Automating Scoliosis Analysis

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Abstract

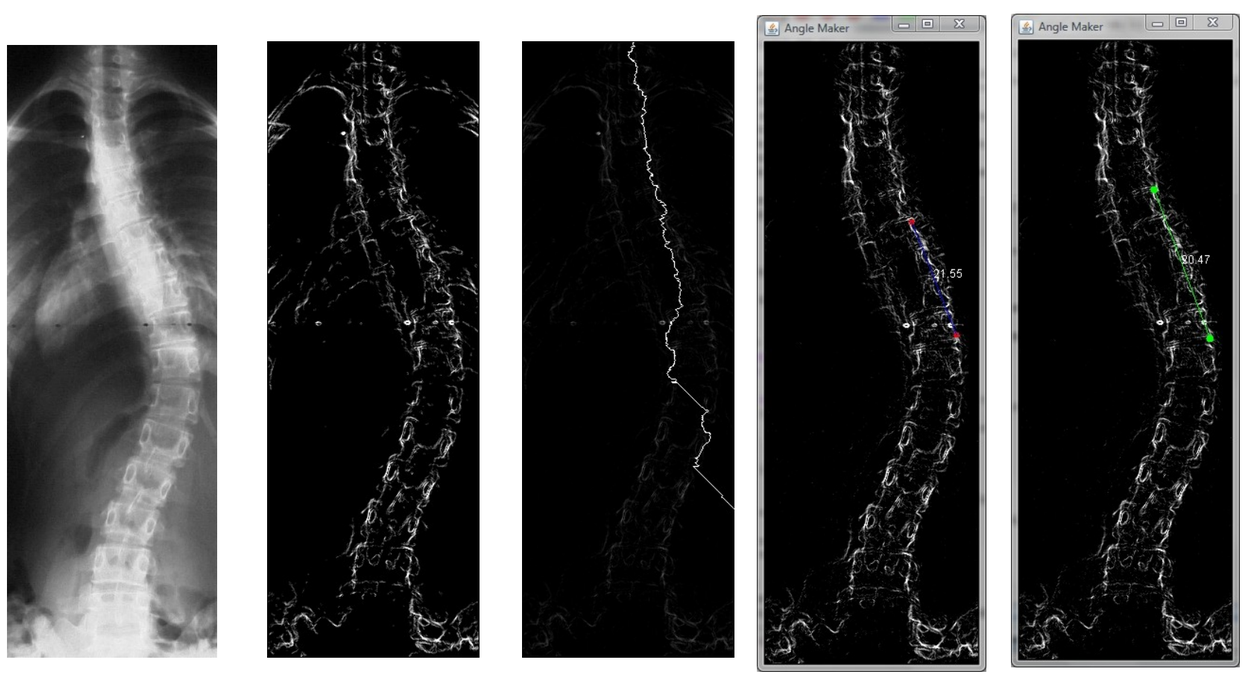
Scoliosis, or lateral curvature of the spine, is a health defect that starts showing signs often in early adolescence. Early and accurate diagnosis of this condition is most helpful in preventing its growth, and thus preventing the need for spinal surgery. One of the current processes to treat the curve is to manually measure the angles of the patient's curve(s) and then determine pressure points. My program will take an x-ray image file and automatically measure the angles and pressure points, and return this image to the user (presumably a doctor).

Procedures

My program takes in x-ray images and outputs modified versions of them. A user would be able to generate these images quickly and use them to analyze and utilize the results of the x-ray.
The main approach to the problem that I have used thus far is edge detection. There are multiple algorithms used for edge detection that differ in sensitivity and output appearance – I chose horizontal differencing and Sobel. Horizontal differencing judges from pixel to pixel, comparing the change in brightness. If there is a sharp jump it counts as an edge. The Sobel method combines horizontal and vertical differencing using gradient masks.

Background

People have tried different approaches to problems similar to the one I am working on. For example, one group of researchers used moire images of patients. backs to detect if they had scoliosis. The program, in the end, had an 88.2 percent rate of accuracy. This tells me that using moire images could be one approach to my problem as well. If I can find out how the authors detected scoliosis through the images, I could perhaps convert the x-ray to one and make more observations from the same findings.
The primary approach I have used to solve my problem so far is edge detection. I have mostly been using two specific edge detection algorithms: horizontal differencing and Robert's cross. In horizontal differencing, edge are determined by contrast from horizontally adjacent pixels.



Results & Conclusion

My program can reduce the noise of the initial x-ray and remove some extraneous parts of the original x-ray, making it easier for the user to use Phase 2. The second phase has a working GUI which can calculate angles from user-constructed lines and also make these lines "stick" to the x-ray for purposes of precision. A program that could automatically analyze an x-ray to detect whether or not the patient had scoliosis would probably require an edge detection algorithm made specifically for that purpose. However, for simply detecting the location of the spine in localized regions, existing algorithms work well.