DustDuino: Developing a low-cost air pollution monitoring apparatus

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Extended Abstract

The goal of the DustDuino project is to create a low-cost airborne particulate matter (PM) monitoring device that can be used to collect indoor air pollution data in low resource environments. In developing countries, approximately three billion people rely on the burning of solid fuels (wood, animal dung, charcoal, and crop wastes) for their cooking and heating needs.[1] Burning these fuels without proper ventilation can result in major health problems, such as respiratory and cardiovascular diseases and cancer. To help alleviate this problem, students and faculty from Mercer University's Environmental Engineering department traveled to the Dominican Republic during the summer of 2017 as part of the University's Mercer on Mission Program to conduct qualitative indoor air quality surveys. In addition to conducting surveys, a team will return to the DR during summer 2018 to collect quantitative indoor PM data using the DustDuino sensors. In order to collect as much data as possible, multiple DustDuino sensors will be sited. The DustDuino sensors and the data that they provide are the first step toward creating cleaner cooking and heating solutions for rural communities in the Dominican Republic, which will help to reduce the health risks for these communities.

Each DustDuino device consists of a Shinyei PPD42 dust sensor module connected to an Arduino Uno microcontroller. The microcontroller outputs data from the sensor module to an external SD card. The unit is powered by a 20000mAh rechargeable battery and encased in a custom designed, modular housing made from ABS plastic. The modular design allows the components to be easily accessible for maintenance. The DustDuino sensors measure the PM_{10} counts (#particles/L) every thirty seconds. The devices were tested in several locations, including the roof of Mercer University's Engineering Building and in a chamber filled with heavy smoke from a controlled flame. An Omega HHTP21 Air Quality Monitor was used to verify particulate matter levels during many tests. The data were graphed using MS Excel.

The resulting graphs were analyzed to find trends in the local air quality. The particulate concentrations trended downward during the night, likely due to reduced traffic on the interstate approximately 0.4 miles from the testing location. The highest readings were approximately 450 to 500 pcs/L (around 9:00 in the morning), and the lowest readings were approximately 0.18 to 10 pcs/L (between noon and 2:00 PM). Data from the Dominican Republic trip field tests will be graphed and analyzed for patterns in much the same way as the Macon test data.

1. "Household air pollution and health." World Health Organization, Feb. 2016
        http://www.who.int/mediacentre/factsheets/fs292/en/. Accessed 21 Aug. 2017.