Development of a Fully Automated 3D-Printed IoT Sensor for Arsenic Detection in Groundwater

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The EPA's Safe Drinking Water Act establishes the Maximum Contaminant Level (MCL) for arsenic, the #1-ranked toxin, in public water systems. The limit was reduced from 50 ppb to 10 ppb because arsenic has been proven to cause cancers, skin and heart diseases, and other health defects. The MCL does not govern sources used by over 50 million people in the United States and 1.8 billion people worldwide who obtain water from ground-water and well-water sources. This leaves entire communities at risk for chronic and acute arsenic exposure The engineering goal is to build an automated, portable, IoT-based sensor for arsenic using a custom circuit board and original 3D-printed components. The primary advantages of this sensor are its cost-effectiveness, ease of operation and portability, and automatic and ongoing data storage in the cloud. The sensor, programmed in Python and C, utilizes a colorimetric technique for arsenic detection where the input is a mercury bromide test strip. Images are detected by an ArduCam, and the lighting is controlled by a custom LED Ring-Light board. A chemical reaction is mechanically performed using a chemical-holding puck, a reaction chamber, and a magnetic stirrer. Color values are converted into arsenic concentrations in ppb using an Arduino Pro Micro. The data is collected and stored in the cloud for easy access and ongoing comparative study of the arsenic levels by the Particle Electron. A sensor like this one is invaluable to researchers and laypersons alike, due to the low cost and ease of use.

Awards Won:

Second Award of $2,000

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Intel ISEF Category