DINE (Digitally INtegrated Environmental) Arduino Platform for Environmental Quality, Safety, and Health

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The Four-Corners region of the Desert Southwest is where much of the Diné (Navajo) population lives remotely, in traditional Hoghans. These Hoghans neither have running water nor electricity, and they are totally dependent upon wood fires for heating and cooking. This research consisted of four major portions. The first portion involved hardware-integration of an Arduino UNO, and three sensors: particulate matter (PM), temperature, and carbon monoxide. The second portion was programming the Arduino UNO to gather these PM data: 0.3, 0.5, 1.0, 2.5, 5, and 10 micrometers, as well as temperature (oF and oC) and carbon monoxide (PPM). The third portion was gathering data at 12 different locations at Navajo Preparatory School, Farmington, NM, and displaying that data on a laptop. This display included current values, averages, maximums, minimums, and sample number. The final portion was using Excel to least-squares fit an analytical model of the particulate matter as a function of count and particle size, and to calculate the correlation between the actual data and the model. Measuring ambient air and cross-correlating the analytical model of particulate matter with actual data was done at 12 locations. The results showed that a negative-exponential theoretical model A*exp(particle_size/tau) correlated with actual particulate matter counts at an astounding 99.74%-99.98% (where 100% represents a perfect correlation). This theoretical model and the data showed that it is the fine particulates, 0.3 micrometers, are the most prolific. These 0.3 micrometer particles can cause cancer, heart attacks, strokes, congestive heart failure, COPD, and nervous system problems.

Awards Won:
Arizona State University: Arizona State University ISEF Scholarship (valued at up to $52,000 each)
University of Arizona: Renewal Tuition Scholarship
International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention, a 1-year free student membership to the INCOSE, and free virtual admission to the 2022 International Symposium of the INCOSE