TJHSST Computer Systems Lab Senior Research Project
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 patients 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).

Keywords: edge detection

1 Introduction - Elaboration on the problem statement, purpose, and project scope

1.1 Scope of Study

This project will require multiple x-ray images for testing the program on, as well as a knowledge of how scoliosis is diagnosed and how the x-rays are analyzed. I can obtain this information from research papers and my own

orthopedist. I may need to try multiple approaches to this, including edge detection and manipulating image files.

I plan to achieve a solution to scoliosis analysis with this project that is simpler and cheaper than existing solutions. If this project turns out to be a success, it would ease the lives of doctors and patients alike.

1.2 Expected results

With this program, I hope to achieve a new form (or at least improve on other forms) of spinal x-ray analysis, especially when dealing with scoliosis. Once completed, this program should be able to measure the angles of curve(s) of the scoliosis on the x-rays of afflicted patients and also output where to put pressure (with a back brace or such device) to best deal with scoliosis as the patient grows.

With this project, I hope to learn more about many methods of computer imaging, including manipulating various image formats, edge detection, and determining lines. The purpose of this project is to further my own knowledge, and perhaps even develop a new technique of x-ray analysis.

1.3 Type of research

My project is pure applied research. My program is made not only to learn about computer imaging, but also to directly to solve a problem.

2 Background and review of current literature and research

Currently, I know of two other ways to approach the problem I am trying to solve. In order to make a mold for the back brace, plaster of Paris must be applied to the patient and then must dry. After this, it is used as a mold around which a brace is built. This is a cheap but time-consuming process for both doctor and patient. The other approach is making a 3D model using a laser computer vision system. This saves time and effort for everybody involved but is a very costly method. /par Other methods have been developed to detect scoliosis, such as using moire images of the back of a patient to detect abnormalities. However, this method does not help

construct the back brace for treatment nor does it provide the doctor with angles of curvature. My approach will (if successful) achieve both these goals.

3 Procedures and Methodology

So far, I have written this project mostly in Java, but I do have one section in C (the primary edge detection). For this project, I will need x-ray images for testing. I can obtain these x-rays from both Google Images and my own orthopedist.

My program inputs x-ray images and outputs modified versions of them. A user would be able to generate these images quickly and use them to check the results of the x-ray. Since doctors would probably be using this program, they would get the initial input x-ray images from their lab.

Since my program directly writes into images and then saves them in separate files, I can just open these files to check for errors. As my program improves, I can also show my x-rays to my orthopedist to check whether I have the scientific information correct.

Currently I am using dynamic testing. I am inputting random x-ray images that I have found and looking at the visual output of my program. If there is a problem with my code, it shows up quite visibly in the output image, making my program easy to test.

Since this project is also intended to work in the medical field it must provide scientifically accurate output. This means that my algorithms must provide output that agrees with the current decisions made by doctors now. Namely, the points that my program indicates to be proper pressure points must be similar to what the doctor would concur with. Also, certain measurements (such as curvature angles) must be correct to the industry's set standards.

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. The two main algorithms that I have used are horizontal differencing and Robert's Cross. Horizontal differencing judges from pixel to pixel, comparing the change in brightness. If there is a sharp jump it counts as an edge.

4 Expected Results

Once I am done with this project, I wish to discover a new way to automate scoliosis treatment, or at least a segment of it. Once satisfactory, I will simply display my results as the input and output images used through each step of my program.