

MACHINE LEARNING, CHEMICAL SENSORS, AND 3D-PRINTING TECHNOLOGY FOR PREVENTIVE CONSERVATION OF CULTURAL HERITAGE

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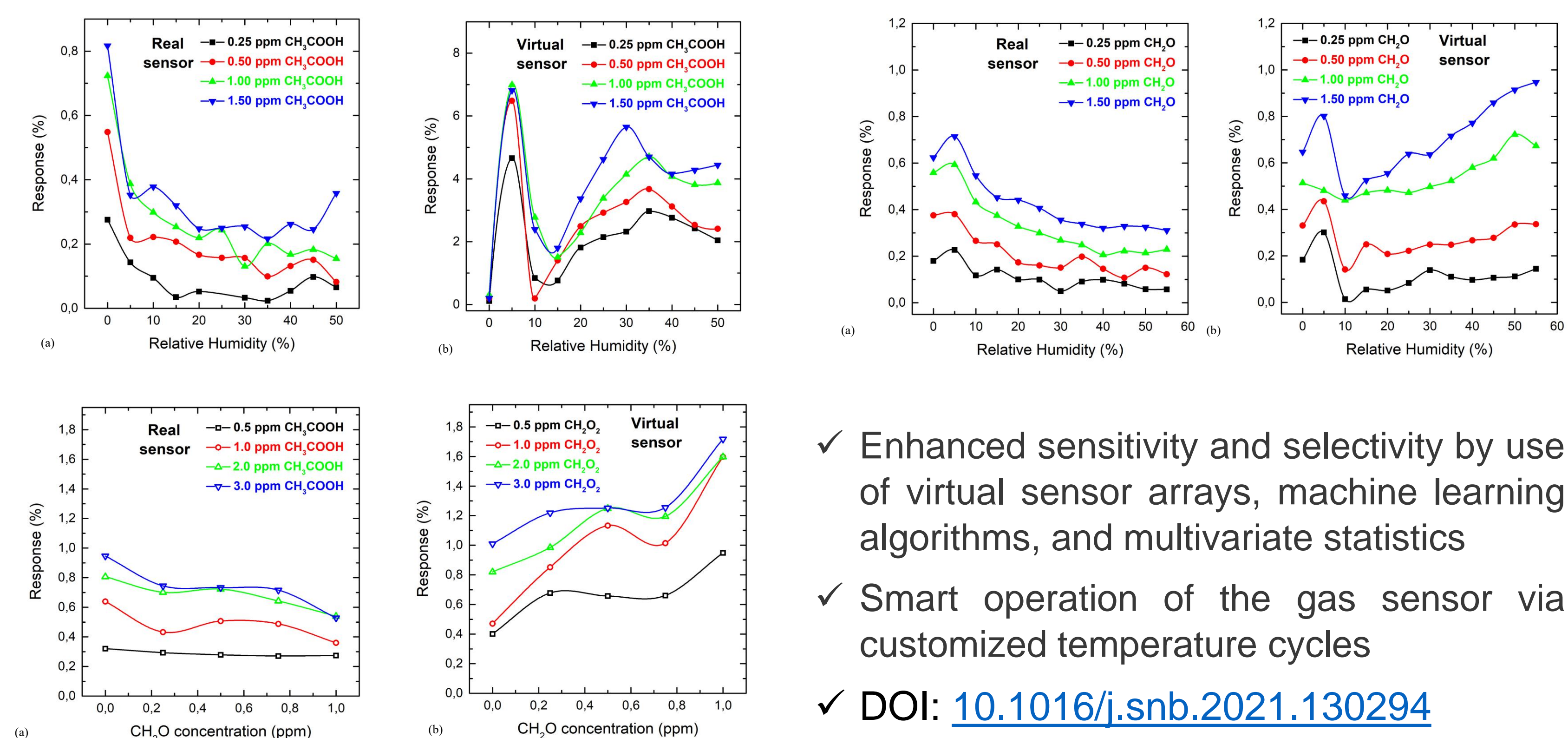
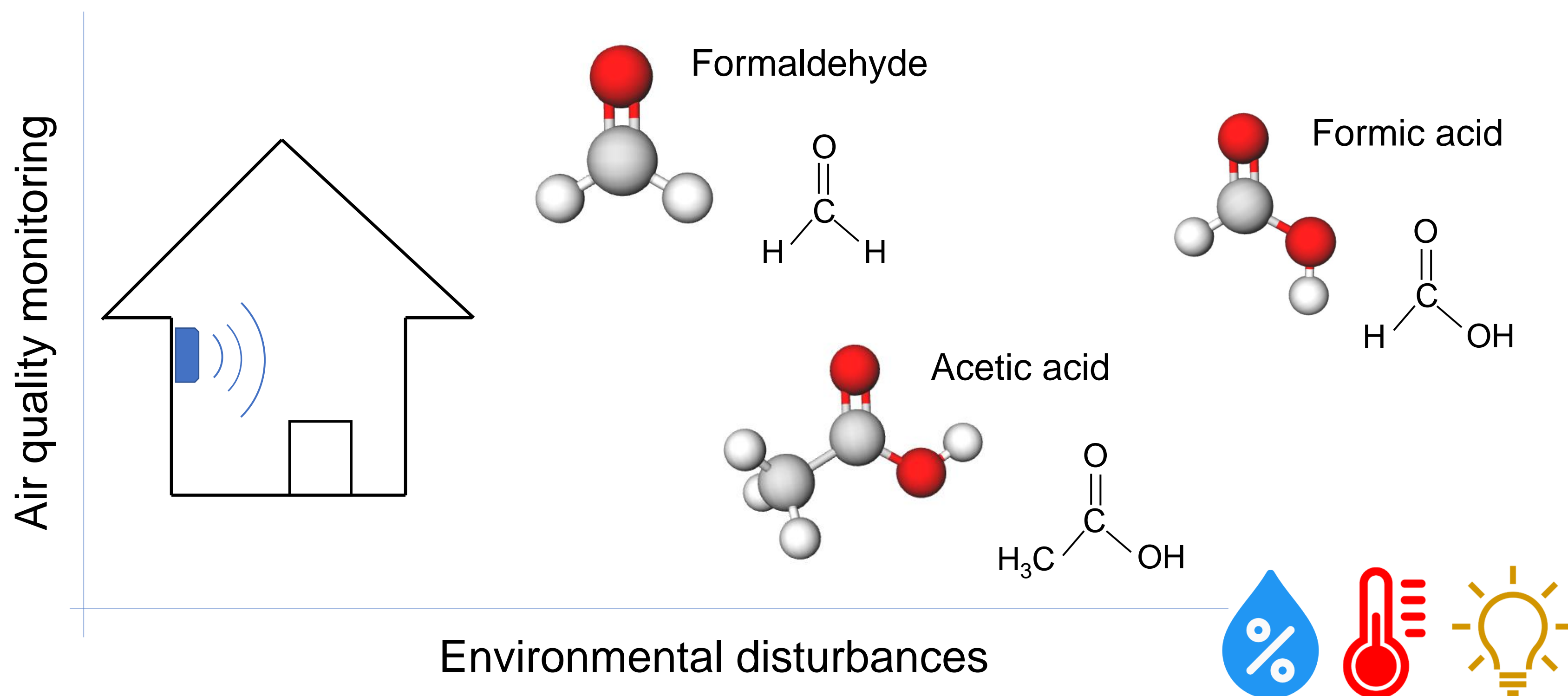
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INTRODUCTION

