Technical Documentation & User Guide

1. System Overview (LandingGear)

This system controls a Dual-Arm Central Motorized Maneuvering/Stand Assist System, enabling secure parking and ultra-low-speed movement of a motorcycle. It integrates safety, synchronization, and data logging features.

Based on the Arduino Nano R4 platform (ABX00143) and its Connector Carrier module (ASX00061), the system includes:

- Two motors controlled by BTS7960 drivers (left/right)
- Current monitoring via ACS712 30A sensors
- Hybrid limit switches: mechanical (TZ-8122) for retraction, virtual (current threshold) for deployment
- Dynamic synchronization via current feedback
- Logging to microSD card (LOG.TXT) for post-event analysis
- Automatic lockout if GPS speed exceeds 25 km/h and automatic retraction if speed ≥ 30 km/h
- User interface with buttons and arm LED

2. Wiring Diagram

Component	Role	Arduino Connection
BTS7960 Left	Left motor driver	EN=A6, RPWM=A3, LPWM=A2
BTS7960 Right	Right motor driver	EN=D3, RPWM=D6, LPWM=D7
ACS712 30A Left	Left current sensor	A0
ACS712 30A Right	Right current sensor	A1
TZ-8122 Limit Switches	Retracted position detection	D9 (left), D8 (right)
Arm Button	System activation	A7
Command Button	Deploy / Retract	D10
Calibration Button	Sensor calibration	D2
Arm LED	Arm status indicator	D5
GPS NEO-M8N	Speed and position	RX=D0, TX=D1
microSD Card	Logging via SPI	CS=D4

3. Technical Operation

System States

- REST: arms stopped, waiting for action
- DEPLOYMENT: arms lowering
- RETRACTION: arms raising
- FAULT: safety shutdown (overload, desynchronization, timeout)

Integrated Safety

- Overload: shutdown if current > configured threshold
- Desynchronization: shutdown if only one arm reaches its limit
- Timeout: shutdown if action exceeds 1.5 seconds
- GPS speed: lockout if > 25 km/h

Motor Synchronization

- Read left/right current
- Calculate difference
- Dynamically adjust PWM to balance arms

EEPROM

- Stores sensor offsets, thresholds, last state and direction
- Validated via checksum

Logging

- Events recorded in LOG.TXT on SD card
- Examples: action start, fault, cycle end, max currents

4. User Guide

Startup

1. Power the system (12V → 5V via converter)
2. Insert FAT32-formatted microSD card
3. Ensure arms are retracted
4. Press and hold the calibration button (D2) for 5 seconds to calibrate sensors

Normal Operation

1. Press the arm button (A7) → LED D5 lights up
2. Briefly press the command button (D10)
    - If arms are retracted → deployment
    - If arms are deployed → retraction
3. The system automatically synchronizes the motors
4. At the end of the action, returns to REST state

In Case of Fault

- LED D5 turns off
- Motors shut down
- Check logs on SD card
- Recalibrate if needed
- Restart the system

Recommended Tests

Test	Method	Expected Result
Sensor Calibration	Long press on D2	Offsets updated
Overload Detection	Simulate >15A	Safety shutdown
Desynchronization	Block one arm	Safety shutdown
Timeout	Simulate >1.5s blockage	Safety shutdown
GPS Lockout	Simulate speed >25 km/h	LED off, system locked
Deployment Stop	Deploy to mechanical stop	Immediate stop, current ≈ 6.0A

5. GPS Safety – Lockout & Automatic Retraction

The system includes dual safety logic based on GPS speed to protect the equipment.

1. Lockout if Speed ≥ 25 km/h (Deployment Prevention)

- Condition: Arms are retracted and speed exceeds 25 km/h
- Action: System locks to prevent unsafe operation:

- Arm LED (D5) turns off
- Motors shut down
- Command button ignored
- System remains locked while speed is too high

2. Automatic Retraction if Speed ≥ 30 km/h (Emergency Stop)

- Condition: Arms are deployed and speed reaches or exceeds 30 km/h
- Action: System triggers emergency retraction:

1. Arms retract automatically
2. System enters LOCKED state:

- Arm LED turns off
- Motors shut down
- Command button ignored
- Next button press will trigger safe deployment

Post-Safety Behavior

- Once arms are retracted, system remains locked while speed ≥ 25 km/h
- When the motorcycle stops or drops below threshold, arming is re-enabled

Sample LOG.TXT Entries

8. Robustness & Precision

- Intelligent motor synchronization via current feedback (P-only)
  - Formula: CorrectionPWM = (I_G - I_D) × K_P with K_P = 20.0f
- Noise filtering using readAdcAvg() (16 samples)
- 14-bit ADC for maximum precision on Nano R4

9. Configuration Management

- EEPROM with magic number for validation
- Saves thresholds, offsets, state and direction
- Non-blocking SD logging via logEvent()