The Leg Length Discrepancy Diagnosis Assistance Service Using Image Segmentation and Landmark

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ABSTRACT

Artificial intelligence technology is increasing in use in disease prediction, disease diagnosis, and diagnosis assistance services. However, in the case of leg length discrepancy, continuous measurement is required even after surgical treatment, but since the doctor is mainly measuring directly, inefficient and subjective judgment may be included. Therefore, in this paper, we proposed a system to accurately measure the length of the leg using deep learning for diagnosis of leg length discrepancy and proper treatment.

KEYWORDS

Image Segmentation, Diagnostic Assistance, Leg Length Discrepancy, Deep Learning

1 INTRODUCTION

The number of patients with musculoskeletal disorders has recently been on the rise due to increased sitting time and reduced exercise time due to long-term work due to industrial development.

In addition, the use of artificial intelligence technology is increasing as one of the ways to solve this problem as the complexity of medical data increases and the misdiagnosis rate increases accordingly.

In particular, in the case of leg length discrepancy, continuous measurement of leg length is required not only after diagnosis but also after surgery. However, most of them are measured directly by doctors, which is inefficient and may include subjective judgment by doctors[1].

Therefore, in this paper, we analyze the iliac data and perform iliac recognition and image segmentation using deep learning to diagnose the leg length discrepancy.

Next, important feature data were extracted and set as a landmark, and a diagnostic assistance service was proposed to provide detailed information to doctors by automatically measuring the length of the femur, tibia, and entire leg.

2 EXPERIMENTAL RESULT

2.1 Methodology

The method proposed in this paper is designed to extract reference points necessary for measuring leg length discrepancy by performing a four-step process on X-ray data.

The first step selects and labels the reference region required for leg length measurement from the X-ray iliac image. The reference areas used in this paper are the femur, knee, and ankle bone areas. The selected images generate an image classification model through learning using YoloV5[2-3]. Three reference regions are extracted from the X-ray iliac image using the generated classification model.

In the second step, three reference area images of different extracted sizes were converted into images of the same size (256x256). In addition, we proceed with a normalization process to equalize the images, and the final result image was extracted only bone regions from three reference regions using U-Net[4-5].

In the third step, the contour was extracted from each of the extracted three bone regions, the feature points were extracted from the contour, and the important feature points were set as Landmarks.

In the final step, the length of the femur, the length of the tibia, and the length of the entire leg are measured using the extracted feature points, and the measured results and values are displayed on the X-ray image.

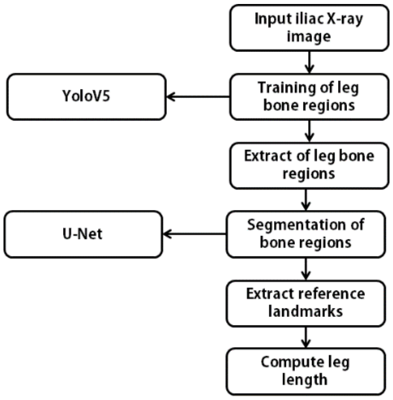


Figure 1: Proposed service flow diagram

2.2 Data Description

The data used were performed using 200 lower body X-ray images provided by healthhub companies, using 170 pieces of train data, 20 pieces of verification data, and 10 pieces of test data.

2.3 Result

Figure 2 shows the result image of the method proposed in this paper. When the X-ray image is entered, the final result is a reference landmark for each part, and a line corresponding to (1) the length of the femur, (2) the length of the tibia, and (3) the length of the entire leg is drawn and the value is calculated.

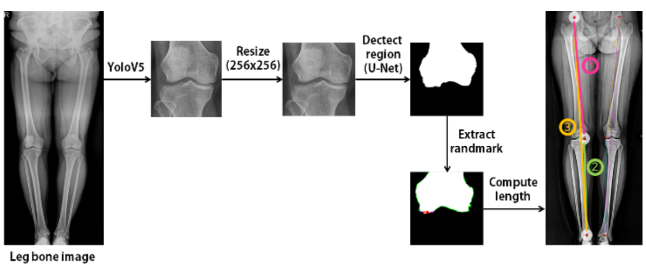


Figure 2: Performance result image of proposed service

As shown in Figure 3, the object recognition accuracy of the femur, knee, and ankle regions using YoloV5 was 99.5% at mAP@0.5.

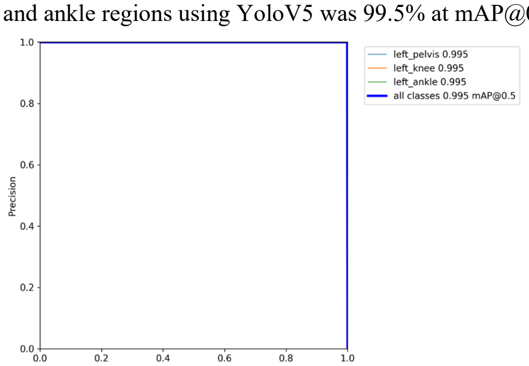
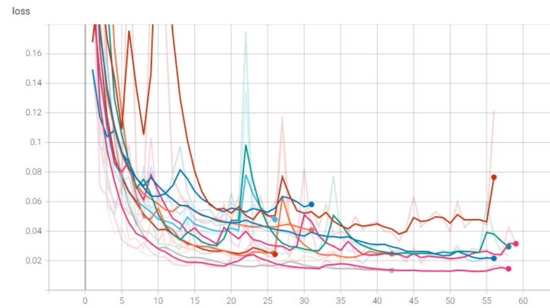
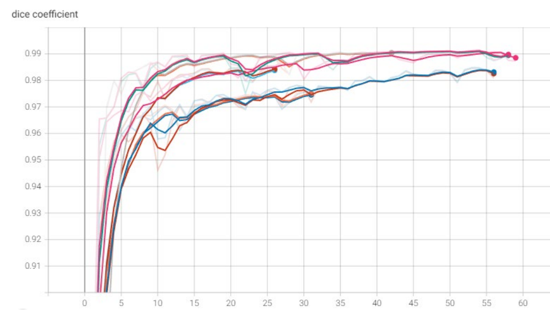


Figure 3: Accuracy of recognition of femur, knee and ankle area using YoloV5

As shown in Figure 4, the average error was 0.02, and the average dice coefficient was 0.98, as a result of bone region segmentation of the femur, knee, and ankle images using U-net.



(a)



(b)

Figure 4: Performance of image segmentation of femur, knee and ankle area using U-net (a) Average error (b) Average dice coefficient

3 CONCLUSIONS

In this paper, the proposed service can automate leg length discrepancy diagnosis. Through this, it is possible to expect a reduction in the subjective judgment or reading time of the doctor. In addition, it can be used for predicting and diagnosing various diseases.

ACKNOWLEDGMENTS

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