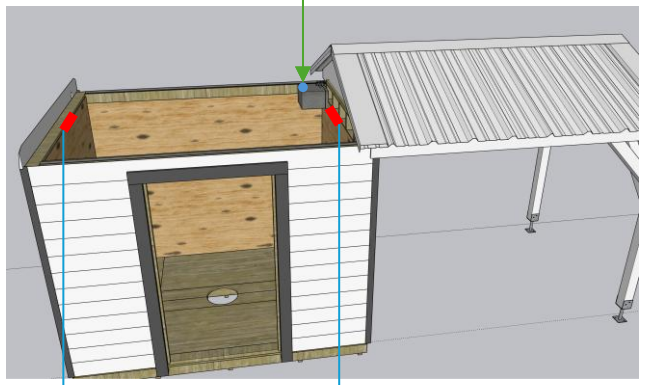
Roll-off Roof Automation Control System



Roof motor drive commands

Emergency Stop

Toggle (Open/Close/Stop)

Telescope Power (on/off)

Roof open sensor (reed switch)

Roof closed sensor (reed switch)

DEC-axis safety sensor (reed switch)

RA-axis safety sensor (reed switch)

Serial Connection (UART)

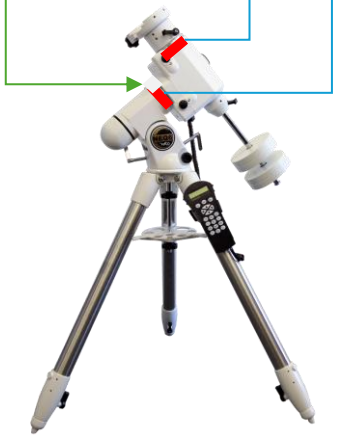
CAT6 cable

Buzzer

HTTP (GET/POST) over Wi-Fi

MQTT over Wi-Fi

TX RX



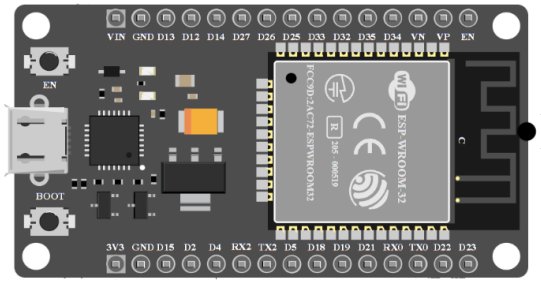
1 User Interface Panel

- **Roof Control**: OPEN/CLOSE, STOP
- **Roof Status**: = Closed, = Moving, = Open
- **Telescope Safety Status**: = Safe, = Unsafe
- **Telescope Control**: On / Off, = Power On
- **Observatory Lights**: MAX, DIM, OFF

CAT6 cable

ROR Control Box

ESP32 Microcontroller



3 Telescope Mini-PC

USB to Serial adapter

2

ASCOM

PowerShell Script

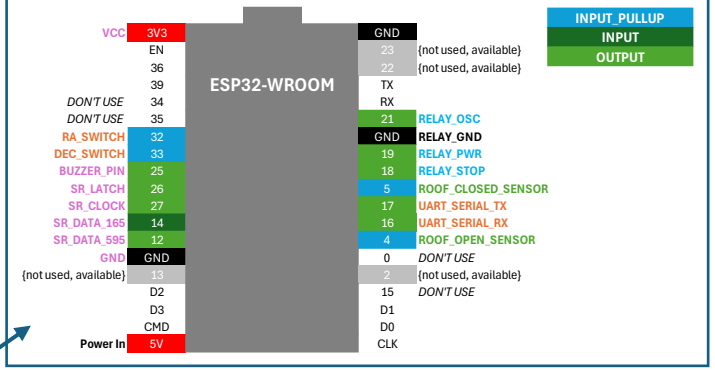
N.I.N.A.

4 Home Assistant Server

MQTT Broker

ESP32 GPIO Pinout:

