CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

34838

Project Title

An Inexpensive, Global, and Effective Means of Diagnosing Heart Disease via Computer Imaging

Abstract

Objectives/Goals

As per the World Health Organization factsheet No. 317, cardiovascular diseases, are the number one cause of death around the world and represent 30 % of deaths worldwide. Furthermore, The Centers for Medicare & Medicaid Services (CMS) report that further hospitalization for deteriorating heart conditions causes $12 Billion in potentially preventable healthcare costs in the US. The Jugular Venous Pulse (JVP) is one of the most critical indicators for cardiovascular diseases.
Currently, measuring JVP accurately is a complex and expensive process fraught with errors, requiring highly experienced physicians to differentiate between the jugular venous pulse and the carotid arterial pulse, identify the sternal notch, and use unwieldy rulers to correctly take JVP pressure. I set out to develop computer vision based diagnosis software that can offer this same diagnosis based just on the video of the neck of a patient.

Methods/Materials

My software utilizes a customized MATLAB Computer Vision algorithm, combining Optical Flow and Blob Analysis to isolate the biphasic pulse rhythm of the JVP and determine its presence on the neck. I constructed and refined a customized Optical Flow and Blob Analysis algorithm, preceded by heavy morphological post-processing. I created a JVP simulator system and then used it to test the software in various lighting conditions to ensure its success under the actual lighting conditions of a user. Finally, the software was tested on actual hospital patients and correctly identified the pulse.

Results

The software was tested using the JVP simulator under environments with a shadow, without a shadow, and with speckle noise and could detect the pulse successfully more than 90% of the time over 30 trials. The software was then used on actual hospital patients and has successfully detected the pulse.

Conclusions/Discussion

The immediate results of the software will allow patients to monitor their heart health on a more regular basis and would allow for a rapid response to deteriorating symptoms. This solution provides an inexpensive, fast, and global means of monitoring and managing cardiovascular health in even the remotest parts of the world. My software is patent pending.

Summary Statement

I created a software that utilizes a customized Optical Flow and Blob Analysis computer vision algorithm to detect the presence of the Jugular Venous Pulse (JVP) to diagnose heart disease from just a video of the neck.

Help Received

Recorded patients at the Stanford University School of Medicine during a paid internship with Professor Paul Wang. Feedback on software design and results by Professor Paul Wang and Dr. Jeffrey Caves at Stanford University. My parents helped with logistics and printing of documents.