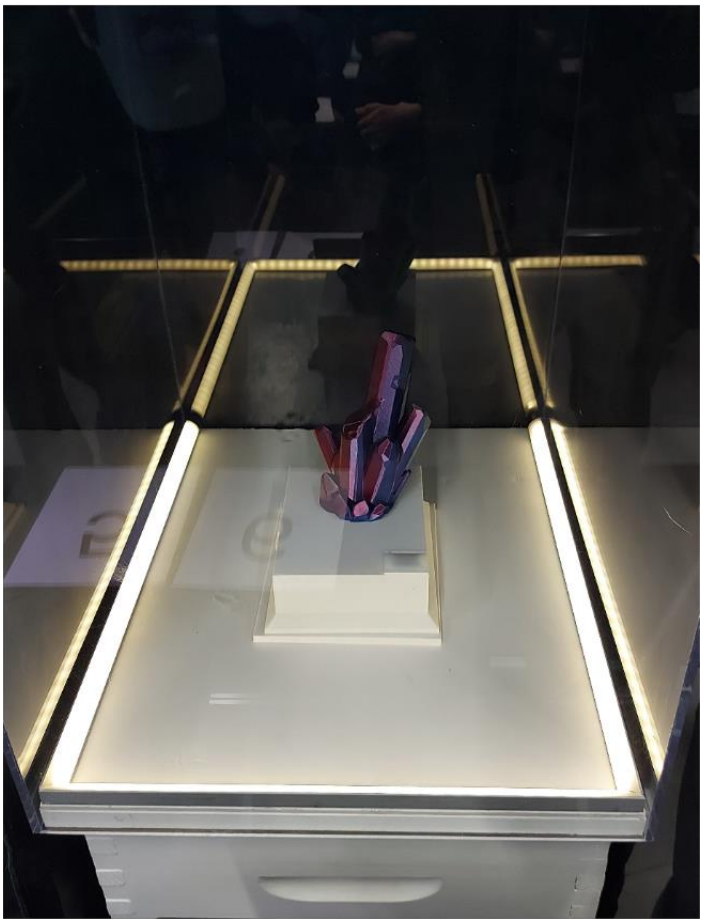
Automated Display System

User Manual



Partners:

ALGONQUIN COLLEGE

Ingenium
Canada's Museums of Science and Innovation

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Introduction

This user manual is for the automated display system, designed for Ingenium museums in Ottawa.

The purpose of this user manual is to show you how to use the automated display system to measure and control the lighting of display items. Tailoring the lighting to the characteristics of a display item has the following benefits:

- Better viewing experience for the museum visitors
- Prevention of light-related damage to the display item

The sections below summarize the organization and the conventions of this user manual.

Organization

After this introduction, this user manual has four parts:

1. About the automated display system: Descriptions of the automated display system's display case and web app.
2. Setting up the automated display system: Important information and step-by-step instructions about powering up and automating the automated display system.
3. Handling the automated display system: Important information and step-by-step instructions about manually adjusting and maintaining the automated display system.
4. Reference material: Content on troubleshooting, accessing the light intensity log, and an index.

Conventions

This user manual uses icons, result statements, and cross-references.

Icons

Icons convey extra information in procedures. Here are the icons you will find in this user manual:

	A **note** provides insight about a step in a procedure so you can understand it better.
	A **tip** indicates an alternative method that you can use to complete a step in a procedure.
	A **caution** signals the task requires care to avoid damaging the automated display system during a step in a procedure.

Result statements

Result statements appear occasionally to tell you what happens after you complete a step in a procedure. Result statements are dark blue, italicized, and appear centred on the page, like this:

This is a result statement.

Cross-references

Cross-references redirect you to different sections of the user manual when you select them. Cross-references are underlined and are blue, like this: This is a cross-reference.

About the automated display system

This section of the user manual describes the parts of the automated display system that you will use.

Reviewing this section will prepare you to operate and maintain the automated display system with ease. This will help you showcase display items in ideal light and preserve them from damage caused by excessive light exposure.

