Wireless Environmental Monitoring: Is it right for you?

Rachael Perkins Arenstein, A.M. Art Conservation, LLC
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Introduction

Conserve O’Gram

Comparing Temperature and Relative Humidity Dataloggers for Museum Monitoring

Introduction

Dataloggers are battery powered devices equipped with sensors and a microprocessor to monitor and record data such as temperature (T) and relative humidity (RH). They log, store, and display readings in either digital or analog form. Dataloggers are typically used to record environmental conditions over time and are often used to monitor climate chambers, growth rooms, or other controlled environments.

This Conserve O’Gram compares several dataloggers and discusses selection criteria focusing on stand-alone devices (those operating independently) rather than networked systems that provide real-time data using wireless or hard-wired technologies. The accompanying tables list basic hardware specifications (Table 1), and software information (Table 2) for the 16 dataloggers evaluated.

Operating Range

The operating range of a datalogger is determined by sensor type and quality. Manufacturers specify range using different terms (e.g., operating, working, display), so some users may be unclear as to which test method is most applicable. Specified ranges are generally the physical limits to which a sensor can be exposed, and manufacturers typically recommend a working range for the device. All the logged hard line functional ranges beyond the parameters expressed in a collection environment should be avoided. A few do not function well at low RH (under 20%).

Table 1

<table>
<thead>
<tr>
<th>Datalogger Brand</th>
<th>Model</th>
<th>Range T (°C)</th>
<th>Range RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataLoggers</td>
<td>D120</td>
<td>-20 to 70</td>
<td>0 to 95</td>
</tr>
<tr>
<td>Relative</td>
<td>RH50</td>
<td>-10 to 50</td>
<td>10 to 90</td>
</tr>
<tr>
<td>Instruments</td>
<td>T-RH1</td>
<td>-15 to 75</td>
<td>20 to 80</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Datalogger Brand</th>
<th>Model</th>
<th>Operating System</th>
<th>Memory</th>
<th>Battery Life</th>
<th>Software Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataLoggers</td>
<td>D120</td>
<td>Windows</td>
<td>16 GB</td>
<td>10 hours</td>
<td>Data analysis</td>
</tr>
<tr>
<td>Relative</td>
<td>RH50</td>
<td>Linux</td>
<td>8 GB</td>
<td>8 hours</td>
<td>Logging</td>
</tr>
<tr>
<td>Instruments</td>
<td>T-RH1</td>
<td>Mac OS X</td>
<td>4 GB</td>
<td>6 hours</td>
<td>Monitoring</td>
</tr>
</tbody>
</table>

Maintenance and Calibration

Information was obtained from publication sheets or manufacturer’s websites. Maintenance or calibration is provided in the manufacturers’ specifications. For a complete list of maintenance requirements, please refer to the manufacturer’s documentation.
Why Monitor?

• Document and record the environment
  • Preservation analysis for items or collections
  • Space conditions
  • Seasonal trends
  • Building characteristics

• Basis of management decisions
  • Performance of AHU
  • Malfunctions
  • Improvements and optimization
What to Monitor?

We concentrate on T & RH

- Heat and humidity are primary drivers of decay
- Relates directly to the HVAC operation
Overview of Hardware Options

- Hygrometers
- Hygrothermographs
- Building management systems
- Dataloggers
- Connected systems
Hardware: Hygrometers

- Traditional monitoring device
- Difficult to examine long-term trends or statistically analyze data
- Precludes use of data in computational tools
Hardware: Hygrothermographs

• Traditional monitoring device
• Difficult to examine long-term trends or statistically analyze data
• Precludes use of data in computational tools
Hardware: Building Management Systems

- Separate, proprietary, secure
- BMS is control, not analysis
- Requires large commitment of facilities staff time
- But, still can have its place
Hardware: Dataloggers

• Electronic devices that measure T & RH for graphing and analysis on computer
• Most popular and practical
### Standalone loggers

<table>
<thead>
<tr>
<th>Stand-Alone</th>
<th>Direct</th>
<th>Indirect</th>
<th>Wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB Port</td>
<td>Flash Drive</td>
<td>IR</td>
<td></td>
</tr>
<tr>
<td>USB Cable</td>
<td>Data Card</td>
<td>Radio</td>
<td></td>
</tr>
<tr>
<td>USB Cradle</td>
<td>Handheld</td>
<td>WiFi</td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>Computer</td>
<td>Bluetooth</td>
<td></td>
</tr>
<tr>
<td>Handheld</td>
<td></td>
<td>RFID</td>
<td></td>
</tr>
<tr>
<td>Smart Phone/Tablet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>Cloud</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Connected Systems

- Wired (Ethernet)
  - Local Network
  - Cloud

- Wireless
  - WiFi
  - Radio
  - Cellular
    - Local Network
    - Computer
    - Cloud

- Receiver
  - USB
  - Ethernet
    - Computer
    - Local Network
    - Cloud
  - WiFi
  - Cellular
Costs

- Viable loggers range in cost from approx. $70 to $900.
- There is a reason why loggers are priced the way they are.
- Do not expect an inexpensive product to perform the same as a high-end product.
- There are uses for both ends of the spectrum.
- Don’t be penny wise and pound foolish.

http://www.cr.nps.gov/museum/publications/conservogram/03-03.pdf
Hardware Specifications

Still Critical
- Operating Range
- Accuracy
- Calibration
- Power Source / Battery Life
- Sampling Rate
- Size Appearance and Construction
- Alerts / Alarms

Less Critical?
- Memory Capacity / Run Time
- Probe
- Display
- Start/Stop Options

Newly Critical
- Transmission
Software Considerations

• Data retrieval options
• Software platform compatibility
• Formats for data and graphs
• Data viewing and analysis options
• Graph modification options
• Customer Service & Technical Support
Terminology

• **Wireless** – “having no wires” but in the technology world describes any network where there is no physical connection between the sender and receiver.

