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Different methods of detection of Scoliosis – a Review

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***Abstract*— Abstract - Diagnosis of a disease needs early estimation of the important factors relating to it. X-ray are generally used for the diagnosis. Scoliosis is a medical deformity related to the spine. It may occur only in the thoriac area or lumber, but in most of the cases in thoracolumbar area is affected from scoliosis. Treatment of scoliosis must be done in its initial stage. The treatment method of scoliosis depends on the degree of scoliosis. For detection of Scoliosis, authors used various methods viz. surface topology with non-rigid matching, the segmentation using mask based algorithm, surface trunk topology, independent component analysis. In this paper we analysis many different technique and method of detection of scoliosis. Different results are obtained from these methods.**

***Index Terms*—Image Processing, Mask Segmentation, Medical Imaging, Surface Topology, Trunk surface topology, Pattern Recognition Algorithm**

I. INTRODUCTION

The spine begins from the base of the skull to the pelvis. Spine protect our spinal cord and bear the body's weight. The spine, or vertebral column, is located centrally and posterior in the body. It is an important part of the body and has many functions. The spine is necessary for our body for providing structure, flexibility, support and movement. It acts as an attachment site for the muscles of the back, as well as the posterior ribs. The word scoliosis (say: sko-lee-oh-sis) derived from a Greek word whose meaning is crooked. Scoliosis means any lateral curvature of the spine. A small degree of lateral curvature does not cause any medical problems, larger curves can cause postural imbalance.

Scoliosis is a physical disorder in which a person's spine is curved from side to side. Although it is a typically complex three-dimensional deformity, on an x-ray, viewed from the rear, the spine of an individual with a typical scoliosis may look more like an "S" or a "C" than a straight line. Scoliosis is a condition which affects the spine's curve of many children, teenagers and adults. The human spine features many natural curvatures which help the body to move and be flexible. Scoliosis is not a disease but it is a descriptive term. Some curvature in the neck, upper trunk and lower trunk is normal. Humans need these spinal curves to help the upper body maintain proper balance and alignment over the pelvis. However, when there are abnormal side-to-side (lateral) curves in the spinal column, it is referred as scoliosis. A measurement used for evaluation of curves in scoliosis on an AP radiographic projection of the spine is Cobb angle. Scoliosis can be categorized into three types according to its severity: mild (Cobb angle is above 10 degrees); moderate (Cobb angle is above 20 degrees); and severe scoliosis (Cobb angle is above 70 degrees). Scoliosis is a painful spinal condition which usually found in young children that can have serious results if detected and cured in its early age. In order to overcome the increasing number of scoliosis cases, many schools have initiated to screen children for signs of this spinal deformity. Usually Scoliosis is detected through manual inspections of x-ray images by trained physicians, but this consumes more time, impractical and it is not also so much accurate to be applied in schools with a large student population [1]

II. DIAGNOSIS OF SCOLIOSIS

In most of the cases, visibility of the deformity is the only symptoms but in least cases of extreme long-standing scoliosis, the sharp angulations of the spinal cord over the apex of the curve may result in the interference with the cord functions, leading to neurological deflect. For proper assessment of scoliosis it is necessary of a full anterior-posterior X-ray of the spine in sloping and upright positions, plus a lateral view. The severity of the curve is measured by Cobb angle which is an angle between the lines passing through the margins of the vertebrae at the end of the curve shown in figure1. Another diagnosis method is Reisser's sign as shown in figure2 . In this the vertebrae fuses with the iliac bone at maturity and indicates the completion of growth, and thus no possibility of the curve worsening. Another diagnosis is Rotation of vertebrae of spine. Normally center of the vertebral body contains the spinous process but in case of scoliosis the spinous process is shifted to one side. Also there will be asymmetry in the position of the pedicles on the two sides[2].