In this section, you will examine the following parts of the automated display system:

About the display case

The display case consists of a flat wooden platform measuring 22 in x 18 in and is topped by an acrylic box measuring 22.75 in x 23.50 in x 18.50 in. The acrylic box is secured to the wooden platform with one square screw per long side. The display case sits atop a wooden column for easy viewing of the display items.

Figure 1 below shows how the acrylic box and the wooden platform fit together.

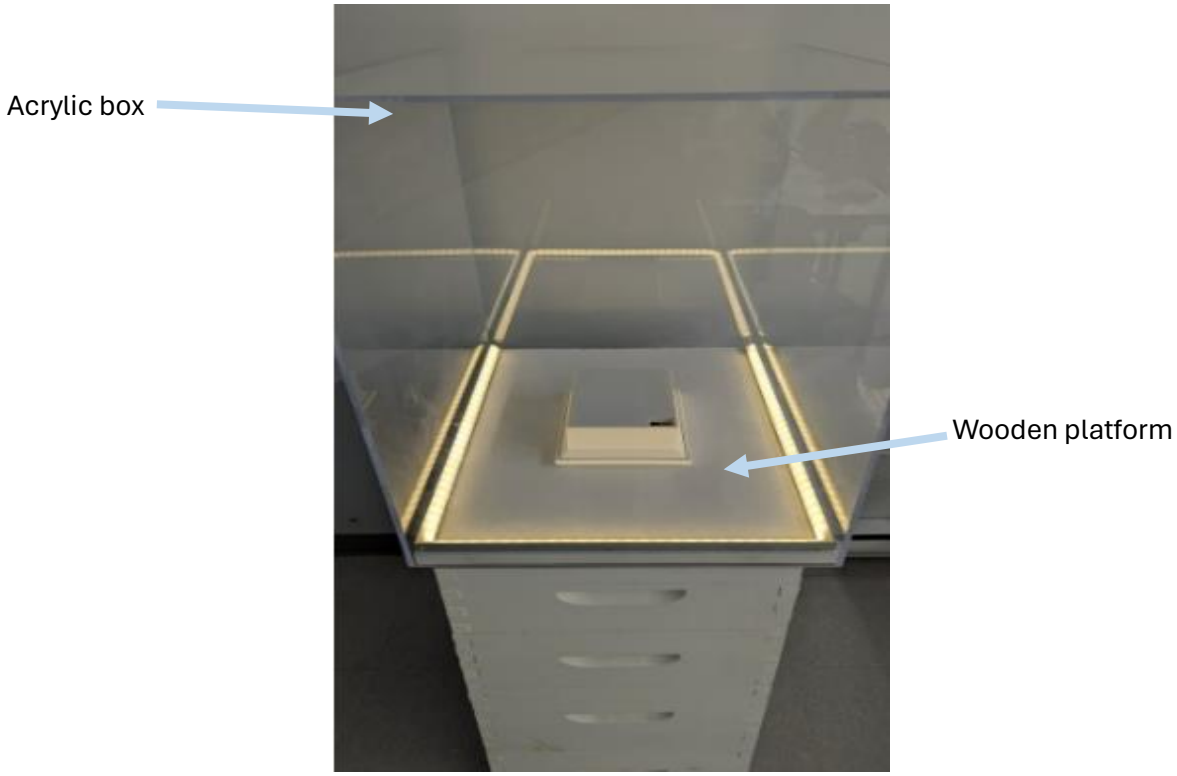


Figure 1: The acrylic box and the wooden platform.

Below is a written overview describing the individual components of the display case.

LED strips

Three strips of light-emitting diodes (LED) run along the front, left, and right edges of the wooden platform. These LED strips face the display item and are covered by diffusers to help spread out and soften the light they emit.

Figure 2 below shows where the LED strips are located.

