NERO SENSE - SYSTEM B (LIDAR RADAR)

High-Performance Tactical Radar Unit

1. Overview

The **Nero Sense System B** is a standalone, high-precision radar unit designed for the Nero Robotics ecosystem. It utilizes a **Time-of-Flight (TOF) Laser Sensor** to map its surroundings with millimeter accuracy and displays the data on a circular **Retina-Grade IPS Display**.

2. Hardware Specs

- **MCU**: Wemos D1 Mini (ESP8266) @ 80MHz
- **Display**: 1.28" Round IPS LCD (GC9A01 Driver) - 240x240 px
- **Sensor**: VL53L1X (TOF0400C) Laser Distance Sensor (Range: 4m)
- **Actuator**: SG90 Micro Servo (Modified for 180° sweep)

3. Wiring Configuration

Component	Pin Name	Wemos Pin	Description
Display	VCC	3.3V	Power
	GND	GND	Ground
	SCL	D5 (GPIO 14)	SPI Clock
	SDA	D7 (GPIO 13)	SPI MOSI
	RES	D0 (GPIO 16)	Reset
	DC	D3 (GPIO 0)	Data/Command

Component	Pin Name	Wemos Pin	Description
	CS	D8 (GPIO 15)	Chip Select
Sensor	VCC	3.3V	Power
	GND	GND	Ground
	SDA	D2 (GPIO 4)	I2C Data
	SCL	D1 (GPIO 5)	I2C Clock
Servo	PWM	D6 (GPIO 12)	Control Signal
	VCC	5V	Power (Direct from USB)
	GND	GND	Ground

4. Firmware Features (Final Version)

A. Cinematic Boot Sequence

A procedural animation sequence that plays on startup:
1. **Singularity**: A single white pixel expands.
2. **Pulse**: Organic "heartbeat" animation.
3. **Ignition**: Cyan ring wipe clears the screen.
4. **Identity**: "NERO ROBOTICS" logo with glitch effect.
5. **Flash**: White screen flash before radar activation.

B. "Tron" Visualization Engine

- **Connected Contours**: Instead of drawing unconnected dots, the engine draws continuous **Cyan Lines** connecting measurement points, creating a solid "wall" effect.
- **Jump Filter**: Prevents connecting foreground objects to background walls (Threshold: 300mm).
- **Hatched Shadows**: Casts dark **Navy Blue** shadow lines behind detected objects to the edge of the screen, simulating occlusion.
- **Data Smoothing**: Implements a **Low Pass Filter** (70% Old / 30% New) to eliminate sensor jitter and create fluid motion.

- **Active Clearing**: The red scanner line actively wipes old data before drawing new readings.

C. Hybrid Network Manager

- **Static IP**: `192.168.178.71` (Gateway: `192.168.178.1`)
- **Fallback Mode**: Attempts to connect for 5 seconds. If WiFi fails, it seamlessly switches to **Standalone Mode** (Red Dot) without blocking the radar loop.
- **WebSocket**: Broadcasts JSON data `{"angle": X, "distance": Y}` to the Nero Dashboard.

D. Stability Systems

- **I2C Bus Reset**: Manually toggles the SCL line on startup to unstick any frozen I2C slaves.
- **Retry Loop**: Attempts to initialize the sensor 5 times before reporting a failure.
- **Watchdog Prevention**: Uses non-blocking `millis()` timers for all servo and sensor operations.

5. Installation

1. **Install Libraries** (via Arduino Library Manager):
   - `TFT_eSPI` (Bodmer)
   - `VL53L1X` (Pololu)
   - `Servo` (Built-in)
   - `WebSockets` (Markus Sattler)
2. **Configure TFT_eSPI**:
   - Edit `User_Setup.h` in the library folder.
   - Select `GC9A01_DRIVER`.
   - Map pins as shown in the Wiring section.
3. **Upload**:
   - Board: "LOLIN(WEMOS) D1 R2 & mini"
   - Upload Speed: 921600
   - Flash Size: 4MB (FS:2MB OTA:~1019KB)

Generated by Antigravity for Nero Robotics
Date: 2025-12-14