GPIO Pin Type: INPUT_PULLUP, INPUT, OUTPUT



Operation

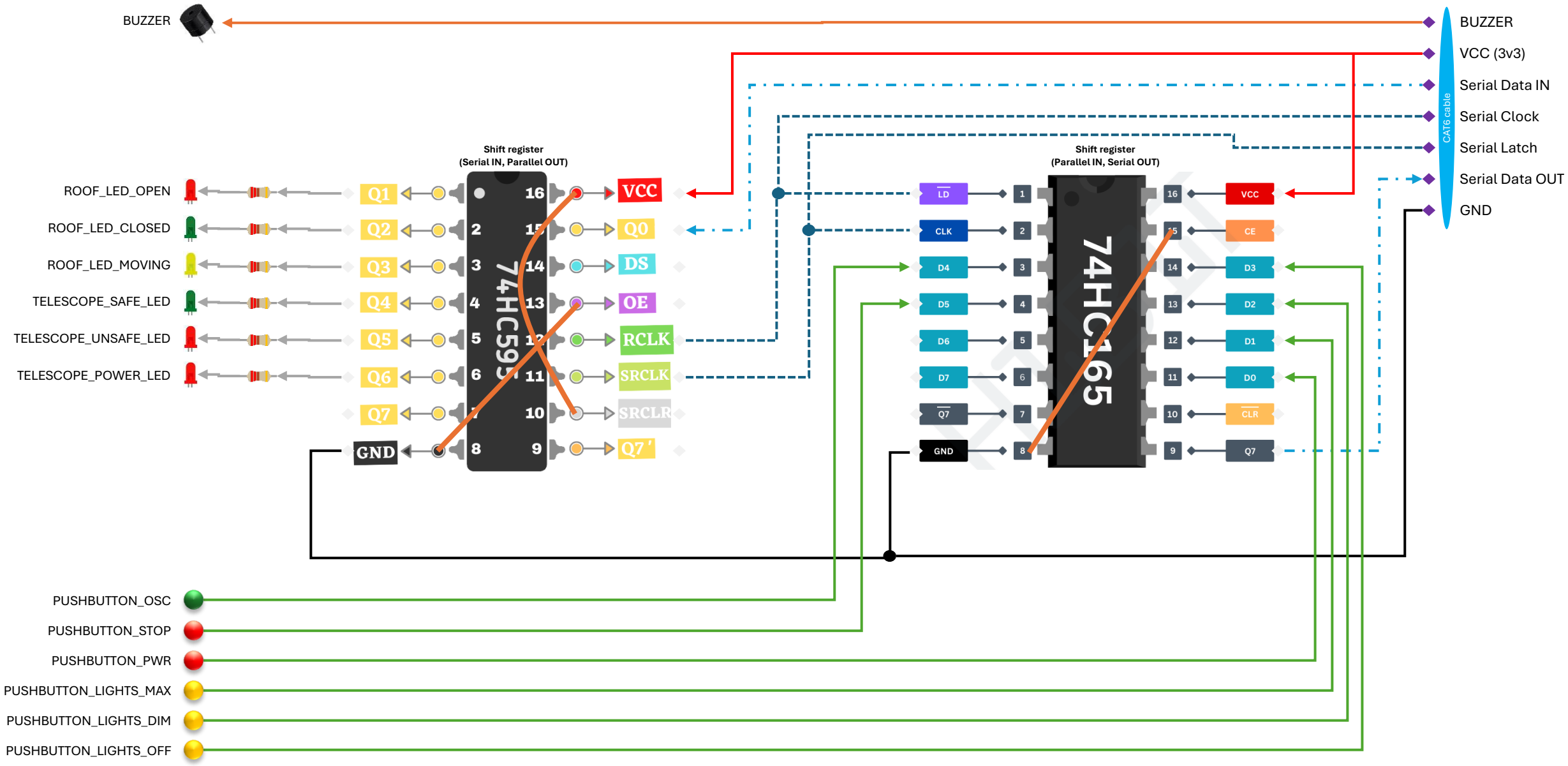
There are 3 separate control mechanisms:

1. **Manual** (via locally wired control panel)
   - Open/Close button and Emergency stop buttons situated on a control panel inside the observatory.
   - Telescope on/off button controls a relay that turns on power to the telescope equipment.
   - LEDs represent status of roof (open/closed/moving/lost), telescope mount (safe/unsafe) and telescope equipment (on/off).
2. **HTTP** (over WiFi)
   - Controlled via HTTP calls (GET/POST) over Wi-Fi connection between ESP32 and miniPC.
   - Can be integrated into N.I.N.A. / SGP imaging sequence to automatically open/close roof at beginning and end of imaging sessions, or when weather requires, using PowerShell script to invoke the HTTP call.
3. **Serial** (wired serial UART connection)
   - Controlled via a wired serial connection between ESP32 and miniPC using UART pins on ESP32. On miniPC a CP2102 USB to serial adapter module is used as this allows longer cable runs than possible with a standard USB cable.
   - The ASCOM Rolling Roof Computer Interface (RRCI) by Chuck Faranda is used on the miniPC to send and receive serial commands to the ESP32.
4. **Home Assistant** (via MQTT over WiFi)
   - Controlled using MQTT via WiFi connection between ESP32 and MQTT broker running on Home Assistant server.
   - Allows Home Assistant to monitor and control roof operation via smart switches, phone apps and touchscreens.