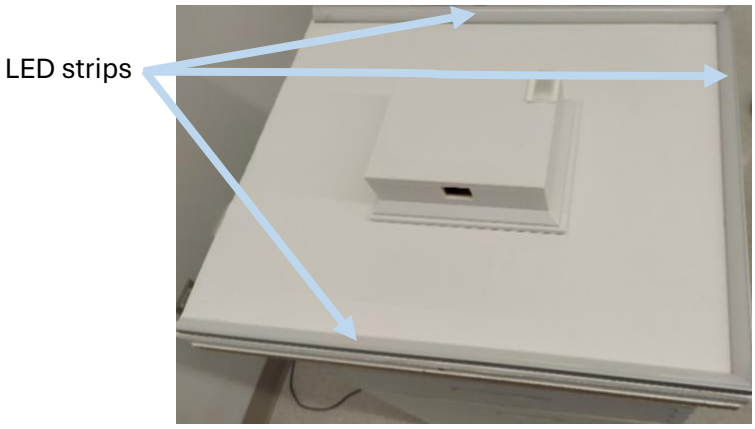


Figure 2: The LED strips.

Display item pedestal base

The display item pedestal base is a plastic piece that sits over the recess in the centre of the wooden platform and supports the display item pedestal.

Figure 3 below shows where the display item pedestal base is located.

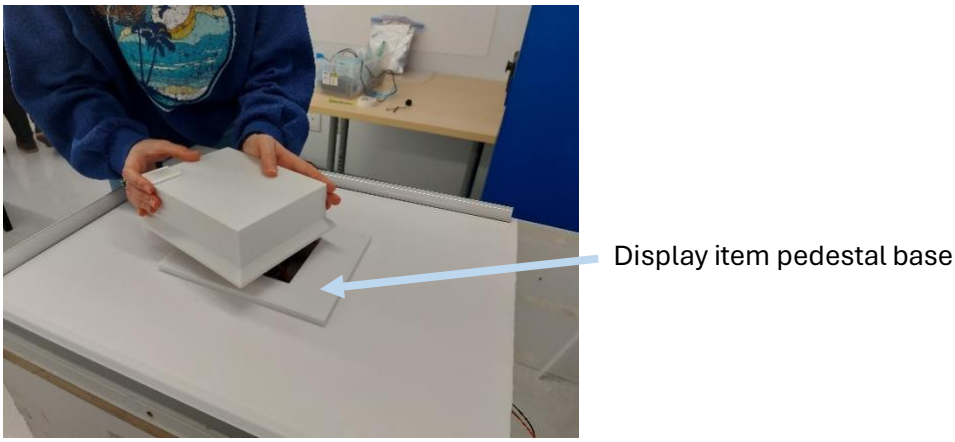


Figure 3: The display item pedestal base.

Display item pedestal

The display item pedestal is a white plastic box that measures 7.87 in x 6.30 in x 2.36 in. It fits on top of the pedestal base and elevates the display item from the wooden platform into the direct light of the LED strips.

Figure 4 below shows the display item pedestal mounted on its base.

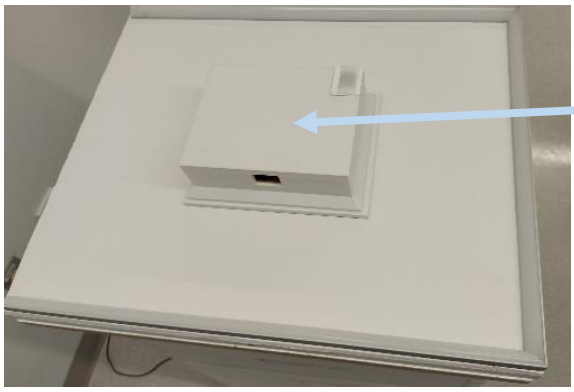


Figure 4: The display item pedestal.

Light sensors

The two light sensors located on the display item pedestal are extremely sensitive to light intensity changes. These sensors are covered by diffusers to help improve the reading of light levels.

Figure 5 below shows where the light sensors are located on the display item pedestal.

