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**Project NavyScope: Stellarium Integration & Precision Focusing Protocol**

**1. The Challenge**

Stellarium provides a digital database of celestial coordinates (Right Ascension/Declination)[1]. However, the physical telescope operates in the real world, where "perfect focus" changes based on internal pressure, temperature, and atmospheric turbulence[2].

Objective: Use Stellarium to identify the target, then use the Samsung S25's processing power to lock focus on it physically.

**2. System Architecture: The "Digital Bridge"**

We will run **Stellarium Mobile Plus** directly on the **Samsung Galaxy S25**. The phone acts as both the star chart and the focus controller.

**The Workflow**

1. **Locate (Stellarium):** User selects a target (e.g., "Jupiter") in the database.
2. **Slew (Manual/Mount):** Telescope is pointed at the target coordinates.
3. **Acquire (Camera Feed):** The object appears on the Canon R5 Live View.
4. **Lock (NavyScope App):** User taps the object on the screen to engage the "High-Pressure Autofocus."

**3. Operational Procedure**

**Phase 1: Database Target Selection**

- **Action:** Open Stellarium on the Samsung S25.
- **Method:** Use the **Sensor View** feature in Stellarium. Input your telescope's specifications (Focal Length: ~1000mm, Sensor Size: Full Frame).
- **Result:** Stellarium displays a rectangular box on the sky chart representing exactly what your Canon camera sees. This confirms you are looking at the correct star field[3333].

**Phase 2: The "Infinity Handoff"**

- **The Physics:** All objects in the Stellarium database (Stars, Planets) are effectively at optical infinity.
- **The Problem:** "Infinity" shifts. As your telescope pressurizes to 1.5 atm, the refractive index of the air inside changes, and the titanium tube expands slightly. A fixed "infinity setting" on a lens will be blurry.
- **The Fix:** We use the database only to confirm *identity*. We rely on the **Contrast Detection Algorithm** (from your Python script) for *clarity*.

**Phase 3: Execution (The "Tap-to-Focus")**

Once the telescope is roughly pointed at the target found in Stellarium:

1. **Switch to NavyScope App:** The Samsung S25 displays the live video feed from the Canon R5 via USB.
2. **Identify Target:** You see a bright (likely blurry) dot in the center.
3. **Tap the Target:** You touch the dot on the screen.
4. **Automated Routine Triggers:**
    - **Step A (ROI Isolation):** The Python script draws a "Region of Interest" (ROI) box around the star[444].
    - **Step B (Contrast Peak Search):** The Arduino drives the stepper motor. The App calculates the "Laplacian Variance" (sharpness score) 30 times per second[5].
    - **Step C (Micro-Step Lock):** The motor oscillates slightly (+/- 10 steps) to find the absolute highest contrast value, then holds position.

**4. Advanced Implementation: "Stellarium Scripting"**

*For a future update, we can automate the 'Slew' command.*

Stellarium supports a "Telescope Control Plugin" that can send commands over the same USB connection[6].

- **Code Concept:** We can write a Python script that listens to Stellarium. When you select "Mars" in Stellarium, it sends a signal to the NavyScope app:
    - TARGET: MARS
    - MAGNITUDE: -2.0 (Very Bright)
- **Adaptive Gain:** The NavyScope app reads this brightness data. If the target is bright (Mars), it lowers the Canon ISO automatically so the autofocus has a clean, non-blown-out edge to lock onto.

**5. Summary Checklist**

| **Component** | **Role** | **Source** |
|---|---|---|
| **Stellarium** | Finds the object and confirms Field of View. | [7] |
| **Samsung S25** | Runs both Stellarium (Map) and NavyScope (Controller). | [8] |
| **Python Script** | Performs the "Contrast Detection" math on the live feed. | [9] |
| **Microscope Lens** | Moves physically to adjust focus based on the math. | [10] |

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