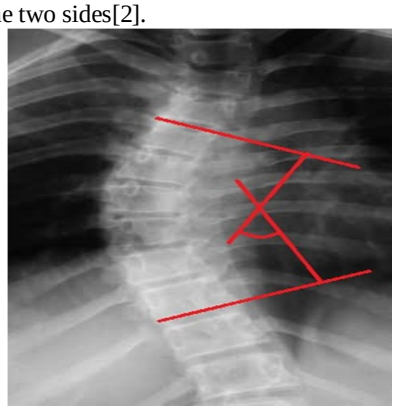

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Fig. 1 Cobb's angle

Fig.2 Riesser sign

Fig.3 Rotation of vertebrae

III. SUMMARY OF RESEARCH

According to [1] an alternative diagnosis which would be an automated scoliosis detection system it would not require the help of an orthopedist. An automated system of detection of scoliosis from x-ray images is proposed which have two methods. The first one approach utilizes an algorithm like edge detection and contrast stretching to present relevant information from the image needed in diagnosing scoliosis. The second method utilizes statistical methods to create junction points that can be treated as basis for approximating the required lines. A system is designed which generates a report of diagnosis of scoliosis from input x-ray images using the algorithms to test the efficiency of the algorithms. These tests contain estimation of the presence of scoliosis, and if detected the orientation and severity of the curvature. Scoliosis detection experimental results were 78.26% and 84.21% for low quality and high quality images for the feature extraction strategy. Detection rates for line approximation technique were 86.96% and 89.47% are achieved for low quality and high-quality images respectively [1].

In [3] author proposed algorithm to measure Cobb angle automatically using mask based segmentation algorithm. The Cobb angle measured by the expert and manually the algorithm were almost same with some difference of 3-4 degree [3].

According to [4], bone fracture detection is not well researched and published as compared to other areas in medical imaging. Approximation of the edges of long bones is determined by the Random, Hough transforms and clustering-based algorithms, it is used to segment X-ray bi-level or localized thresholding methods and the global segmentation algorithms. Bi-level thresholding categorize each pixel of the image as either a part of the background or as a part of the object. Clustering-based algorithms, based on a specified threshold. But sometimes the Global segmentation algorithms is better than clustering-based algorithm which take the whole image into consideration. Some methods like edge detection, region extraction and deformable models include Global segmentation algorithm This Research has been done by the National University of Singapore to segment and detect fractures in the thigh bone [4]. Canny algorithm for edge detection is used by Authors of [5] and modified Canny edge detector to detect the edges in the thigh bone to separate it from the X-ray. Segmentation of the X-ray done by using Snakes or Active Contour Models and Gradient Vector flow. In this 94.5% accuracy found according to the experiments done by the author. Author [6] is also used Canny edge detectors and Gradient Vector Flow.

In [7] least squares approach is used in novel non-rigid matching to model the surface deformations due to scoliosis with the help of new parameters (3 scales and 6 shears non rigid parameter) in the algorithm. Patient back scans are captured by the 3D laser scanner and then generated into surface topography. The system implemented on MATLAB in which surfaces are automatically matched by a new least squares non-rigid matching algorithm. The rigid algorithm does not compensate for the lack of matching the deformed areas but the non-rigid approach provides more credible matching results on the deformed areas [7].

Another system [8] to predict the scoliosis curve based on the analysis of the surface of the trunk. The deformity of spine is measured on several cross-sections of the trunk and described by the back surface rotation. The latter is acquired and reconstructed in 3D using a non invasive multi-head digitizing system. Scoliosis detection measured made by the trunk's surface in 72.2% cases correctly. Results show that BSR measured on 100 cross-sections of the trunk is a desirable feature for this classification problem [8]. Bio feedback sensor is proposed in paper [9] is to prevent the spinal deformity for further destruction but not to cure scoliosis. Biofeedback sensor is used which is connected to an alarm system through a wire placed at the back of the child suffering from juvenile or acquired scoliosis. The biofeedback sensor can be set to a particular angle around 15 degree when the child with scoliosis sways sideways from right to left during standing or walking above 15 degrees of bending sideways the alarm blows a sound

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to alert the child to be upright or stand straight [9]. Using ICA for scoliosis trunk deformities analysis in [10] describes Independent Component Analysis (ICA) for analyzing scoliosis trunk deformities. Methodology is first the independent components capture the local scoliosis deformities as the shoulder variation, the scapula asymmetry and the waist deformation then different scoliosis curve. Types are characterized by the combination of specific independent components. The local scoliosis deformities as the shoulder variation, the scapula asymmetry and the waist deformation are captured by the independent components [10].

IV. CONCLUSION

The Perfection of diagnosis degree in scoliosis can help in better treatment. The paper explores and discussed on various types of diagnosis like segmentation with mask algorithm, surface topology, trunk surface topology and pattern recognition. The algorithm after the review and analysis were founded that Cobb architecture to detect scoliosis is one among the best known in medical field till date. The future work can be further extended in modifying the existing algorithm and design some specific patters for enhanced diagnosis degree useful for scoliosis medical treatment.

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