PK-04: A Robust, Inexpensive Solution for **Alarm Monitoring** of Freezers, Incubators, and Other Biobank Equipment Based on Readily Available, Easy to Deploy **Home Alarm Equipment**

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Summary

- Biobank equipment monitoring is IMPERATIVE for sample protection
  - ... freezers
  - ... incubators
  - ... cold rooms
- Bespoke alarm systems...
  - ... are expensive
  - ... often become obsolete
  - ... often are hard to maintain

- In contrast, "**Home" alarm systems**...
  - ... are inexpensive
  - ... are robust against silent failure (power outage, cut wires, failed control unit will all alarm)
  - ... integrate well to email/SMS
  - ... provide apps for remote monitoring

- Home alarm system feature gaps
  - ... does not provide temperature logging (but does provide event logging)
  - ... can be tricky to integrate with equipment that does not have contact relays

In this poster, we highlight the logistics of deployment and features for this robust alternative.

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Friday, May 5th, 7:45a-8:45a

Introduction: Equipment monitoring plays a vital role in specimen storage infrastructure, however, the bespoke nature of these solutions often result in significant expense as well as short operational lifespans.. Surprisingly, residential burglar alarms offer various features that make them highly desirable for professional biorepository monitoring applications. Their robust design, built to withstand adversarial attacks, ensures no silent failures. Moreover, their reliable 24/7 operation is based on well-supported technology that has been in use for decades. These alarm systems can also provide automated alerts, such as email or SMS, and be integrated with call centers featuring tailored phone trees.

Process:

1) **Assess**. How many devices do you need sensors for, will they all fit in range or will you need range extenders (Figure 1)? Does your equipment provide alarm relay contacts (see Figure 2)? Do you desire monitoring? if so, will you use WiFi or Cellular connectivity?

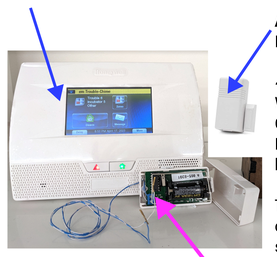
2) **Acquire hardware**. We have the most experience with the Honeywell 5800 series of sensors and panels (Figure 1) such as the 5816 sensors and the LYNX 5210 panel. Other equipment will work; the key elements are as follows: The sensors must be compatible with the panel. The sensors must have a hard wired contact pair that can be wired to the equipment relays (Figures 1,2). The panel must support communication to a monitoring station and you must set up monitoring service (typically $10-$30/ month).

3) **Configure Panel**. Connect panel to WiFi/Cellular. Pair panel to the sensors and program the sensors (Figure 3).

4) **Download App/Configure your account**. With self-monitoring events are only sent electronically. With active-monitoring, events will trigger a person in a call center to try to make contact with individuals. We use **self-monitoring** and route our messages to SMS and email (Figure 4) and use the **app** to perform **real time**

Resideo/Honeywell L5210 LYNX Touch
Alarm Control Unit

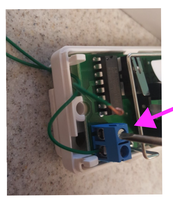
~$300
Wireless (345 MHz)
AC Power with Battery Backup
Communicates to Central Monitoring via WiFi or Cellular



Ademco/Honeywell 5816WMWH
Door/Window Transmitter

~$35
Wireless (345 MHz)
CR123 Battery (up to 5+ years)
Long Range (up to 1/2 mile (0.8 km))

These window/door sensors are commonly used in alarm systems, with the sensor on the frame and the magnet on the window/door. If the magnet moves, the alarm goes off.



However, these devices also have a **second integrated zone**, in which an alarm can be triggered by "breaking" the loop of wire connected to the posts, as can be done with the Normally Closed **(N.C.) alarm contact** on a freezer.

* Note this workflow is compatible with the more current PROA7C panel with the SiXCT sensors (which also have the hard wired loop) as well as the older 5800 series panels.

Figure 1: Example Core Technology

A

Laboratory freezers, incubators and other such equipment (e.g. A) can be programmed to alarm when they are outside of specified operational parameters.

Most such devices also provide "**contact closure**" or "**relay contact**" points to which you can connect. These relay contacts are linked to the alarm state of the device. When the device is **not** in alarm, a **normally closed** contact pair (B, between **NC** and **COM**) will appear as a short. A **normally open** pair will appear as electrically disconnected (B, between **NO** and **COM**).

B

When the device goes into alarm, the relay will reverse state (i.e., a short will become open). **By connecting the NC terminals to the 5816 terminals, the home-alarm system zone will go into fault when the equipment goes into alarm**. Because "normal" is the shorted/closed state, it will also go into fault if the wire accidentally gets unplugged or if the equipment loses power.

