MACC Greenhouse control system
User Manual

Disclaimer

This manual is designed for the purpose of educating authorized users on the tools available for the ITC Greenhouse control system. Usage of these tools is subject to the Acceptable Use Policy (AUP) of Moberly Area Community College, which can be accessed at https://www.macc.edu/about-us/about-macc-computing-resource-policy/. By using these tools, you acknowledge that you have read and understood the terms of the AUP and agree to be bound by them. Failure to abide by these terms may result in the revocation of access to the Greenhouse control system and/or prosecution to the fullest extent of the law.

Overview

Welcome to the ITC Greenhouse User Manual for Moberly Area Community College! This manual is designed to allow authorized users to connect to the greenhouse control system to monitor and manage sensors, devices, and controllers, view a live video feed of the plants in the greenhouse, integrate new devices into the greenhouse environment, and to overall enhance the learning experience for students in their courses. Whatever the task at hand, this system will make it easier to monitor the plants in a greenhouse. This user manual will walk users how to access the greenhouse and how to manage its features.

Table of Contents

2. Getting Started - This section will outline how to access the system and create an account, if necessary, as well as some select features
3. Main Dashboard - This section will outline the key features that will be shown to a user upon logging into the website
4. Administration - This section will outline features available only to the administrator account
5. Conclusion - This will summarize the features of the greenhouse control system and include resources for additional troubleshooting if needed

Required Software

If remote access to the Greenhouse CLI is needed, users will need to install the Tailscale software on their device. Tailscale creates a mesh network using Wireguard to encrypt the traffic over the Internet. Tailscale will add a secondary network interface onto the computer with an IP address in the 100.64.0.0/10 range to facilitate remote access to the command line. To install Tailscale, users may download the software from https://tailscale.com/download according to their operating system or mobile device. Users will also need to follow the steps for connecting the Pi to their Tailscale network, which is linked at the bottom of this manual. Users will also be required to have access to a Command Prompt or equivalent program such as PuTTY, KDE Konsole, or Windows Terminal to start the remote session.

Once a user has successfully created their Tailscale connection, users will need to initiate an SSH connection to the Tailscale IP address of the Pi, which will be located in the Tailscale Admin console on Tailscale.com. For an additional measure of security, user accounts on the Pi will be configured with Two-Factor Authentication (2FA), which will require users to have an authenticator app like Google Authenticator or Authy on their mobile device.

Getting Started

The greenhouse control system can be accessed through the following url: https://greenhouse.ngrok.io/. Upon accessing the website, users will be presented with a login page featuring an assortment of items for viewing. Directly

below the login fields, a sensors and devices table are available for quick viewing of their values.

Sensors available for viewing:

Sensor Name
DHT_Temp
DHT_Humid
C02 Sensor*
Indoor Temperature*
Light Sensor*
Soil Moisture Sensor*
Wind Speed Sensor*

*denotes simulated sensor with simulated data values. These sensors would be ready for deployment upon purchase of additional hardware sensors

Devices available for viewing:

Device Name	**Status**	**Control Mode**
Black Light	Off	time
Heat Lamp	Off	time
White Light	Off	time

In addition to the included tables, there is also a live camera feed available for viewing inside the greenhouse in the top left corner of the screen.

In order to access the greenhouse control system, users will be required to login with their account. At present, there are three accounts that may be used to

access the system: **junior**, the account intended for students, which is only able to view the sensors, toggle the white light on or off, and view the configured settings for the lights, **senior**, the account intended for MACC faculty and staff, which is able to perform all actions of the junior account, as well as being able to modify the settings of the lights, and **admin**, which is able add and manage all devices, sensors, and controllers for the greenhouse. Future integration of the greenhouse control system may allow for the use of configured professor and student MACC accounts to login and inherit permissions based on their account configuration, but this has not been configured at the time of writing.