Environmental monitoring systems are used to ensure that artifacts and collections are always maintained in optimal conditions. The level of all volatile organic compounds (TVOC) is typically used as an indicator of overall air quality. However, TVOC have not been linked to any material damage. Formaldehyde, formic acid, and acetic acid are the primary organic carbonyl pollutants of concern for cultural heritage. As such, there is a strong demand to develop monitoring systems capable of discriminating and quantifying the presence of these pollutants to prevent or mitigate their adverse impact on cultural property.



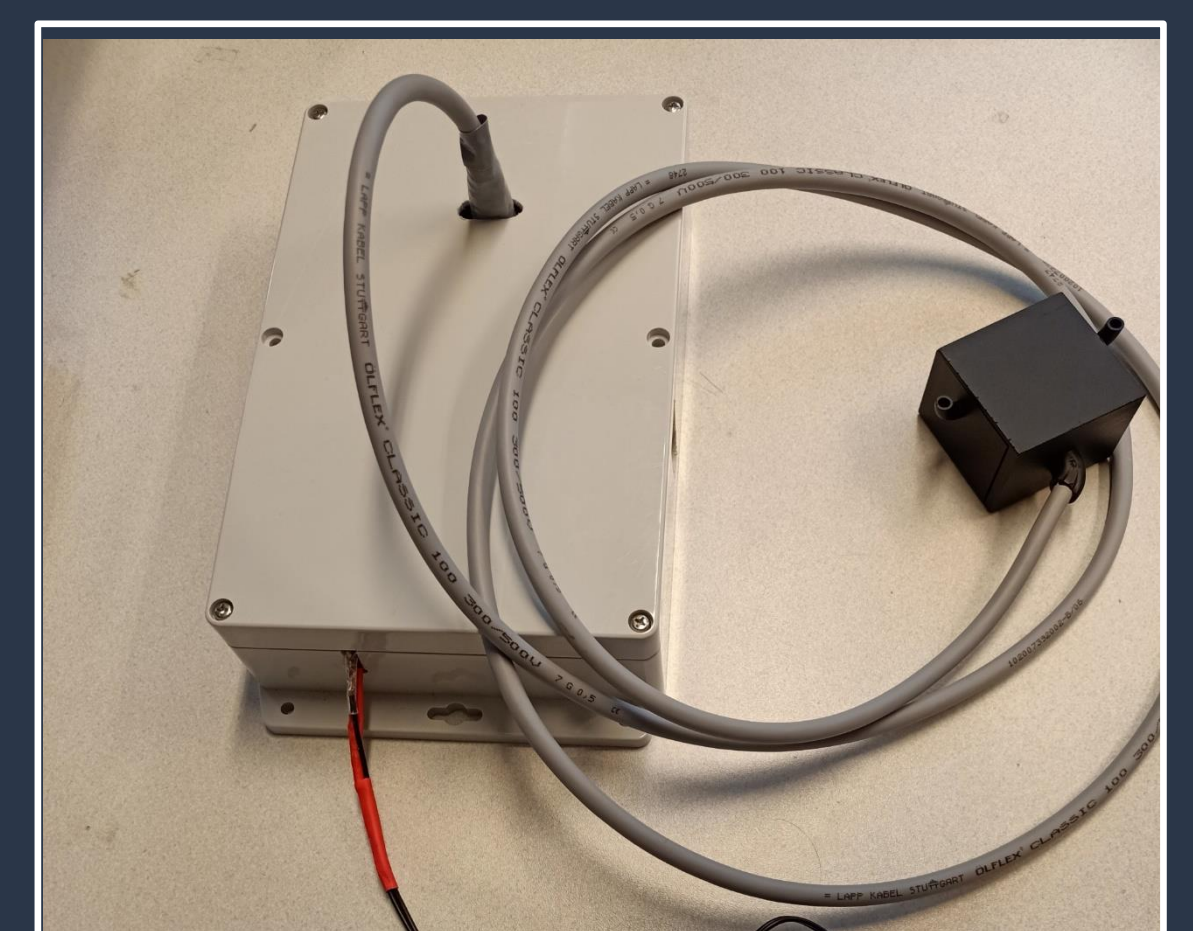
- ✓ Enhanced sensitivity and selectivity by use of virtual sensor arrays, machine learning algorithms, and multivariate statistics
- ✓ Smart operation of the gas sensor via customized temperature cycles
- ✓ DOI: [10.1016/j.snb.2021.130294](https://doi.org/10.1016/j.snb.2021.130294)

INNOVATION

Automated monitoring will offer museums and facility curators a proactive solution that implies better informed decisions alongside faster and easier protective measures.

RESULTS AND DISCUSSION

We present a cost-effective and user-friendly monitoring system prototype capable to detect formaldehyde, formic acid, and acetic acid in the measurement range 150 to 3000 parts per billion independently of relative humidity. An innovative sensor housing has been designed with 3D-printing technology to screen the gas sensor from environmental disturbances. Measurements can be evaluated in near real-time thanks to machine learning, cloud-based solutions and long-range wireless data transmission.



Technology development and demonstration in laboratory environment.