Development of Portable Real-time Instrument for Three-Dimensional Measurement and Analysis of Spinal Curve

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INTRODUCTION

This study presents a novel method measuring the 3D curve of a spine. Techniques employed were "Computer Vision", "Stereo Vision Triangulation" and palpation of the characteristic of spine, from which the three-dimensional curve of a spine can be constructed. With further analysis algorithm, the information about scoliosis, kyphosis, lordosis can be captured. This non-radioactive portable method provides information in real time. Therefore, it can be used to screen the occurrence of scoliosis in adolescence or long-term intensive follow-ups in remote areas and analyze clinical parameters to identify abnormal patients.

METHODS

Our system comprises two parts. The first part is for 3D curve measurement. It is composed of (1) two webcams, (2) a fixing frame on a tripod to accommodate the cameras, (3) a pointer for palpation of the trace of a spine, (4) a pair of RF transmitter and receiver for tracing point confirmation, and (5)an underline program which using pre-calibrated information, processes the images from the two cameras. To measure the spine curve, an examiner uses a pointer to palpate the spinous processes. When a characteristic position is found (indicated by a confirming switch on the pointer), two different view-angled images are captured simultaneously into a PC, from which the 3D coordinates of the characteristic point is calculated. By scanning from C1 to L5 sequentially, the 3D spinal curve can be constructed.

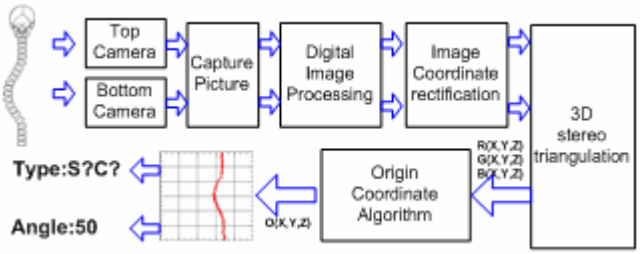


Figure 1: Flowchart of system

The second part is for curve information extraction with developed algorithm to calculate (1) scoliosis's type and angle in the frontal plane and (2) abnormal shape and angle in the sagittal plane.

Examiner was wore a pointer of three-dimensional coordinate device. A full spinal uninterrupted scan was performed by palpation the spinous processes from C1 to L5 .When examiner find the characteristic position, push the switch. Utilize some algorithm to calculate this some three-dimensional space coordinates of characteristic, and set up the three-dimensional backbone curve of whole 3D.,then calculate automaticity scoliosis's type and angle in the frontal plane and abnormal shape and angle in the Sagital plane.

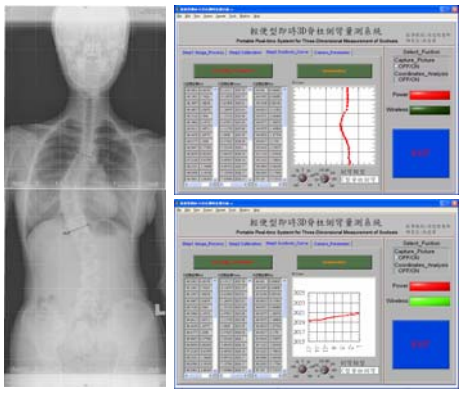
RESULTS AND DISCUSSION

Experimental result, able to calculate the three-dimensional changes in the space coordinate of coordinate device. Simple algorithm and digital image processing and constructs the three-dimensional curvature of spine.

CONCLUSIONS

In the course of the experiment, factors of color complexity of the background are great influences of the results. The calculation of the angle and traditional Cobb Angle methods are different in this research, but still can measure the severity of scoliosis, the angle measured increases as the curve become greater as well, but how to define the angle, still need further studies.

Build and construct 3D curvature, allows study of the changes on three-dimensional space of scoliosis. X-Y direction can interpret the type and angle; Y-Z direction can interpret the severity of humpback. Because we believe, scoliosis not only causes influence on X-Y direction, but also causes a great influence on Y-Z direction. Unlike the traditional method which only deal with the angle of X-Y and type, to diagnosis scoliosis.



(a) (b)

Figure 2: Results. (a)X-Ray (b) Experiment

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