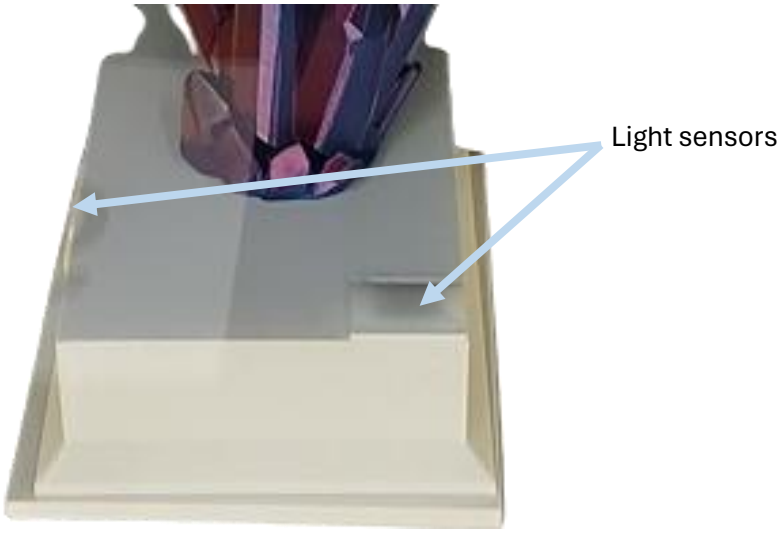


Figure 5: The light sensors.

Microcontroller

The microcontroller is hidden in the centre of the wooden platform's recess. It interprets inputs from the light sensors, web app, and manual control knob to adjust the light level accordingly.

Figure 6 below shows the recess where the microcontroller is located.

Figure 6: The microcontroller in its recess.

Components at the back of the automated display system

The display case is also connected to a manual control knob, a microSD memory card slot, and a power button. These components are located under the wooden platform's short edge at the back of the automated display system.

Figure 7 below shows where the manual control knob, memory card slot, and power button are located.

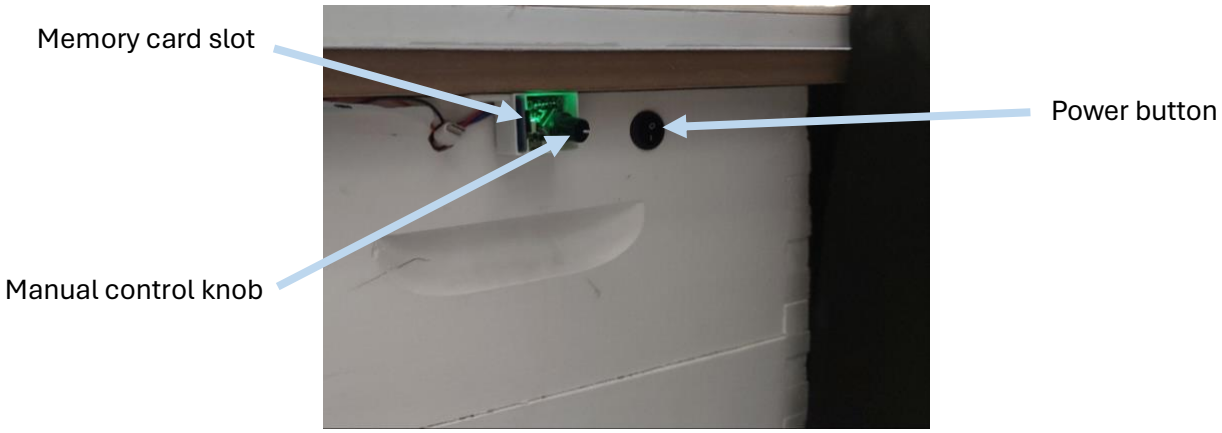


Figure 7: The manual control knob, memory card slot, and power button.

You can use the manual control knob as a dial to adjust the automated display system's lighting by hand, and as a push button to restore the lighting auto-schedule. The memory card stores light levels recorded by the display case's light sensors and converts the data into a light intensity log.

About the web app

The automated display system's web app is hosted by the microcontroller and offers a virtual interface to adjust the lighting of the display case. The web app can be accessed through any web browser, using a phone, tablet, or computer.

The web app is protected by a secure Wi-Fi network that is only accessible with a password. When accessing the web app, your device must always be within range of the microcontroller's Wi-Fi signal.

The web app allows you to:

- View the live light levels
- Adjust the light levels
- Set a lighting auto-schedule

Figure 8 below shows the web app's interface, followed by a written overview.

