



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Pranav Kakhandiki	Project Number S0815
Project Title Automated Diagnosis of Aortitis Using Machine Learning	
<p style="text-align: center;">Abstract</p> <p>Objectives Aortitis is a rare heart disease characterized by inflammation in the aorta. My goal is to create a reliable tool in diagnosing aortitis by developing an accurate machine learning algorithm to analyze CT scans of the heart. Specifically, the algorithm analyzes the aorta and determine whether it is inflamed. Aortitis frequently goes undiagnosed due to its rarity, so my program will assist doctors in diagnosing it early.</p> <p>Methods To store and compare the CT scans, the python program uses HOG (histogram of oriented gradients) descriptors. They store a histogram of gradients (consisting of x and y derivatives which have direction and magnitude), which is more efficient than storing the entire image because the useful data consists of abrupt changes in the derivatives. In the case of aortitis, likewise, the key difference between an inflamed aorta and a normal aorta would be an increased area with a lesser change in the derivative (due to the thickened aortic wall). For classification, Linear-SVC, an algorithm which establishes a hyperplane between clusters of data, was used. LinearSVC uses the parameters which the HOG descriptor provides to train the program and draw the hyperplane, effectively classifying each image as either having or not having an inflamed aorta. This unique combination of Linear-SVC and HOG descriptors is more accurate than generic deep learning models as it is customized and specific to aortitis.</p> <p>Results With an overall accuracy rate of 94% and a type II (false negative) error rate of only 1.4%, the algorithm proves to be effective. Using the program along with analyzing ESR and CRP levels (two tests in which the levels will be abnormally high in an aortitis patient) makes diagnosing aortitis reliable and less error-prone for doctors. Studies show ESR and CRP to be roughly 96% accurate, so just with my algorithm and these levels alone, Doctors can diagnose aortitis with a 99.8% accuracy.</p> <p>Conclusions I developed a unique and innovative machine learning algorithm which uses HOG descriptors to extract features and Linear-SVC to classify CT scans of the heart to determine whether the aorta is inflamed. In short, I constructed a computer vision program to accurately diagnose patients with aortitis, a rare heart disease. My project expands our horizons in the field of diagnosing rare diseases as well as developing unique machine learning models.</p>	
Summary Statement I developed a unique and novel machine learning algorithm to diagnose aortitis, a rare heart disease.	
Help Received My AP statistics teacher helped me with the 'Data Analysis' section of my project.	