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Ventilation

Controller

Project

User Manual

Second-year Hardware Project

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To maintain standards of comfort, health, and safety in today's quickly changing living and working settings, it is imperative to ensure appropriate ventilation. Whether it's managing indoor temperature fluctuations, regulating humidity levels, or monitoring CO2 concentrations, effective ventilation is indispensable for creating spaces conducive to productivity and well-being.

The Ventilation Controller Project represents a significant step forward in achieving optimal ventilation control. This project aims to develop a sophisticated ventilation controller system capable of seamlessly integrating both local and remote user interfaces, thereby providing users with convenient and versatile control over their ventilation systems. This manual will guide you through the setup and operation of the Ventilation Controller. This manual serves as a comprehensive guide to the setup and operation of the Ventilation Controller. Through detailed instructions and clear illustrations, users will gain a thorough understanding of how to install, configure, and utilize this innovative system to optimize ventilation in their respective environments.

Table 1 presents the peripherals in the system and their general functionalities.

Peripherals & Components	Purpose/Functionalities
SW_0 (Button)	Confirm the selection on the menu
SW_2 (Button)	Access the main menu
Rotary encoder	Navigate the selection in the menu
OLED display	Local User Interface on Raspberry Pi Pico
MQTT based controller UI	MQTT controller

Table 1. Components, peripherals and their functionalities

Initial display:

Once the microcontroller boots, the program attempts to connect the microcontroller with MQTT broker. During the connection, OLED display shows the MQTT symbol. As soon as the connection is completed, the display switches to status menu showing the measurement parameters in the systems.



Figure 1. MQTT connecting once program boots

Upon booting the program mode, fan speed, and pressure value are shown according to the latest measurements which are stored in the system earlier. To navigate to main menu, press switch SW_2.

Main menu:

In main menu, there are four selections which allow users to navigate to other sub-menu. Rotating the knob to move between different selections. Confirm the selection by pressing switch SW_2. Table 2 below shows the sub-menu shown in main menu and their descriptions.

Main menu selections/sub-menu	Description of menu selection
Set fan speed	Manual mode. Set the desire fan speed
Set pressure	Automatic mode. Set the target pressure and fan speed will change accordingly
Show Status	Show current state of vent system
Wifi and MQTT	Change network credentials and MQTT broker IP

Table 2. Main menu selections

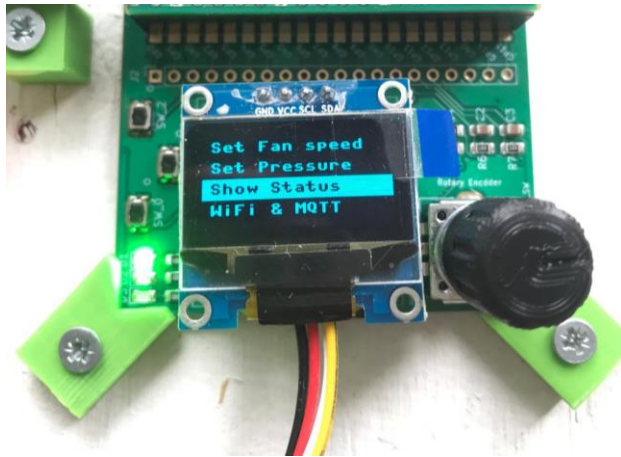


Figure 2. Main menu on OLED display

'Set fan speed' sub-menu:

In sub –menu 'Set fan speed', user enters manual mode. A rotary encoder can be used to adjust the speed as desired. It is in a range of 0 and 100%. Increasing the speed by rotating the knob clockwise direction and decreasing the speed by rotating the knob anti-clockwise. Confirm the desired speed value by pressing switch SW_2. Once SW_2 is pressed, OLED display switches to status menu where it shows measured parameters. Access the main menu by pressing SW_0.



Figure 3. Fan speed sub-menu showing slider to adjust the speed value

'Set pressure' sub-menu:

In sub-menu 'Set pressure', user enters automatic mode. A rotary encoder can be used to adjust the pressure as desired. It is in a range between 0 and 12pa. Increasing the pressure value by rotating the knob clockwise direction and decreasing the pressure

value by rotating the knob anti-clockwise. Confirm the desired pressure value by pressing switch SW_2. Once SW_2 is pressed, OLED display switches to status menu where it shows measured parameters. Access the main menu by pressing SW_0.

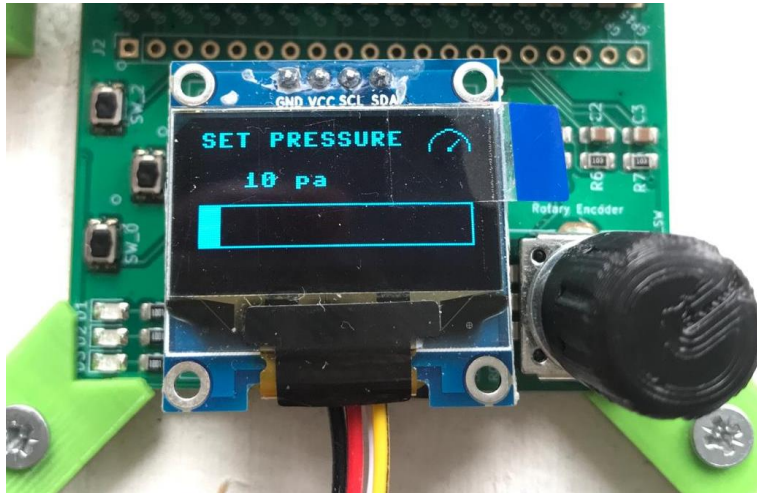


Figure 4. Pressure submenu showing a slider to adjust target pressure value

‘Show status’ sub-menu:

In sub-menu ‘Show status’, all measured parameters are shown and updated every 3 seconds. Press SW_0 to access to main menu.

Parameters in Status menu	Unit	Min/Max
CO2	ppm	
Relative humidity	%	
Temperature	C (Celcius degree)	
Fan Speed	%	0/100
Pressure	pa	0/125
Program mode	Auto/Manual	

Table 3. Measurement Parameters in status menu

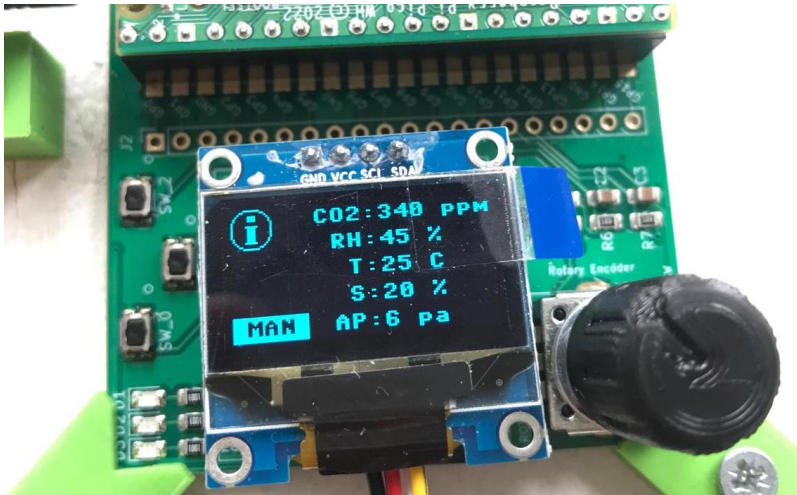


Figure 5. Status menu in manual mode

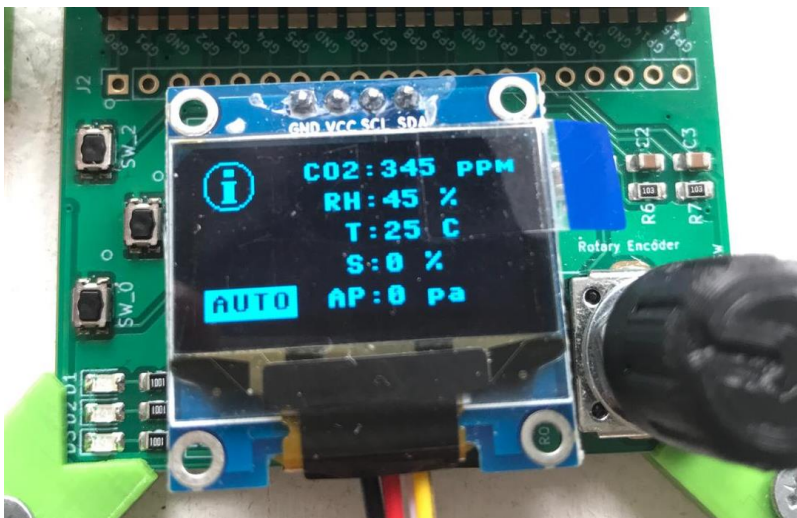


Figure 6. Status menu in automatic mode

‘Wifi and MQTT’ sub-menu

Sub-menu ‘Wifi and MQTT’ shows the currently stored network credentials and MQTT IP. User can configure and change SSID name, network password and MQTT broker IP address from this sub-menu.

Editing Process:

- Rotate the rotary knob clockwise or anticlockwise to select the desired setting.
- To edit, press switch SW_0.
- Use the rotary knob to navigate and change characters.
- Confirm the selected character by pressing switch SW_0.

- Hold SW_0 for a minimum of 1 second to confirm the entire string input.
- Navigate to the 'Save' option and confirm by pressing SW_0 to store the changes.
- Upon confirmation, the microcontroller will store the new values and prompt the user to reboot for the changes to take effect and reconnect to MQTT with the updated input.
- To cancel the input, navigate to the 'Cancel' option and press SW_0. The OLED display will return to the status menu.



Figure 7. Wifi and MQTT submenu allowing configure network credentials and MQTT IP



Figure 8. Reset device to connect MQTT again after saving new input

'Error' menu

Error menu occurs during automatic mode when the pressure can not be adjusted to meet the targeted value within 1 minute.



Figure 9. Error menu showing on OLED screen after failed to adjust target pressure

MQTT –based Controller UI:

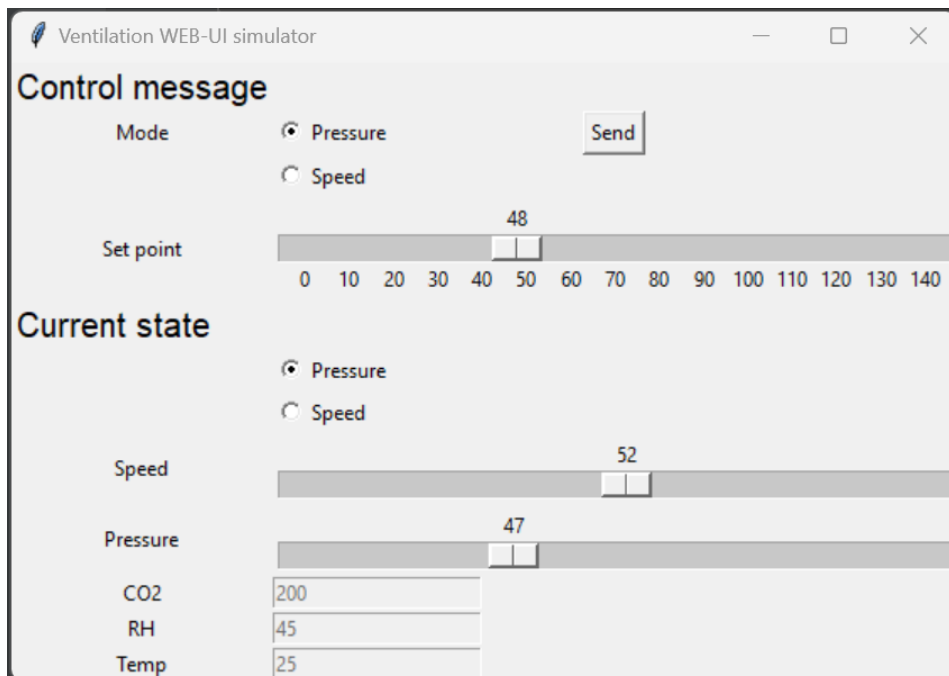


Figure 10. Ventilation User Interface

Manual Speed Adjustment:

To choose manual control over airflow speed, simply press the "Speed" button on the controller interface.

Use the slider field "Setpoint" to adjust the airflow speed. Move the slider to increase or decrease the airflow speed according to your preference.

Once users have set the desired airflow speed or pressure mode, press the "Send" button to execute the command.

Automatic Pressure Management:

Alternatively, to choose automatic pressure management, press the "Pressure" button on the controller interface.

Press the "Send" button to execute the command. Then the system will automatically adjust the pressure to maintain optimal ventilation conditions without the need for manual intervention.

Current state:

Current state session in the interface displays the status of ventilation system, showing the measured parameters and have them updated every 3 seconds.