TJHSST Computer Systems Lab Senior Research Project
Analysis of Runner Biomechanics Through Edge Detection and Image Processing
2007-2008

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November 2, 2007

Abstract

The biomechanical features of a runner in an image can be analyzed by using certain image processing techniques, the primary method being edge detection. By constructing an accurate, two-dimensional model of a runners lower body from a rear angle, it is possible to extrapolate the underlying qualities of that runners biomechanics. This is done by creating an outline of a runner's lower leg and feet. An edge detection algorithim is applied on an image to create this outline. In this type of situation, algorithim speed is not a very relevant issue; accuracty is far more important, the reason being that you only need to analyze a few images to create a two dimensional model of the lower body, as well as the fact that the time it takes to analyze a runner does not directly affect his performace as a runner.

Keywords: Biomechanics, Running, Edge Detection, Image Processing

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

1.1 Scope of Study

The project will strictly be involved in analyzing images from a controled environment and determining biomechanical features from analysis of images. This means that the project will not be concerned with selecting images from a video feed or trying to analyize images taken in random and widely variying situations. For instance, it is expected that images will be taken from the back of a runner running on a labratory treadmill, not from a runner running in stormy weather in an urban environment, taken at an awkward camera angle. There is very little purpose in trying to determine the biomechanics of random people walking in the street, so focusing on controled environments makes the project much more feasible at almost no cost to applicability in the real word.

1.2 Expected results

The expected goal of this project is create a system that can acurately determine the biomechanical features of a runner and come up with a verdict concernign the efficiency and proper shoe type of the runner. The system is not designed to totally replace human analysis of runner biomechanics, but rather to assist human analysis and eliminate at least partially mistakes made in the human biomechancis analysis process.

1.3 Type of research

This project is pure applied research. The fundamentals of human biomechanics are already known. A lack of knowledge is not a problem that this project is proposing to address, rather, the project is addressing the problem of automatically determining variables in different situations and assisting current methods of a process that is already being conducted by humans.

2 Background and review of current literature and research

The aim of this project is largely unique in the acadmic world. However, the commercial sector has tackled this problem, but only because of motivation to sell more running shoes and increase profits. Fundamentally, this project is venturing into unknown territory. It is a melding of known information about biomechanics and edge detection and image processing techniques. Consiquently, the background of this project lies in two, distinctly different areas.

3 Procedures and Methodology

The first step in the process will be to get an outline of the lower leg and feet from an image. Once an outline is made, another algorithim will determine the straightness of the leg and foot seperately. Biomechanical features will be analyzed by determining the general angle of the lower ankle and foot and comparing it to the angle of the leg. Disparities in the two angles will conclude either pronation or supernation, depending on the sign of the angle difference.

4 Expected Results

This project is expected to create an overall algorithim that can analyze images of a runner under a controled environment and come up with a biomechanical fingerprint for the runner. The implication of the project is a new precedent for accurately determining proper shoe type for runners and preventing common injuries.