# Internet-Of-Things for The Twenty-First Century Archivist: Innovative Technologies for Environmental Monitoring

Pratt School of Information

Monica Maceli, Ph.D.

## Abstract

Environmental monitoring devices, commonly known as dataloggers, serve a vital purpose in archival organizations to ensure collections are preserved effectively. Prior research has identified several issues with the currently available commercial environmental monitoring systems, including prohibitive costs, lack of networked features, and inflexibility. This poster presents a research project exploring the suitability of popular Internet-of-Things devices, standards, and technologies, applied in the context of environmental monitoring needs of archivists.

## Background

Controlling environmental conditions is an important tool used in preserving collections, with building design and HVAC systems widely used to achieve the desired conditions. Tools used in conjunction with HVAC systems are independent datalogger devices, which store and monitor data such as temperature, relative humidity, light, and air quality. Commercial devices in this realm range from simple dataloggers with USB access to more complex and costly networked solutions that include WiFi or Bluetooth capabilities, with tools for reporting and data analysis.

## Motivation

A review of related literature and the findings of a focus group and usability testing [1,2] with archivists revealed problems with the available commercial dataloggers including: difficulty monitoring collections that are housed off-site, budgeting for costly devices, excessive time spent in collecting data by hand from dozens of devices, and maintaining devices that are unable to be recalibrated easily. To explore alternative approaches, the prototype system presented here was developed for cultural heritage organizations desiring a fuller-featured, lower cost environmental monitoring system based on popular, open source Internet-of-Things technologies (described further in [3]).

ARCHIVES RECORDS 2020 SAA | CoSA

Creating Our Future

## System Developed

**Environmental Monitoring System Design**

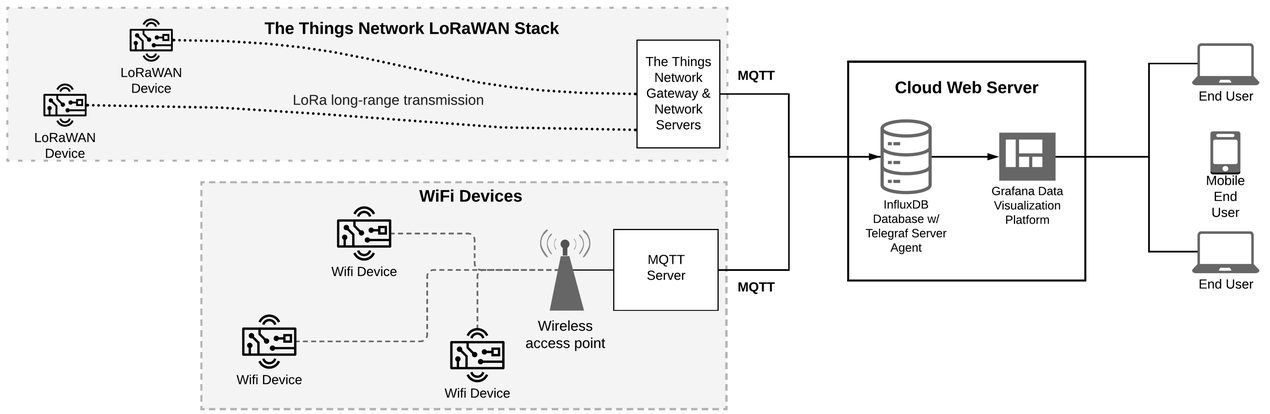


Figure 1: Diagram of the environmental monitoring system design, based on both WiFi network and long-range Internet-of-Things technologies.

The environmental monitoring system developed (Figure 1, above) consisted of several battery-powered devices, outfitted with temperature/humidity sensors, constructed of either WiFi-capable microcontrollers for shorter-range or LoRaWAN®-capable microcontrollers for longer-range (Figure 2, right). The free Things Network LoRaWAN cloud and Adafruit.io MQTT server were used to collect the device data and transmit it across the wider Internet using MQTT to an InfluxDB database for storage and data visualization on a cloud server.

The user interface – *a data dashboard* – was created using the built-in visual design tools within the Grafana platform, which allows for a drag-and-drop means of adding charts and other dashboard elements. A home screen (Figure 3, right) provided users with a high-level overview of the system and individual device's status.

## Findings

The data dashboard was usability tested with archivists and generally found to be efficient and easy to use; there were several problems identified that require further development and evaluation, some of which may be more technically challenging than reasonable to expect from archivists. The system will be revised to correct the usability problems and next employed in a case study approach as described in the future work section.

## Future Work

The system prototype will next be deployed in cultural heritage organizations, including an art library and museum, for longer-term testing. This will include revisions to the design and features based on end-user feedback, as well as continued support for WiFi and LoRaWAN devices for greater range.

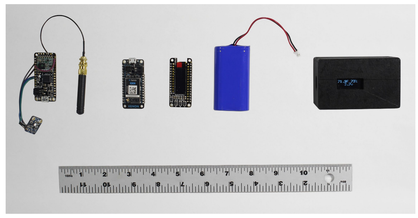

Figure 2: Components of the microcontroller-based data collection devices

Figure 3: Web-accessible data dashboard with several devices placed in multiple locations

## References

1. Maceli, M. & Yu, K. (2020). Usability Evaluation of an Open Source Environmental Monitoring Data Dashboard for Archivists. *Archival Science*. DOI= https://doi.org/10.1007/s10502-020-09340-1
2. Maceli, M., Villaespesa, E. & Adams, A. (2019). Environmental Monitoring of Archival Collections: An Exploratory Study of Professionals' Data Monitoring Dashboard Needs and Related Challenges. In *Proceedings of the 2019 iConference*. Springer. DOI= https://doi.org/10.1007/978-3-030-15742-5_73
3. Maceli, M. (2020). Internet of things in the archives: novel tools for environmental monitoring of archival collections. *Records Management Journal*, Vol. ahead-of-print No. ahead-of-print. DOI= https://doi.org/10.1108/RMJ-08-2019-0046