Notes:

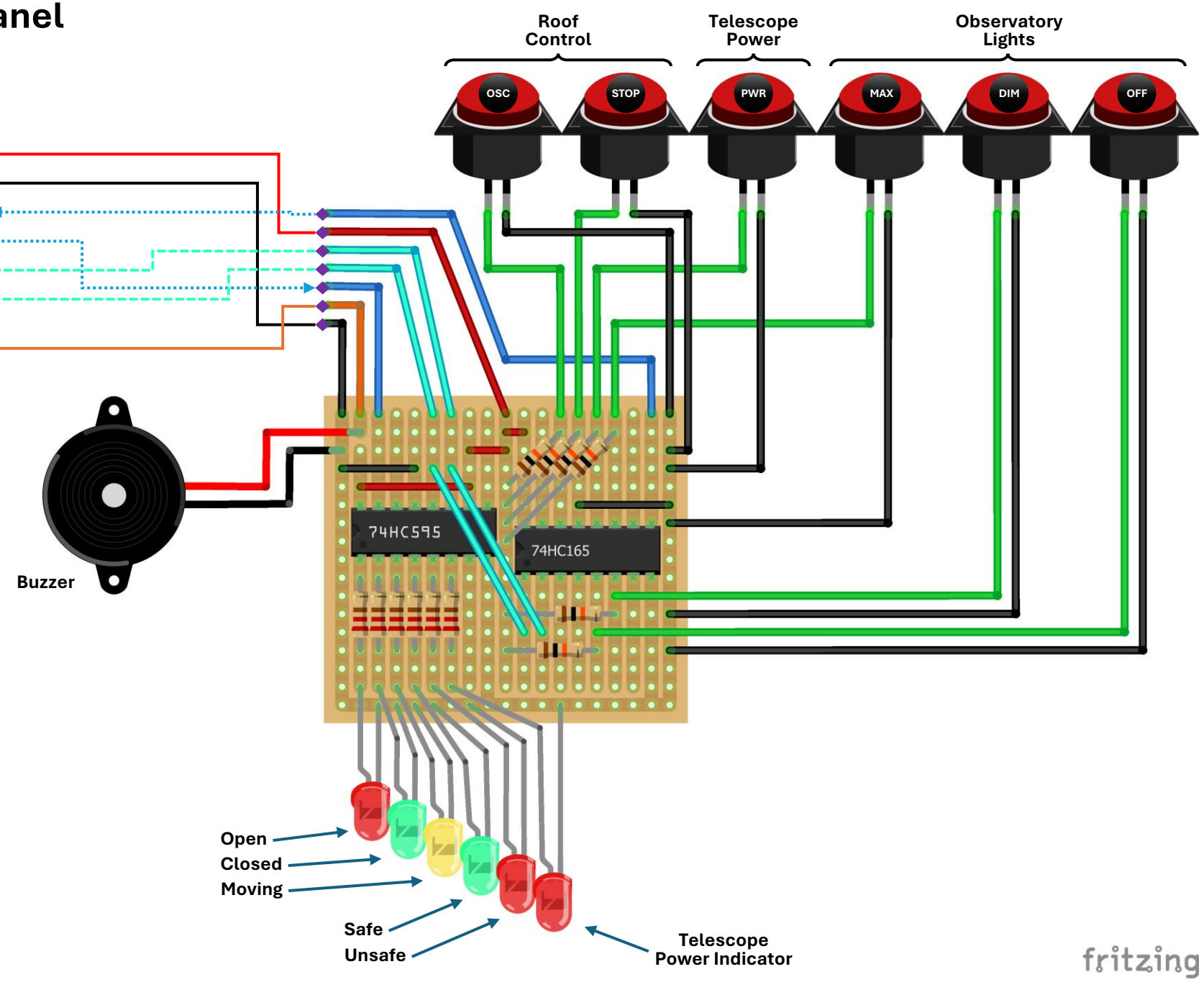
- All 4 mechanisms only allow roof movement when telescope is “safe” (i.e. RA & DEC axes are parked in safe position, as measured by external reed switches on mount.
- A local buzzer will sound if roof movement is not allowed.
- LEDs on control panel provide visual indicators of roof and telescope status. To reduce the number of wires running between the User Interface Panel and the ROR Control Box (and allow a CAT6 cable to be used), a 74HC595 shift register is integrated into the user interface panel to control all the local LEDs. This allows up to 8 LEDs be controlled using just 5 wires. The remaining 3 wires carry the pushbutton switch signals. Similarly, a 74HC165 shift register is used to multiplex the button commands onto a single data wire.