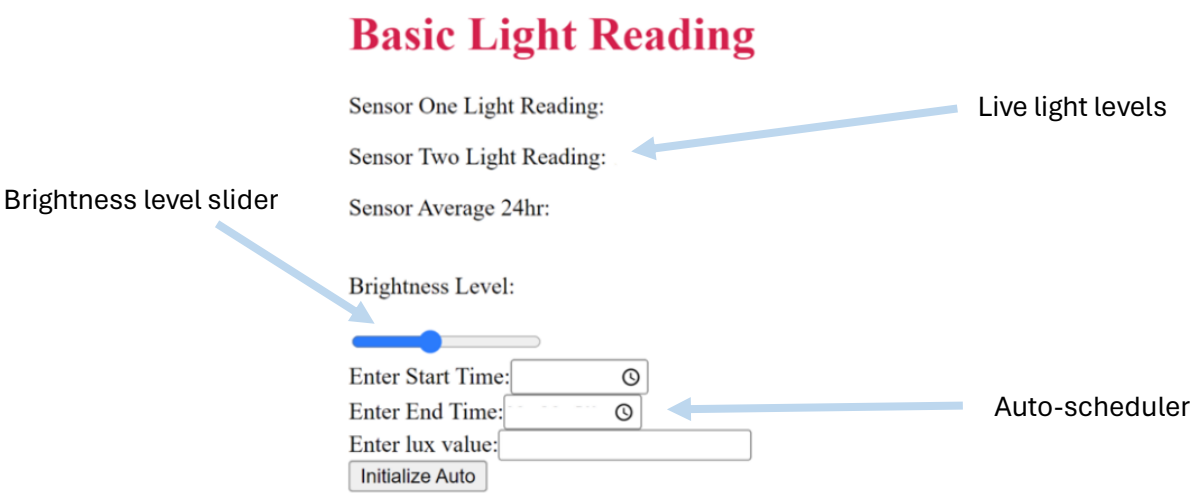


Figure 8: Web app interface.

Live light levels

The first three values of the web app let you view the live light levels. The benefit of the web app being hosted by the microcontroller is that you do not have to refresh the web app. Light levels are updated as soon as they are available.

The light levels detected by the two sensors can be found next to **Sensor One Light Reading** and **Sensor Two Light Reading**. The **Sensor Average 24hr** provides you with a calculated light intensity average in the past day. All light levels are displayed in lux, a unit of light intensity measurement.

Brightness level slider

You can adjust the light levels by using the **Brightness Level** slider. To increase the brightness, you will move the slider to the right. To decrease the brightness, you will move the slider to the left. As you move the slider, the lux value will appear next to **Brightness Level**.

Lighting auto-scheduler

You can set a lighting auto-schedule by choosing a start time, an end time, and a lux value. The lighting auto-schedule is useful when you would like the automated display system to follow a recurring schedule, such as operating hours. Once you set the auto-schedule, you don't need to refresh the web app; the auto-schedule is automatically sent to the microcontroller.

Setting up the automated display system

The automated display system automatically adjusts the lighting of a display item according to your preferences. Each day, the automated display system monitors and controls light levels between the two times that you specified in the lighting auto-schedule. Powering up and automating the automated display system takes just a few minutes and will help you present display items in lighting that flatters them without damaging them.

This section of the user manual discusses the following topics:

Powering up the automated display system

The automated display system is powered by electricity. You will first want to place the automated display system in its museum location. This topic is important as proper set up and preparation will allow you to use the automated display system with ease.

This topic of the user manual will show you how:

To turn on the automated display system

1. Plug the power adapter into an electrical outlet.
2. Switch the power button to the ON position.

To restart the automated display system

1. Switch the power button to the OFF position.
2. Unplug the automated display system from the electrical outlet.
3. Wait 30 seconds.
4. Plug the power adapter back into the electrical outlet.
5. Switch the power button to the ON position.

Automating the automated display system

For the automated display system to follow a recurring schedule, you will need to set up a lighting auto-schedule. You can do this by connecting your mobile device to the microcontroller and using its web app. This simple process enables you to achieve ideal lighting for a display item in a couple of minutes.