C

Note that the appearance of the terminals can vary greatly and may require examination of the documentation to determine the N.C. terminals (e.g. D)

D

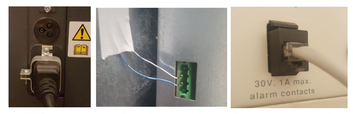
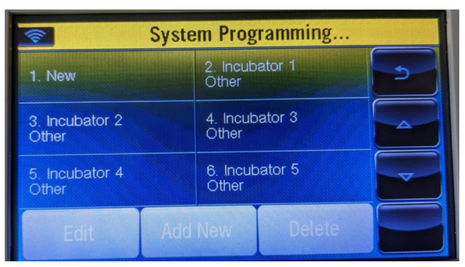


Figure 2: Basic Sensor Integration

A

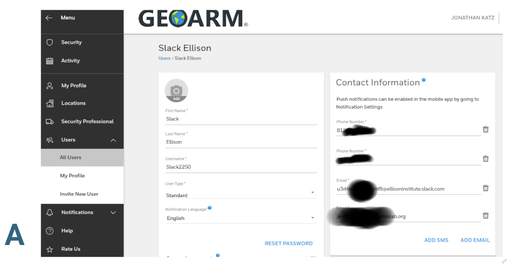


B

Zone programming requires pairing the individual sensors to the panel (A, "Add New"). After the sensor is paired, there are several configurations you will want to set (see panel B), specifically, you will want to **set the name** in the Zone Description (e..g, Incubator 5) and you will want to change the **loop number** to match the "wired" loop (e.g. "1") and you will want to set the **response type** to alarm even if the system is disarmed (e.g., "Day / Night").

Figure 3: Zone Programming

A



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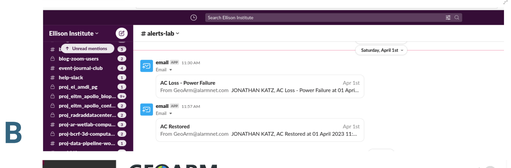

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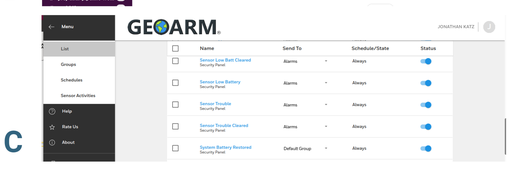
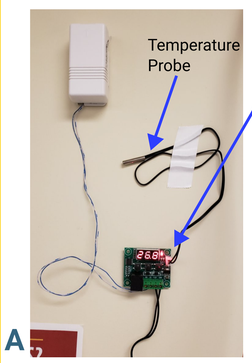


Via the web interface, you can configure which alerts you want sent to which "users". In A, direct messages go to multiple users through SMS and email. Note the email account linked to a "slack channel" (shown in B). We use Slack as a way to provide a general alerting mechanism and coordinate our response. The "Day/Night Zone" produces a trouble condition if the sensor is activated while the system is disarmed. Panel C.shows how to set sensor "trouble" states to produce alerts.

Figure 4: Alert Configuration

A



B

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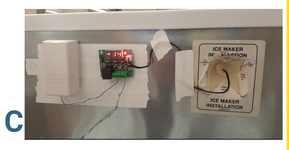

Any hardware with "relay contact" functionality can be integrated into the system. Here, several **thermostat module devices**, acquired for approximately $5/ea from eBay, are utilized for various temperature monitoring purposes.

These modules are designed to control heating or cooling elements. In Scenario A, the device is set as a "heater" at 28 °C. It closes the contact relay to "turn on the heater," -- this does nothing -- but if the room temperature reaches 28 °C, the relay will open to "turn off the heater," triggering an alarm. In Scenario B, the probe is placed inside a cold room with the heater set for 6 °C. In Scenario C, the probe is run through an "ice maker" port in a residential freezer and set for -10 °C, which must be maintained for 10 minutes before the relay closes— this delay is a setting on the thermostat module.

Figure 5: Adding Alarm Functionality

Conclusions/Practical Observations:

We implemented a monitoring system for 11 incubators, 7 -80 °C freezers, 3 refrigerators, a cold room, and an equipment room (see Figure 5 for the latter devices). This solution had an initial cost of **approximately $500 and a monthly fee of $10**, which covered the connectivity between our panel and the self-monitoring service. The alert mechanisms, including **SLACK, email, and SMS**, have proven to be robust and reliable. Over eight years, no failures of monitored devices have gone unnoticed. In academic settings like UCLA, CSHS, and USC, departmental resources are often insufficient for maintaining commercial solutions. This system was initially deployed at USC when $20,000 was unavailable to repair their failed monitoring system.

Limitations: This solution is uncertified and does not provide temperature logging. However, considering its cost and features, it offers very accessible biospecimen protection.

Source: The equipment mentioned in this poster, without endorsement, can be found on websites such as **www.alarmgrid.com** and **www.geoarm.com**. As of the time of writing, SimplySafe and Ring do not offer the necessary connectivity to implement this solution.

A reprint of this poster, along with additional details and comments, can be accessed at:

https://reprints.katzlab.org/isber-2023-alarm/

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