Wiring Diagram: User Interface Panel

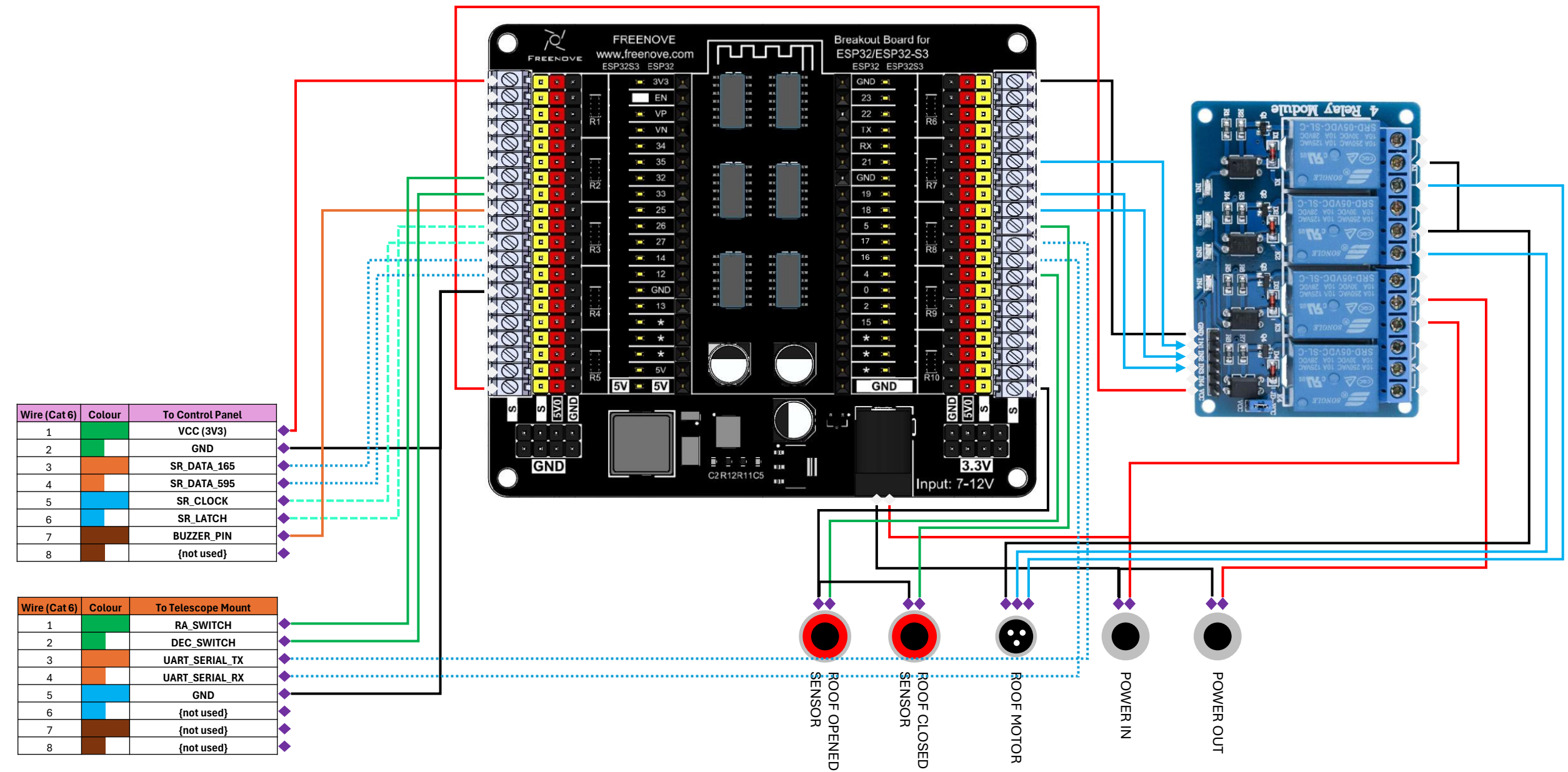


PCB Layout: User Interface Panel

Wire (Cat 6)	Colour	To Control Panel
1		VCC (3V3)
2		GND
3		SR_DATA_165
4		SR_DATA_595
5		SR_CLOCK
6		SR_LATCH
7		BUZZER_PIN
8		{not used}



Wiring Diagram: ROR Control Box



Wire (Cat 6)	Colour	To Control Panel
1		VCC (3V3)
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3		SR_DATA_165
4		SR_DATA_595
5		SR_CLOCK
6		SR_LATCH
7		BUZZER_PIN
8		{not used}

Wire (Cat 6)	Colour	To Telescope Mount
1		RA_SWITCH
2		DEC_SWITCH
3		UART_SERIAL_TX
4		UART_SERIAL_RX
5		GND
6		{not used}
7		{not used}
8		{not used}