces developed by SOSORT with SRS, ISPO, and POSNA and approved by ESPRM. European Spine Journal, p. 1-10.

LENZ, M. et al. (2021). Scoliosis and Prognosis—a systematic review regarding patient-specific and radiological predictive factors for curve progression. European Spine Journal, 30(7), 1813-1822.

BRADKO, V. et al. What is the role of scoliosis surgery in adolescents and adults with myelomeningocele? A systematic review. Clinical Orthopaedics and Related Research®, p.10.1097, 2021.

VILELA JUNIOR, G. B. (2015). Reflexões e refrações epistemológicas nas ciências do movimento humano. Revista CPAQV–Centro de Pesquisas Avançadas em Qualidade de Vida, Vol 7(2), 2.

UEDA, A. (2022). O futuro da inovação digital. MIT Technology Review.

ZHANG, T. et al. (2022). A clinical classification for radiation-less monitoring of scoliosis based on deep learning of back photographs. Research Square; (2022). DOI: 10.21203/rs.3.rs-1655808/v1.

SAMINA A., et al. (2022). "Optimizing Convolutional Neural Networks with Transfer Learning for Making Classification Report in COVID-19 Chest X-Rays Scans", Scientific Programming, Article ID 5145614, 13 p., https://doi.org/10.1155/2022/5145614.

WANG, S. H.; KHAN, M. A.; ZHANG, Y. D. (2021). VISPNN: VGG-inspired Stochastic Pooling Neural Network. Comput Mater Contin, 70(2), 3081-3097. doi: 10.32604/cmc.2022.019447.

FATIMA, J. et al. (2021). Spinal vertebrae localization and analysis on disproportionality in curvature using radiography—a comprehensive review. EURASIP Journal on Image and Video Processing, doi:10.1186/s13640-021-00563-5.