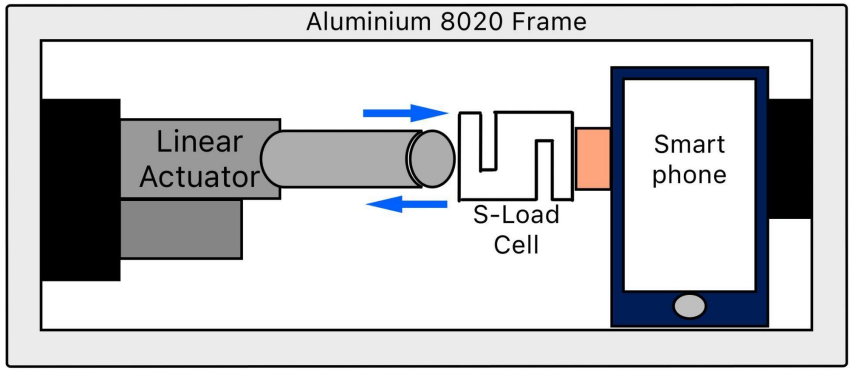
Initial Design

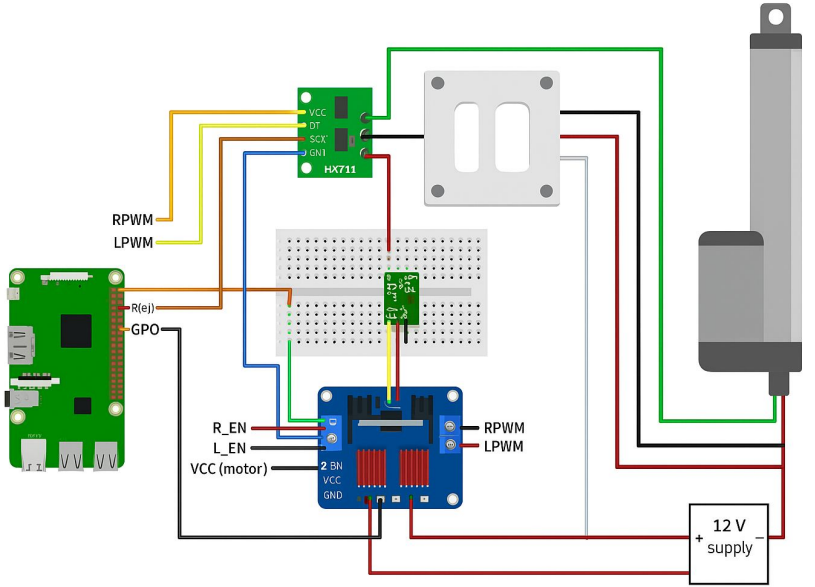
Components

- **Linear Actuator**: Applies controlled force to the smartphone.
- **Raspberry Pi 5**: Controls and coordinates all components.
- **Load Cell**: Measures the applied force.
- **HX711 Amplifier**: Amplifies signals from the load cell.
- **H-Bridge Motor Driver**: Powers the linear actuator with 12V.
- **Aluminium 8020**: Provides structural support.

Plan for Rig Setup



Circuit



Raspberry Pi – Linear Actuator Setup

Pin Setup

🟥 **Power Circuit**

- **BTS7960 VCC** → Pi 5V (Pin 2)
- **BTS7960 GND** → Pi GND (Pin 6) and 12V power supply GND
- **BTS7960 M+ and M-** → 12V linear actuator terminals
- **12V Power Supply** → + to BTS7960 VCC (B+), – to GND (B-)

🟦 **Control Pins from Raspberry Pi to Actuator**

- **RPWM** → GPIO 27 (PWM) (Pin 13)
- **LPWM** → GPIO 22 (PWM) (Pin 15)
- **R_EN** → Pin 4 (5V PWR)
- **L_EN** → GPIO 17 (Pin 11)

Enable Pins (R_EN, L_EN):
These pins are held **high at all times** to keep the motor driver active, allowing the control logic to function. They are not used for direction switching in this setup.

Direction Control:
The **direction of motion** is controlled by the **polarity of the voltage** applied to the linear actuator terminals, determined by the state of the **RPWM** and **LPWM** signals:

- **Forward Motion:** LPWM = HIGH, RPWM = LOW
- **Reverse Motion:** RPWM = HIGH, LPWM = LOW

PWM Signal Use:
The **PWM pins** (RPWM, LPWM) are used not only for direction but also to **modulate speed**.

- In the **first test**, fixed HIGH/LOW signals generate a basic to-and-fro motion.
- In the **second test**, the **duty cycle** of the PWM signal is varied at a fixed frequency to control the **speed of actuator movement**.

HX711 Amplifier Setup

Pin Setup

🔌 HX711 → Load Cell Connections

- 🔴 **E+ (Excitation +)** → **Red** wire (Power to Load Cell)
- ⚫ **E− (Excitation −)** → **Black** wire (Ground to Load Cell)
- 🟢 **A+ (Signal +)** → **Green** wire (Load Cell output)
- ⚪ **A− (Signal −)** → **White** wire (Load Cell output)

🖥️ HX711 → Raspberry Pi Connections

- 🟠 **DT (Data)** → Connect to **GPIO** pin – GPIO2
- 🔵 **SCK (Clock)** → Connect to **GPIO** pin – GPIO3
- 🔺 **VCC** → Connect to **5V** on Raspberry Pi
- ⚫ **GND** → Connect to **Ground** on Raspberry Pi