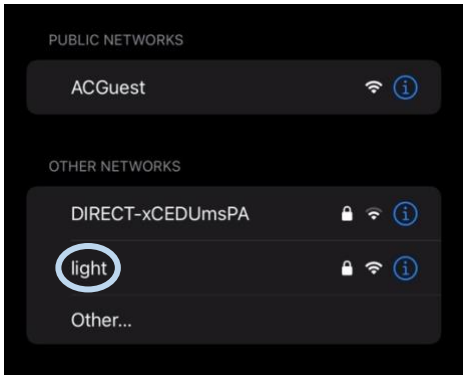
This topic of the user manual will show you how:

To connect your mobile device to the automated display system

1. Make sure the automated display system is turned on.
2. Go to your mobile device's network settings.

> Going to a device's network settings varies depending on the device. Typically, you must go to **Settings** and then **Wi-Fi**, **Connections**, or a similar section.

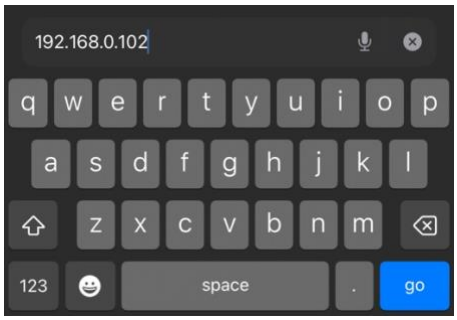
3. Select the **light** network.



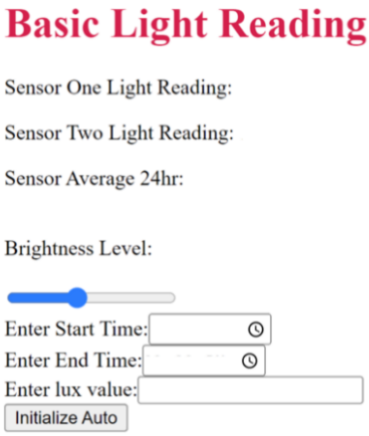
4. When prompted for the password, enter **123456789**.

To open the automated display system's web app

1. Make sure that your device is connected to the **light** network.
2. Open an Internet browser.
3. In the browser's address bar, enter **192.168.0.102**.



After a few seconds, the web app will load in your browser.

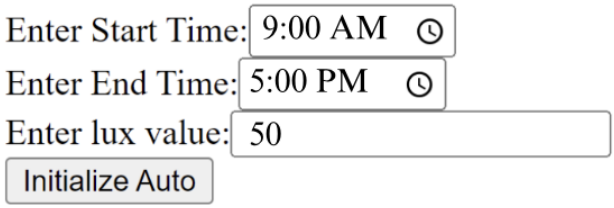


To set a lighting auto-schedule

1. Using the web app, select **Enter Start Time** to choose the auto-schedule's daily start time.
2. Select **Enter End Time** to choose the auto-schedule's daily end time.

50 lux is the universal benchmark for museum lighting. Light levels that exceed 50-60 lux may cause photochemical reactions that damage display items over time.

3. Select **Enter lux value** and enter the light level.
4. Select **Initialize Auto**.



The automated display system will automatically adjust light levels throughout the day to keep them at the specified lux value.

After setting a lighting auto-schedule, remember to disconnect your device from the **light** network and reconnect it to a regular Wi-Fi network with Internet access.

Handling the automated display system

Knowing how to handle the automated display system is the key to an optimal viewing experience. This includes increasing or decreasing the light intensity levels within the display case for a given audience and knowing how to care for the automated display system.

This section of the user manual discusses the following topics:

Overriding the lighting auto-schedule

When viewing needs differ from what was set in the lighting auto-schedule, you can override the auto-schedule's settings by using the manual control knob. This will adjust the light levels to the needs of the audience for as long as you need it, without altering the auto-schedule's settings.

This topic of the user manual will show you how:

To adjust the automated display system's light levels by hand

- At the back of the automated display system, rotate the manual control knob clockwise to increase the light levels or counter-clockwise to decrease the light levels.

The manual control knob does not have any pre-defined light level values when rotated. It simply increases or decreases the current light level of the LED strips, depending on the rotation direction.

You can also manually adjust the lighting with the brightness level slider in the web app.

To restore the lighting auto-schedule

- Press and hold the manual control knob for three seconds.

