A Portable Optoelectronic Molecular Identification and Spectral Analysis System for Assessing the Quality, Safety, and Composition of Food and Pharmaceuticals Using Machine Learning

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Food safety, quality, and composition have become major health concerns with ingredients sourced globally to satisfy our ever increasing demand for packaged, pre-cooked, and fast food. The situation is worse in developing countries where adulteration in medicines/food/drinks cause serious ailments and death. Furthermore, information about composition of food is critical for maintaining a healthy diet, especially for diabetics. Commercially, near-infrared spectrometers are widely used for food quality control. However, spectrometers are large, expensive and lab-based, so they can't be used to check the quality of the things people eat or drink every day. My goal was to develop a low-cost, smartphone-connected spectrometer utilizing advances in microelectronic sensors and machine learning techniques to instantly analyze food/medicine quality and composition prior to ingestion. The components developed include: (1) Optoelectronic sensor and circuitry for scanning spectral fingerprints (2) Cloud-based reference spectral database to train machine learning models (3) Smartphone app to identify and match spectral fingerprints and predict the composition or quality of the sample. An affordable, compact spectrometer was successfully developed along with self-learning software that improves with every item scanned. The system is capable of detecting pharmaceutical adulteration and predicting ripeness, age, calories, sugar, etc. in food/drinks. The system can also be used for neuroimaging, urology, non-invasive blood-sugar monitoring, and internal injury detection for hemoglobin. This low-cost, smartphone peripheral device has the potential to enable non-invasive medical screening, eliminate food related health risks, and fundamentally improve the quality of life.

Awards Won:
International Council on Systems Engineering - INCOSE: First Award of $1,000