E-StoP.

Our robot uses a hardware emergency stop button that directly drives a relay cutting power to all actuators, including the wheel and manipulator motors.
This ensures the robot stops immediately even if the Arduino or ROS fails.

The Arduino monitors the emergency stop state using a separate contact for software coordination, but safety does not rely on software.

After an emergency stop, the robot does not resume automatically. A manual reset is required, ensuring controlled and predictable recovery.

EMERGENCY STOP DESIGN

- Hardware E-STOP button directly controls a relay that cuts actuator power (TB6600, DM542, servos).

- Arduino does NOT enforce physical safety. It only monitors E-STOP state via a separate contact.

- When E-STOP is pressed:
  * Relay drops → motors lose power
  * Arduino latches EMERGENCY_STOP
  * All ENABLE pins are disabled

- Releasing the E-STOP does NOT resume motion.
  A manual reset command is required.

- This design ensures safe stop even if:
  * Arduino crashes
  * USB disconnects
  * ROS or Jetson fails

Switch code: 11
1,2 are normal closed
3,4 are normal opened

E-STOP has:

1× NC contact (Normally Closed)
1× NO contact (Normally Open)

NC contact → relay coil (power cut)
NO contact → Arduino input (status)

A) NC contact → RELAY (HARD SAFETY) - Terminals 1–2 (NC)

Wiring Map:

+24V (or +12V)
  |
  |----[E-STOP NC (1–2)]----[Relay Coil]---- GND

Behavior:
Button released → circuit closed → relay energized → motors powered
Button pressed → circuit opens → relay drops → motors DEAD

B) NO contact → ARDUINO - Terminals 3–4 (NO)

Wiring Map:

Arduino D12 ----[E-STOP NO (3–4)]---- GND

pinMode(ESTOP_PIN, INPUT_PULLUP);

Button	**NO contact**	**D12 reads**
Released	**Open**	**HIGH**
Pressed	**Closed**	**LOW**

What happens electrically, when Switch is pressed:

- Relay drops → motor power cut
- Arduino DOES NOT lose power
- Jetson DOES NOT lose power
- USB connection stays alive

What happens logically:

- **Arduino:**
  - latches EMERGENCY_STOP
  - disables ENABLE pins
  - keeps running firmware
- **Jetson:**
  - nodes keep running
  - Nav2 pauses
  - wheel_command_bridge may keep publishing (ignored)

Everything is frozen.

When you pull the E-STOP back out:

- Arduino is still alive
- USB never disconnected
- No reboot
- No state loss

Final Architecture: