Max Health: A Smart Textile Biosensor System for Remote Health Monitoring and Anomaly Detection

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The coronavirus pandemic has highlighted the need for remote health monitoring for chronic diseases. To help patients manage their conditions, a user-friendly smartphone application (with a smartwatch companion application) and clothing biosensor were developed to detect arrhythmias, measure glucose levels, detect neurological disorders, and predict asthma attack risk. The biosensor was comprised of a smart shirt to monitor electrocardiogram (ECG), seismocardiogram (SCG), and gyrocardiogram (GCG), and smart pants to monitor inertial measurement unit (IMU) data and extract gait characteristics. Three machine learning models were developed, trained, and tested. A multiclass support vector machine(SVM)uses cardiogram data to classify the user's heart rhythm as healthy, atrial fibrillation, atrial flutter, ventricular flutter, or ventricular tachycardia. A random forest regression model monitors glucose levels using cardiogram data and classifies the user's glucose level as healthy, hypoglycemic, or hyperglycemic. A random forest classification model uses gait analysis to classify the user's neurological condition as healthy, Parkinson's, Huntington's, or Amyotrophic Lateral Sclerosis. The models were tested on new data separate from the training data to eliminate overfitting the models. The arrhythmia classifier achieved 98% accuracy, glucose monitor accuracy of 93%, and neurological classifier accuracy of 100%.To predict asthma attack risk, a program was developed which extracts asthma trigger data from APIs and smartphone data and then uses it in a decision matrix risk assessment(DMRA)to predict low, medium, or high risk of suffering an asthma attack. These results are promising, as they indicate the system may be a viable solution for patients with chronic diseases.

Awards Won:

Third Award of $1,000

International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention