CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

S1413

Project Title

DermatoScan 2.0: Image Analysis Optimizations for the Early Detection of Skin Cancer

Abstract

Objectives/Goals

To develop a simple, responsive and reliable method of digitally assessing the risk of cancer in skin lesions using an iPhone app.

Methods/Materials

8 numerical methods were defined and implemented. An evolutionary machine learning algorithm was developed to optimize the weights of each factor in the analysis. A#Complexity# method was then developed and added to the original analysis network, increasing the sensitivity and specificity of the resulting assessments. Each feature extraction method was optimized and tested, yielding a 300% average acceleration with no loss of reliability. The methods were ported from C++ into Swift. A new class was created which incorporates many of the feature analysis processes and replaces the image manipulation functionality originally provided by OpenCV.

The app tested successfully on preloaded images, but analysis performance on an iPhone was extremely slow. A new user-interface was designed to allow the user to adjust three interactive parameters, enabling the user to limit the size, color-space and border isolation threshold of the captured image. When the iPhone camera failed to deliver reliable images, the app was tested against enlarged image samples displayed on a second computer screen.

Results

The analysis process consistently achieved better than 98% accuracy within its test sample image set. The embedded DermatoScan iPhone app achieved similar results when the iPhone camera captured enlarged images but could not achieve consistent results capturing actual size samples with the iPhone#s camera.

Conclusions/Discussion

This experiment was conducted over the course of a year, building on the work of my previous experiments, based on research over the previous year. The success of this demonstration supports two of the three components of the hypothesis. The code produced consistent and reliable results even after substantial optimization. Optimization efforts achieved a 3:1 average acceleration from the improved feature extraction methods and an additional 10:1 average acceleration from the user-guided optimizations.

The code was successfully translated and embedded in an iPhone app. The iPhone camera had difficulty focusing and the internal flash proved ineffective at such close range, but these issues might be mitigated in the future with additional image processing, an optical lens attachment or an alternative external camera device.

Summary Statement

I designed, developed and tested an iPhone app to record, analyze and assess the risk of malignancy in skin lesions.

Help Received

Help Received: My dermatologist initially explained the characteristics which commonly indicate malignancy. I showed DermatoScan to 2 engineers and a scientist at Amgen, who suggested a possible attachment to achieve a more consistent image with the iPhone camera. A family friend introduced me to