The manual control knob clicks when you press it. After you hold it for three seconds, it will beep to let you know that the lighting auto-schedule has been re-activated.

Maintaining the automated display system

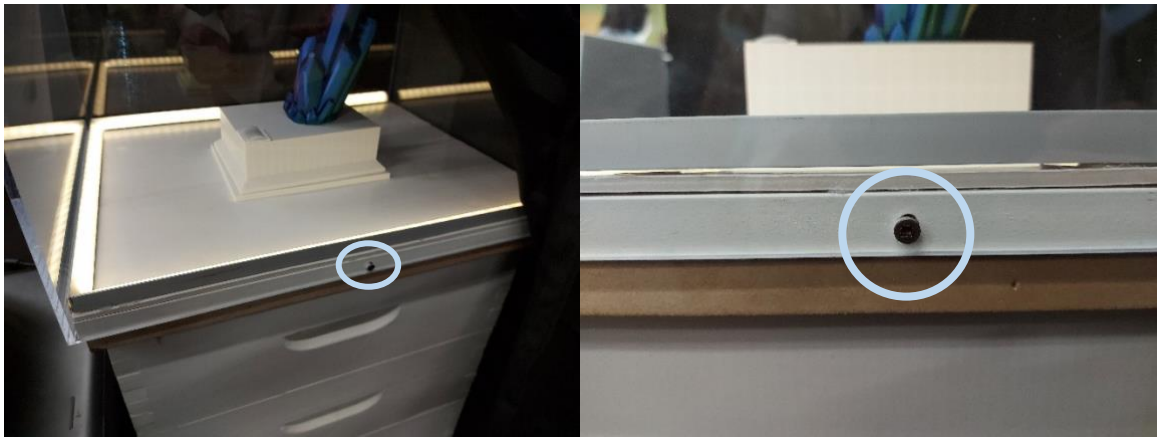
To keep the automated display system functioning at its best, some maintenance is required. This involves cleaning the light and sensor diffusers so that the light can be clearly emitted and sensed. Other maintenance involves replacing the microcontroller's real-time clock battery to make sure the lighting auto-schedule is saved, even when the automated display system is turned off.

This topic of the user manual will show you how:

To remove the acrylic box

⚠ The acrylic box is secured to the wooden platform by two screws. When you remove these screws, the acrylic box becomes unwieldy. If you do this by yourself, the acrylic box may fall and cause harm to you, the display item, and the display case. Work with another team member so that one person holds the acrylic box while the other removes the screws. Once the screws are removed, both people move the acrylic box together.

1. Remove the two square screws securing the long sides of the acrylic box to the wooden platform.



2. Lift the acrylic box up and over the wooden platform and the display item.
3. Gently place the acrylic box down somewhere safe and out of the way.

To clean the diffusers

1. Remove the acrylic box.
2. Lightly moisten a microfibre cloth with water.

⚠ You may damage the diffusers if you apply too much pressure while cleaning them.

3. Using one finger, gently run the moistened microfibre cloth along the diffusers of the three LED strips and the light sensors on the display item pedestal.

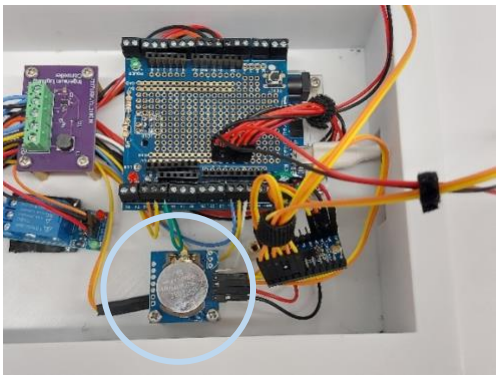
To replace the battery of the real-time clock

1. Remove the acrylic box.

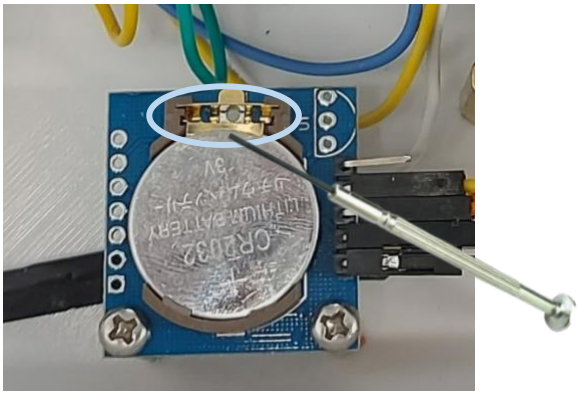
> ⚠ The light sensors and their wires can be damaged if the display item pedestal is moved too quickly or too far from its base.

