TJHSST Computer Systems Lab Senior Research Project Automating Scoliosis Analysis 2008-2009

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Abstract

My program will analyze a spinal x-ray for scoliosis in two phases. It will first take a spinal x-ray image file and detect the edges of the spine, isolating it from the rest of the x-ray. Then, that image is inputted into another program which can automatically measure the angles of curvature and points at which to apply pressure for optimum treatment. This second part of the program will have a GUI to allow manual user input as well.

Keywords: edge detection

1   Introduction

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 operate in two phases. The first phase will take an x-ray image file and execute certain algorithms on it to remove parts unnecessary

or hindering spinal analysis. The second phase will take the input from the first phase and automatically measure the angles and points at which to apply pressure for optimum treatment and return this image to the user (presumably a doctor). This will make optimum treatment of scoliosis a partially automated (and thus much easier) process for both the doctor and the patient.

2   Background

People have tried different approaches to problems similar to the one I am working on. For example, one group of researchers used moi 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 moir 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.

3   Development

So far, the primary approaches I have used for the first phase of my program are edge detection by horizontal differencing and with the Robert's cross algorithm. Since these approaches have been mainly unsuccessful, I plan on trying simpler methods to achieve the same goal. Instead of attempting to trace out the spine with edge detection, I will simply remove the ribcage from the picture and then find the rightmost and leftmost points. These will be the points at which the spine curves and thus where pressure should be applied for optimal treatment. Another feature I could add to my program is calculating the angles of curvature. I would use this by approximating edge detection and then measuring the angle between the two resulting lines.

In the second phase, I use edge detection for my semi-automatic detection mode. The edge detection I use in this phase is currently a crude approximation. It searches for the brightest pixel in a certain sized square centered

at the mouse and uses that as the point to click on for creating a line to determine an angle.

The input my program takes is the x-ray in a .pgm picture file format. In order to test my program, I just input the .pgm file I currently have and examine the final output using GIMP to view it. For the second phase of my program, I convert the output from the first phase to a .gif and use that as the input. To test the second phase, I simply open the program and test the features a user would use.