Main Dashboard

After logging in, users will be immediately presented with the main dashboard view with a toolbar on the top of the page with three or four tabs; Dashboard, Control, Settings, and exclusively for admin accounts, Admin. The dashboard tab on the site provides users with two drop-down menus to view a selected sensor or a group of selected sensors over the preceding time range of one, six, or twelve hours. Selected sensors will be displayed in a graph format, with the x-axis of each graph representing the time period selected, and the y-axis representing the value of the data points (temperature levels, wind speed, etc).

The Control tab allows users to see the configured physical devices connected to the Pi. At present, three devices are configured, those being the White Light, Black Light, and Heat Lamp. Each configured device will have a drop-down menu allowing for the device mode to be switched between Auto and Manual configuration, as well as a text box below the menu displaying the device's current power status. For Auto devices, a separate box will be displayed to denote that they are being configured automatically. If the device is configured to be turned on and off manually, a button will be displayed to the left of the power status to turn the device on or off.

The Settings tab allows users to see the configured settings for the devices in the Control tab. Each device in the Settings tab will display their control mode, their power configuration (automatic or manual), auto time, auto duration,

whether the device is automatically enabled, the connected General Purpose Input/Output (GPIO) Pin, and the devices power status. For users with senior account permissions and above, they will be able to edit the device settings with an edit button on each device. Currently, users with permissions will be able to edit the auto time, auto duration, and whether the device will be automatically enabled.

On the right hand side of the toolbar, the currently logged in user will be displayed as well as a logout button if a user needs to switch accounts for configuration management. Users will also be able to toggle between light and dark mode for a more desirable viewing experience, which will be applied site-wide.

Administration

Accounts with admin access will have an additional admin tab on the toolbar when accessing the system. This tab will provide admins with the ability to add and manage devices connected to the Pi, add and manage sensors, as well as add and manage controller rules.

The Device Management tab provides admins the ability to add and manage devices connected to the Pi. When this tab is displayed, a menu to add a new device will appear at the top of the screen and a list of all currently configured devices will appear below it. To configure a new device, users will have to enter a device name, whether the device is time or sensor based, the Auto time and duration, whether the device will be automatically enabled, the GPIO Pin the device is using on the Pi, which mode the device should be placed in (Manual or Auto), and whether the device should be simulated. After adding a new device, it will appear in the list of devices on the lower part of the screen. This list allows for admins to edit the configured settings of a device or delete the device altogether.

The Sensor Management tab provides admins the ability to add and manage sensors within the physical greenhouse. Similar to the Device Management tab, when this tab is displayed, a menu to add a new sensor and a

list of all currently configured sensors will be displayed. To add a new sensor, admins will need to enter a name for the sensor, what type of data the sensor will be monitoring (currently, sensors can be configured for Temperature, Humidity, CO2, Light, Soil Moisture, and Wind Speed), and whether the sensor should be simulated. A spot for additional configuration with JSON is available for further customization. Newly added sensors will be displayed in the list directly below the new sensor form, which allows for admins to edit and delete any configured sensors.

The Controller Setup tab provides admins the ability to configure rulesets for when a defined sensor reaches a specified threshold. To add a new controller rule, admins will need to select a sensor, an actuator (device), define a threshold value (value for when the logic should activate or not), define whether the ruleset should activate when below or above the threshold value, and the hysteresis value. Configured rules will be displayed in a list for admins to edit and delete as desired.

Conclusion

Congratulations on finishing this manual, and thank you also for using the MACC Greenhouse Control System! After reading this manual, you should now have a clearer understanding of how to navigate through the system and use its features. Users will be able to easily monitor the sensors and control devices connected to the greenhouse, and teachers and administrators will be able to add new devices and controllers as the greenhouse environment grows. This manual also helps users with accessing both the site and CLI of the greenhouse system. We hope that this manual was helpful in explaining the features of the system, and we wish you all the best in your usage of the system.

