**Hardware Support Documentation – Stoplight Control System**

**1. Overview**

The Stoplight Control System is built on a Raspberry Pi and is designed to control a physical stoplight (LEDs) via GPIO. This document describes the hardware components, wiring, common issues, troubleshooting steps, and escalation guidelines related to the hardware.

**2. Hardware Components**

• **Raspberry Pi:**

The system runs on a Raspberry Pi 5

• **Stoplight LEDs:**

Typically three LEDs representing:

• **Green LED:** Indicates “Go”

• **Yellow LED:** Indicates “Caution”

• **Red LED:** Indicates “Stop”

• **Resistors:**

Each LED is connected through an appropriate resistor (typically 220Ω to 330Ω) to limit the current and protect the LEDs.

• **Breadboard & Jumper Wires:**

Used for prototyping the circuit connections.

• **GPIO Interface Library:**

The Flask application uses **gpiod** (via the Linux GPIO character device) to control the hardware. Ensure that the Pi’s GPIO pins are enabled and correctly configured.

**3. Wiring Diagram & File Structure**

**3.1 Wiring Diagram (Simplified)**

+3.3V (or 5V)

│

[Resistor]

│

LED (Red/Yellow/Green)

│

GPIO Pin

│

GND

• **GPIO Pin Assignments (as per stoplightv2.py):**

• **Red LED:** Connected to GPIO 17

• **Yellow LED:** Connected to GPIO 27

• **Green LED:** Connected to GPIO 22

*(Note: Verify these pin numbers against your actual wiring and code.)*

**3.2 File Structure**

/home/pi/stoplightv2

├── stoplightv2.py # Main Flask application

└── templates

└── stoplightv2.html # Web interface for the system

**4. Common Hardware Issues & Troubleshooting**

**4.1 LED Not Lighting Up**

• **Symptoms:**

• LED remains off when expected to be lit.

• **Troubleshooting Steps:**

1. **Check Wiring:**

• Ensure each LED is connected correctly: the resistor, LED, and ground.

• Verify that the correct GPIO pins are used per your code.

2. **Resistor Value:**

• Confirm that the resistor values are within the recommended range (typically 220Ω to 330Ω).

3. **Test LED Individually:**

• Use a multimeter or a simple test circuit to check if each LED lights up when connected to a power source.

4. **Check Connections:**

• Ensure that jumper wires and breadboard connections are secure and not loose.

**4.2 No Response from GPIO (Hardware Interface)**

• **Symptoms:**

• The Flask application commands do not result in any change in LED state.

• **Troubleshooting Steps:**

1. **Verify GPIO Access:**

• Confirm that the Pi’s GPIO is enabled.

• Check that no other process (or daemon) is interfering with gpiod (e.g., ensure pigpiod is not running if you are using gpiod).

2. **Permissions:**

• Ensure that the user running the Flask application has the necessary permissions to access GPIO. If running as a non-root user, verify that they are in the appropriate group (often gpio or similar).

3. **Check Logs:**

• Review system and application logs for errors related to GPIO access.

**4.3 Hardware Damage or Component Failure**

• **Symptoms:**

• One LED consistently fails to light regardless of troubleshooting.

• **Troubleshooting Steps:**

1. **Swap Components:**

• Replace the LED with a known-good LED.

• Try a different resistor.

2. **Inspect the Circuit:**

• Look for signs of physical damage on the breadboard or loose connections.

3. **Consult Schematics:**

• Review the wiring schematic to confirm that all components are connected as intended.

**5. Escalation Procedures**

If Tier 1 support cannot resolve a hardware-related issue, escalate with the following information:

• **Detailed Description:**

• Describe the symptoms (e.g., which LED(s) are not lighting, or if there is no response from the GPIO).

• **Troubleshooting Steps Taken:**

• List the steps you have already tried (wiring checks, individual LED tests, etc.).

• **Wiring Diagrams/Photos:**

• Provide a wiring diagram or photos of the physical setup.

• **Logs/Output:**

• Include any error messages from the Flask logs or system logs.

• **Environment Details:**

• Specify the Raspberry Pi model, OS version, and any relevant hardware modifications.

**6. Contact Information for Tier 2 Support**

For unresolved issues, please contact Tier 2 support with the above details via the designated support channel (e.g., email or ticket system).

This document is intended as a quick-reference guide for Tier 1 hardware support for the Stoplight Control System. Feel free to modify or expand it to suit your specific environment and troubleshooting process.

You can now print this document for your support desk. Let me know if you need further modifications or additional details!