



Digital Particulate Sensor for Room Alert

ELECOMP Capstone Design Project 2018-2019

Sponsoring Company:

AVTECH Software, Inc.
16 Cutler Street, Cutler Mill
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<http://www.AVTECH.com>

Company Overview:

AVTECH Software (AVTECH), a private corporation founded in 1988, is a computer hardware and software developer and manufacturer. Our Room Alert ® products monitor computer rooms, data centers and other facilities for conditions such as temperature, humidity, power, flood / water leakage, smoke / fire, air flow, room entry, motion, cameras and more.

Device ManageR™ will automatically discover devices across the network, log and graph sensor data, alert users when environmental events occur or thresholds are passed, and allows reporting, auto response, and more. Automatic corrective actions resolve issues for a lights out response, allowing 'Disaster Prevention' instead of 'Disaster Recovery'.

Room Alert Accounts™ allows users to remotely manage Room Alert monitors. This powerful service allows access from any mobile or internet connected device. Room Alert Accounts will monitor, alert, log, graph, map, report and protect.

AVTECH has over 150,000 end users located in over 180 countries, including organizations in every industry and on every continent. AVTECH products are heavily used by the Fortune 1000, U.S. Government, U.S. Military, banking, telecommunications, energy, silicon and high tech manufacturing, pharmaceuticals, public utilities, defense contractors, publishing, education and organizations of all types and sizes.

(The project will be carried out at the Sponsor's Facility in Warren, RI. Team members must have their own transportation)



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Project Motivation:

Room Alert provides business continuity by notifying staff if environment extremes threaten their computers, facilities and other assets. Thirty percent (30%) of unexpected downtime for a small to mid-sized business is caused by environment factors. In the USA alone, that means that millions of businesses are impacted every year. Room Alert helps to monitor, alert, and ultimately prevent this downtime.

Dust and other airborne particulates can have a significant impact on other environment conditions and a facility as a whole. Not only can high levels of particulates impact workers' health, it can also cause premature wear on equipment, rapid filter clogs, and can even indicate that smoke or smoldering materials are present.

Adding an intelligent particulate sensor that can not only detect that particulates are present, but also dynamically detect and report changing particulate levels, will add significant value to Room Alert users and will provide new insights that could help reduce downtime and equipment damage.

Anticipated Best Outcome:

The anticipated best outcome is a fully-functional engineering prototype; composed of an electrical schematic, circuit board design, and a bill of materials that can be used to manufacture the product. All components and design choices should consider the eventual CE & FCC certification desired for this product. A mechanical enclosure design should also be included, and ideally would be tested with multiple variations that optimize air flow and particulate detection.



Project Details:

Overall system concept

Room Alert interfaces with digital sensors via a 1-wire protocol. This new sensor should output a 1-wire value that can be read by Room Alert with limited modification.

We suggest starting with a DS2438 - which Room Alert already supports - that can report a temperature value and analog reading between 0-5VDC. Following this initial guidance, the team would need to identify a particulate sensor that could be powered by a 5V source with <25mA, and ultimately output a value from 0-5VDC representing the amount of particulate in the air. This may require incorporating a microcontroller to act as a protocol interface.

Hardware/Electrical Tasks:

- Identify and test a particulate sensor and verify that it can be powered and interfaced with separately from the rest of the system.
- Determine what interface is required to be compatible with Room Alert.
- Determine what intermediate interface is required to convert existing output to be compatible with Room Alert.
- Develop a power budget and confirm that all components selected will work with the power available from a standard Room Alert.
- Schematic, breadboard and PCB design.

Firmware/Software/Computer Tasks

- Microcontroller interface between the particulate sensor and Room Alert.
- Calculation and output of appropriate scale representing typical and relevant particulate levels.
- Potentially work with Room Alert firmware in C to develop UI.

Composition of Team:

1 Electrical Engineer & 1 Computer Engineer, in addition to in-house AVTECH team.



Skills Required:

Electrical Engineering Skills Required:

- Analog and Digital Circuit Design
- Circuit board design (*preference will be given to seniors enrolled simultaneously in ELE391 Course on PCB Design, to be taught by Mike Smith*)
- Sensor module integration
- Some mechanical engineering design skills for enclosures

Computer Engineering Skills Required:

- Experience with embedded systems and low-level programming
- Logic analyzer and protocol analysis experience (e.g. I2C/SPI)
- Knowledge of Linux and C programming is desirable

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

One of the world's largest retailers has expressed specific interest in deploying a sensor like this in all of their warehouses and distribution facilities world-wide, which would likely require several thousand to tens of thousands of sensors depending on how many are required for each facility. At an estimated list price of \$145, this one customer represents significant revenue opportunity.

Broader Implications of the Best Outcome on the Company's Industry:

Most sensors are focused on reporting information about a very specific and distinct event: smoke detected, temperature > 75F, power on, etc.

With Room Alert, we're trying to move from "What", to "Why" and "What Next". The more context we can provide to our customers, the better decisions they can make and the more value they can receive from our products. This sensor provides another piece of the puzzle that could help customers understand why other conditions are impacting their facility. Is it too hot? Maybe the A/C failed because high levels of dust and particulates have clogged the filter prior to its annual maintenance? Warehouse employees calling out sick? Maybe high levels of particulates are a workplace hazard. This additional context has potentially significant applications across the industry by providing context and information that is not currently available.