



# CALIFORNIA STATE SCIENCE FAIR 2017 PROJECT SUMMARY

<b>Name(s)</b> <b>Patrick Liu</b>	<b>Project Number</b> <b>S1011</b>
<b>Project Title</b> <b>CordisX: Personalized Cardiac Monitor</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Nearly a fourth of the U.S. population suffers from cardiovascular diseases and require regular checkups with clinicians. CordisX aims to provide a cost-effective, personalized cardiac diagnosis system that integrates the hardware and software aspects of automated ECG interpretation and the monitoring of the correlation of heart rate and oxygen saturation data. The ECG signal is compared to a normal (baseline) database, while the heart rate/oxygen saturation system retrieves the user's age and gender for healthy ranges.</p> <p><b>Methods/Materials</b> Theorized relationship between heart rate and oxygen saturation, derived 'normal' range of vital data based on age/gender through experimental data set. Created LCD hardware interface for dual-sensor system, established Bluetooth link with self-made Android app for diagnosis based on age/gender. Researched automated ECG analysis and feature extractions, drew out data flow. Perfected circuit, displayed real-time ECG signal on JSCanvas and MATLAB. Machine learning technique for extraction of baseline features from MIT-BIH Database. Developed method to export data to MATLAB, and created algorithm to detrend and diagnose ECG signal through comparing wave components to baseline features.</p> <p><b>Results</b> The smoothing method in MATLAB resulted in efficient color-coded filtering of noise and variation in the ECG signal. Peak analysis techniques recognized different segments and peaks of the signal, but simulated irregular signals resulted in lack of signal component recognition in the output. An overall percentage error of 8.02% of my ECG signal compared to the database was calculated, proving the system's reliability. The dual-sensor system took around 30 seconds to stabilize its data, providing consistent general diagnoses.</p> <p><b>Conclusions/Discussion</b> The ECG analysis system proved to be useful in data transmission and recognition of the different components of an ECG wave. The MATLAB script filtered noise and produced a cleaner signal, recognizing different components of the ECG wave. In combination with the dual-sensor mobile system, the ECG analysis framework allows a user to better visualize his or her overall heart health through vital heart data and examinations of the ECG signal. A total cost of \$131 was calculated for CordisX, a midrange price compared to other cardiac monitors. However, its measurement capabilities and personalized diagnosis features outweighed other market devices.</p>	
<b>Summary Statement</b> In combination with a self-made ECG interpretation framework based on MATLAB, the dual-sensor system synced to a mobile application allows a user to better visualize overall heart health through diagnosis based on his or her age and gender.	
<b>Help Received</b> Dr. Zhaoxia Yu of UCI's Data Science Department provided me with insight into statistical analysis methods. Dr. James Li gave me general advice on my overall research process.	