2. Carefully manoeuvre the display item pedestal away from its base and onto the wooden platform so that it reveals the recess of the microcontroller.


3. Locate the real-time clock battery.



4. Using your fingers or a mini flat-head screwdriver, gently hold up the metal tab securing the battery.



5. Lift the non-tabbed end of the battery up and out.
6. Insert the new battery ('+' side up) underneath the metal tab and firmly press down on the centre of the battery to secure it in place.

Appendix A: Troubleshooting

Table 1 below lists some issues you may have while using the automated display system, their possible causes, and their solutions:

Table 1: Troubleshooting the display system.

Issue	Possible Cause(s)	Solution
You cannot turn on the automated display system	The automated display system is not receiving electrical power	Plug the automated display system into a working electrical outlet
Your device cannot find any network to connect to	The Wi-Fi setting is off on your device	Turn on your device's Wi-Fi
Your device finds networks to connect to but not the "light" network	The automated display system is off or has encountered an error	Turn on or restart the automated display system
Your device finds the "light" network but cannot connect to it	The network password is incorrect	Use **123456789** as the password
Your browser cannot access the web app's address (**192.168.0.102**)	The automated display system has encountered an error	Restart the automated display system
The automated display system is not adjusting the lighting automatically	The lighting auto-schedule has not been set	Set an auto-schedule for the automated display system
The LED strips are not responding to the manual control knob	The automated display system has encountered an error	Restart the automated display system
The lighting auto-schedule is not working	The automated display system is in manual mode	Restore the auto-schedule
The web app displays incorrect light levels	The diffusers are dirty or smudged	Clean the diffusers and restart the automated display system
Restarting the automated display system resets the lighting auto-schedule	The battery of the real-time clock is dead	Replace the battery of the real-time clock

Need extra help? Contact the design team of the automated display system:

- [redacted]@algonquinlive.com
- [redacted]@algonquinlive.com
- [redacted]@algonquinlive.com
- [redacted]@algonquinlive.com

Appendix B: Accessing the light intensity log

The automated display system records light intensity levels in a text file with comma-separated values (CSV). The light levels are recorded at regular intervals throughout the day. This light intensity log will give you more data to analyze than the 24-hour light intensity average visible on the web app's UI.

Table 2 below contains an example scenario of how you might use this data:

Table 2: Data-driven decision-making with the light level log.

Scenario	Inference	Adjustment	Result
Data shows very high light levels on irregular intervals.	Museum visitors are using flash photography.	You place a "No flash photography" sign next to the display system.	You prevent light-related damage to the display item.

The light intensity log is stored in the automated display system's microSD memory card. Figure 9 below shows the location of this memory card in the automated display system.

Figure 9: Memory card slot

Use a spreadsheet application such as Microsoft Excel or Google Sheets to open the light intensity log in CSV format. As shown in Figure 10 below, this log contains columns that represent the day, month, year, hour, and intensity (in lux) of the recorded light level.

	A	B	C	D	E
1	6	4	2024	16:34:09	75
2	6	4	2024	16:34:19	77
3	6	4	2024	16:34:29	76
4	6	4	2024	16:34:09	82
5	6	4	2024	16:34:19	82
6	6	4	2024	16:34:29	83
7	6	4	2024	16:34:39	84
8	6	4	2024	16:34:49	85
9	6	4	2024	16:34:59	86
10	6	4	2024	16:35:09	87
11	6	4	2024	16:35:19	87
12	6	4	2024	16:35:29	88
13	6	4	2024	16:35:39	90
14	6	4	2024	16:35:49	99
15	6	4	2024	16:35:59	116

Figure 10: This light intensity log records light levels every 10 seconds.

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