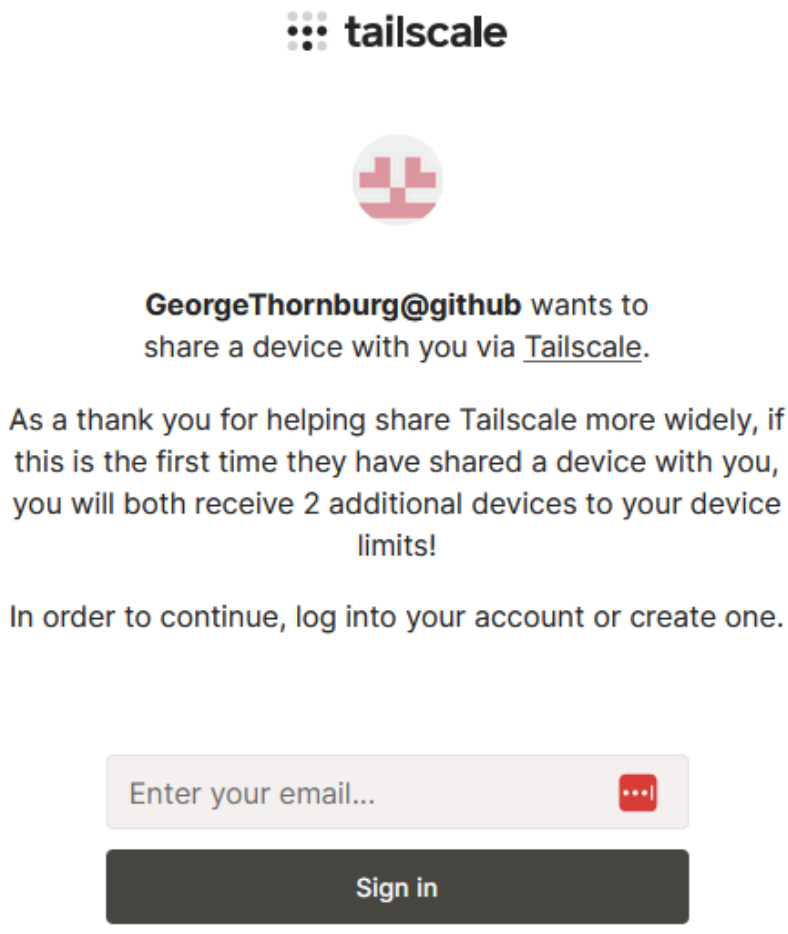
Tailscale installation instructions

Download and run the installer according to your specific operating system at the following URL (installation steps may vary):

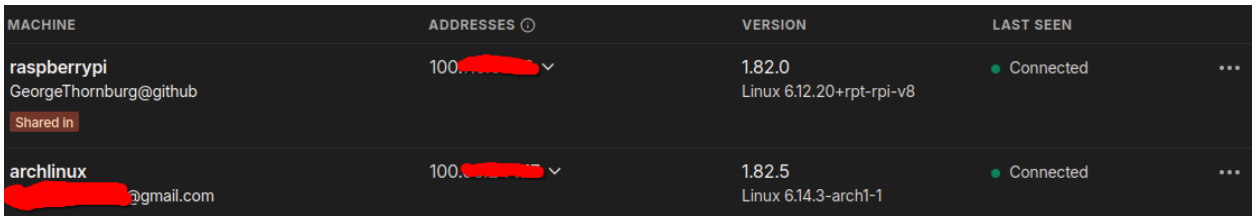
https://tailscale.com/download/

After the installation process, use the following link to add the Pi's remote address into your "Tailnet" (Tailscale network). This will require you to create an account with Tailscale.

https://login.tailscale.com/admin/invite/rHyECnCmFn5



After creating an account and adding the Pi, your Tailscale homepage should now have an entry for both your personal device and the Pi. Note that the IP addresses shown in your homepage are not reachable through the wider Internet.



Using your choice of terminal emulator, initiate an SSH connection to the Tailscale address of the Pi with your pre-configured username on the Pi.