Detection of spine deformities using deep learning models

Student`s Photo

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ABSTRACT

This research outlines a medical mapping sequence designed for body part segmentation and disc data processing, specifically focusing on the lumbar spine. By customizing the list of body parts, the system enhances diagnostic precision by concentrating on specific regions. This targeted approach not only increases mapping accuracy but also improves visualization for medical professionals, educators, and researchers. The default implementation segments lumbar vertebrae (L1-L5), labeling and visualizing each with green coloration, with customizable color options for different vertebrae classes.

An image processing algorithm has been developed that easily detects and measures the vertical distances between green-colored contours representing the intervertebral discs for the purpose of disc data processing. In the implementation, HSV color space was used which is perfect for color-based segmentation tasks; the journey by converting images from BGR to HSV, isolating green regions, contour finding, and calculating vertical distances between them begins. This guarantees the accurate vertebral spacing measurement and detection corresponding to medical imaging requirements.

The algorithm makes the visualization drawing contours and vertical distances on the input image, connecting midpoints of bounding boxes, annotating vertical distances. These processed images and calculated measurements provide valuable data for subsequent research, thus boosting the precision in spinal diagnostics. This research focuses on the requirement for fine-grained segmentation and deep imaging processing for enhancing medical diagnostic tools.

1. Problem Definition

The research addresses challenges in AI-based medical image analysis, particularly for lumbar spine diagnostics. Key issues include low-resolution images affecting feature extraction and segmentation, noise from surrounding tissues in imaging, and difficulties in accurately localizing and clustering vertebrae. Additionally, the variability in vertebrae due to patient-specific factors like gender and medical history, and the complexity of diagnosing various lumbar spine diseases further complicate automated diagnostics. The study seeks to improve diagnostic precision and reliability by tackling these challenges.

2. Objectives

1. Improving the accuracy of vertebrae localization
2. Improving the accuracy of lumbar spine diagnostics
3. provide variety of visualization system

3. Brief Introduction

9.1. Brief Introduction / Background

Objective of Artificial Intelligence, it is required to serve most fields. research fields are to implement AI (Artificial Intelligence) in medical usages at least with a limited processed asgenerating medical report based on some types of data as medical scan including X-ray, positron, emission tomography (PET), magnetic resonance imaging (MRI) and computed tomography (CT). Spine, which could be scanned using magnetic resonance imaging or computed tomography, is one of the known applications related to AI medical usage for case description

4. Summary of Previous Work

For example, (Mushtaq et al., 2022) used YOLO annotations to perform the localization process, and the scan type of the dataset was MRI. The photos got some smoothing procedures before being executed by the yolo model. The researchers got Mean average precision equals to 0.975. and the required task in this paper was to get segmentation if there is any problem related to lordosis in the lumbar spine.

Another research (van der Graaf et al., 2023) was using U-net for 3D data at the localization process and for segmentation tasks concerned with Anatomical label prediction and Completeness prediction.

In this paper (Healthcare Engineering, 2023) , the researchers used MRI dataset and tried to improve the required total time of processing and getting good accuracy while performing the segmentation using U-net.

5. Research Methodology

There are Two datasets that have been selected. And the reason for choosing two datasets is to try to get high numbers of samples for testing and for a variety of the cases of diseases which gives the opportunity for the unsupervised learning model do segment the most possible types of diseases available in the two data sets. Specifically, that there are some diseases recognized better with CT imaging technique and another type of diseases recommended to be checked and diagnosed using MRI technique

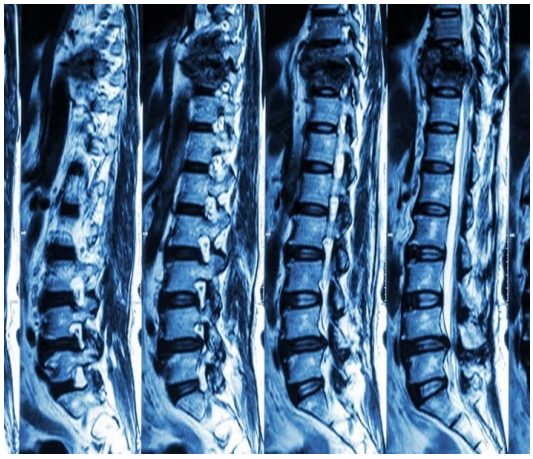

Figure 1 - MRI

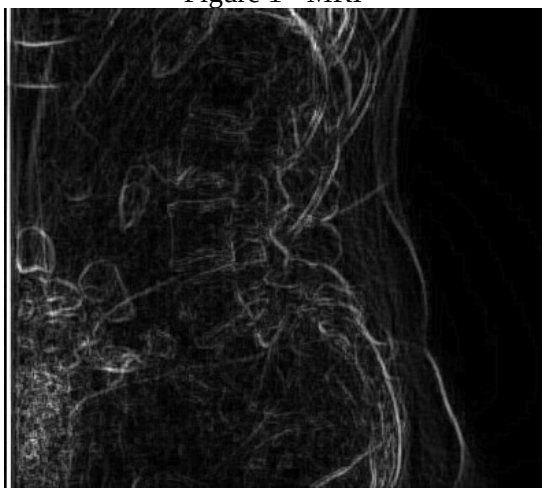

Figure 2 - Preprocessing

6. Experimental Work and Main Results

Get the system of localization vertebrae

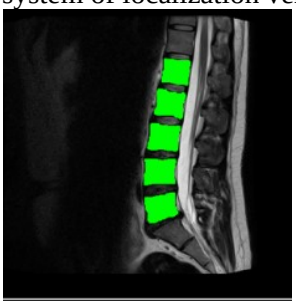

Figure 3 - The (L1:L5)

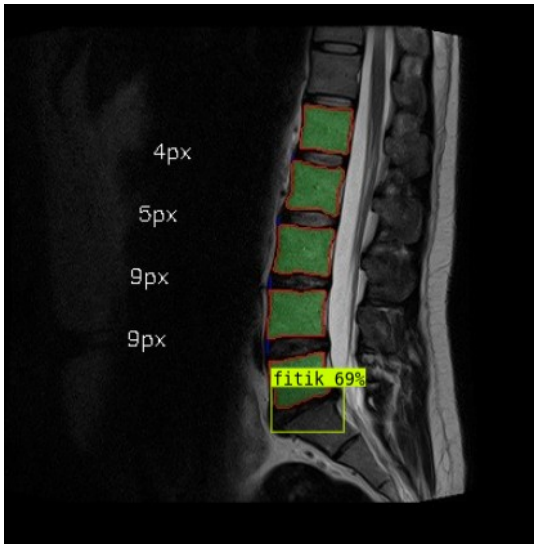

Figure 4: Full system
the system shows combinations of many models for localization and diagnostics. In addition to some analysis

7. Conclusion and Future Development/Improvement

Integrating AI into the analysis of the lumbar spine requires two steps, the first of which is to determine the location of individual vertebrae, followed by the selection of five levels. We need to check whether medical cases are related to problems or not.

The previous two units have been used in many papers investigating the integration of AI and lumbar medical cases. But in this magazine. We focus on how to add the new step necessary to control the specific cause of a medical problem. This section primarily helps scan providers prepare reports for patients. However, the big challenge is to focus on getting the right diagnosis for the current case. Because there are many problems with the lumbar spine that vary from place to place. for example, vertebra 1 has a medical problem different from subsequent vertebrae.

So a proper diagnosis must be followed from the beginning, which depends on how to get accurate localization and segmentation, or before continuing this step. In this report, we also focus on combining image processing techniques with machine learning or deep learning techniques.

8. Future Development

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References

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