• **Cloud** – shared computing resources on demand rather than using local servers or devices to handle applications. “THE cloud” = “the Internet”
Terminology

• **Wi-Fi** – a popular networking technology that uses radio waves to provide wireless high-speed network connections.

• **Network** – computers that are linked together into a system. A LAN or *local-area network* generally describes a system in a single building using *Ethernet*. 
• **RF** – *radio frequency*, is any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current reaches an antenna, an electromagnetic field is created that can propagate through space.
Terminology

• **Bluetooth** – a short-range radio technology aimed at simplifying communications between devices.

• **NFC** – *Near Field Communication* is a technology that enables convenient short-range communication between electronic devices.
Terminology

• **Cellular**
  - GSM - *Global System for Mobile Communications*
  - CDMA - *Code-Division Multiple Access*
  - GPRS - *General Packet Radio Service*

• **Infrared** – also sometimes seen as “IrDA” short for *Infrared Data Association*, a group of device manufacturers that developed a standard for transmitting data via infrared light waves.

• **RFID** – *Radio Frequency Identification* is a short-range radio technology aimed at simplifying communications among devices.
What to Choose?
RTR-500 Series loggers

Unique in the industry, T&D offers a line of 5 Wireless Data Collectors to meet specific needs.
TR-7 Series
Testo Saveris2

**Saveris 2 Basic**
- Measuring cycle: 15 min
- Data storage: 3 Months
- User: max. 1
- Alarm by e-mail

**Number of WiFi data loggers**
Unlimited

**Term and payment interval**
This license is free of charge

**Total price: 0.0 USD**

**You will receive your invoice in your country’s currency, additional local taxes may be charged extra.**

**Saveris 2 Advanced**
- Measuring cycle: 1 min - 24 h
- Data storage: 12 Months
- User: max. 10
- Alarm by e-mail and SMS

**Number of WiFi data loggers**
- Minus
- 2
- Plus

**Term and payment interval**
- 12 Months 17.60 USD / Year
- 24 Months 30.80 USD / Years
- 36 Months 39.60 USD / Years

**Automatic license renewal**

**Total price: 35.20 USD**

**You will receive your invoice in your country’s currency, additional local taxes may be charged extra.**
Lascar EL-WiFi-TH and TH+
EasyLog WiFi Software
Onset Bluetooth Temp/RH MX1101
Lascar EL-BT-2 Bluetooth Wireless Temperature and Humidity Data Logger
GR4 Series

- Bluetooth logger
- Phone or tablet app
- Expected early 2017
RADIO
Hanwell

- Smart Receiver - SR2
- ML4000RHT Humidity series sensors
- Repeater
- Synergy Software
Eltek GenII Wireless Logging System
Onset Hobo ZW Data Nodes
Log-EZ RTR322
DIY Options

Registrar Trek Blog by Angela Kipp
http://world.museumsprojekte.de/
Reasons To Use Wireless Or Connected Systems

• Real-time data
• Off-site locations
• Lots of data
• Enclosed spaces
Are you ready for a connected system?

• How many spaces are you monitoring?
• Do you have the budget?
• Do you have a robust network in your institution?
• Do you have an IT person/department?
  • Are they on board?
• What is your building construction?
• Are you ready to keep up with the costs?
Troubleshooting Wireless & Connected Systems

- Building construction
  - Metal
  - Concrete
  - Other wireless devices e.g. wireless phones
  - Other “noisy” devices e.g. fluorescent lights
- IT knowledge and support
- Device compatibility
- Firmware updates
Guidelines: Logger Locations & Coverage

- No magical number of monitors/locations
- Monitor what YOU need to know
- Wherever there is reason to believe conditions may differ
  - Source of heat, cold, moisture
What are you monitoring?

What have you been monitoring with your loggers or networked systems?

- Climate controlled...
- Non-climate controlled...
- Inside a display cases
- Conditions during travel...
- Inside HVAC ducts
- Exterior environment
- Off-site storage...

Answered: 19    Skipped: 4
Guidelines: Logger Placement

• Amidst collections or in display
• 4-6 feet from floor
• Accessible for downloading
• Away from HVAC supply ducts
Guidelines: Data Management

- Data should be examined regularly
  - Monthly
  - Seasonal
  - Anomalies or emergencies
- Data should be easily accessible
  - Backup to network/dedicated folder
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Rachael Perkins Arenstein

www.AMArtConservation.com
rachael@amartconservation.com