Wonrabai ESP32-S3-LCD-1.28

Wonrabai ESP32-S3-LCD-1.28 Development Board User Manual

Model: ESP32-S3-LCD-1.28 | Brand: Wonrabai

1. Introduction

The Wonrabai ESP32-S3-LCD-1.28 is a low-cost, high-performance microcontroller development board designed by Waveshare. It integrates a 1.3-inch round IPS LCD with 240x240 resolution, a portable recharge manager, and a 6-axis sensor (3-axis accelerometer and 3-axis gyroscope). This design facilitates rapid development and product integration.

The board utilizes the ESP32-S3R2 System-on-Chip (SoC), which features low-power Wi-Fi and Bluetooth 5.0 capabilities. It includes an external 16MB Flash and 2MB PSRAM. The SoC also incorporates hardware encryption accelerators, a Random Number Generator (RNG), HMAC, and a digital signature module, addressing IoT security requirements. Its various low-power operating modes are suitable for IoT, mobile devices, wearables, smart homes, and other application scenarios.

Figure 1: Wonrabai ESP32-S3-LCD-1.28 Development Board with round LCD display.

2. Key Features

- Equipped with Xtensa LX7 dual-core 32-bit processor, operating at up to 240 MHz.
- Supports 2.4 GHz Wi-Fi (802.11 b/g/n) and Bluetooth 5 (BLE), with an integrated antenna.
- Built-in 512 KB SRAM and 384 KB ROM, with 2 MB integrated PSRAM and an external 16 MB Flash memory.
- Integrated 1.3-inch round IPS LCD display with 240x240 resolution and 65K colors.
- Integrated QMI8658 6-axis IMU (3-axis accelerometer and 3-axis gyroscope) for motion gesture detection.
- Integrated 3.7V lithium battery recharge/discharge header and GPIO headers.
- 30 multi-functional GPIO pins with configurable pin functions for flexible development and integration.
- USB Type-C connector for modern connectivity and ease of use.
- Supports flexible clocking and independent power supply configuration for low power consumption in various scenarios.
- Integrated with a full-speed USB serial port controller, allowing flexible GPIO pin function configuration.

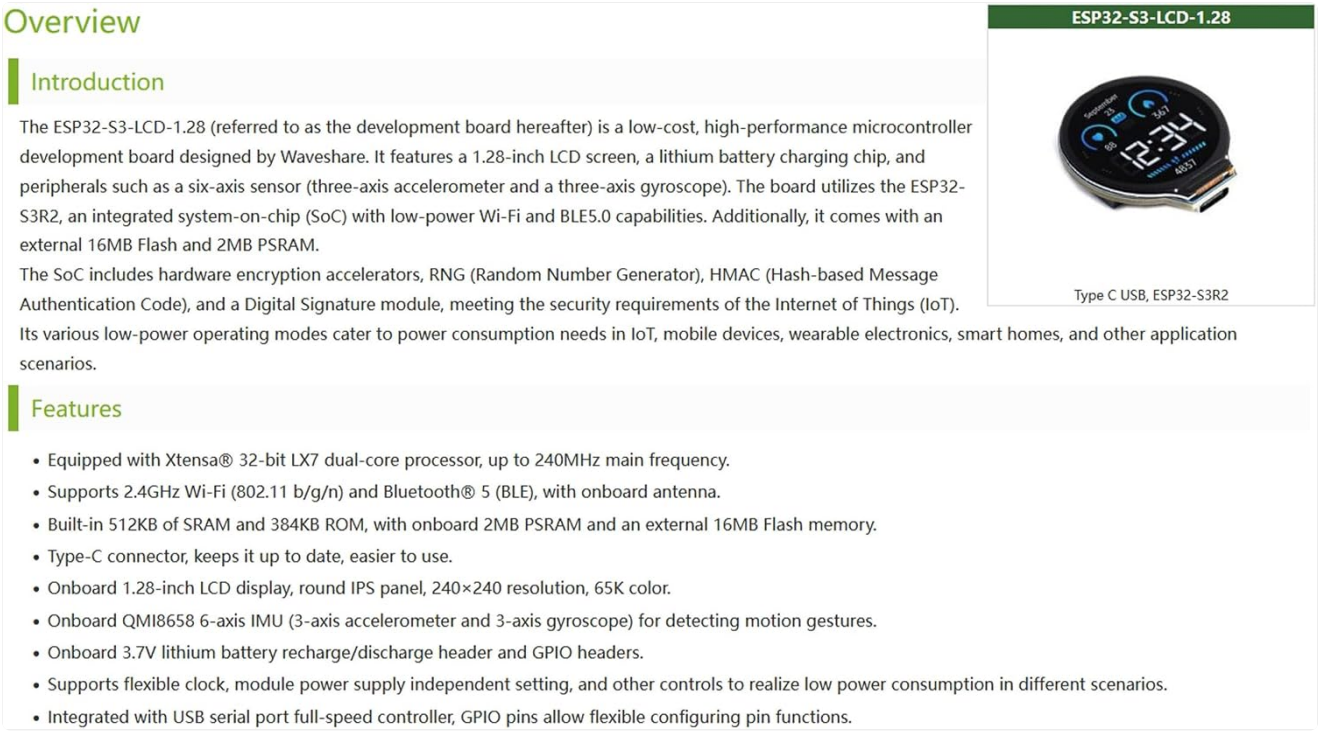

Figure 2: Overview of the ESP32-S3-LCD-1.28 board highlighting its key features.

3. What's On Board

The following diagram illustrates the main components and their locations on the ESP32-S3-LCD-1.28 development board.

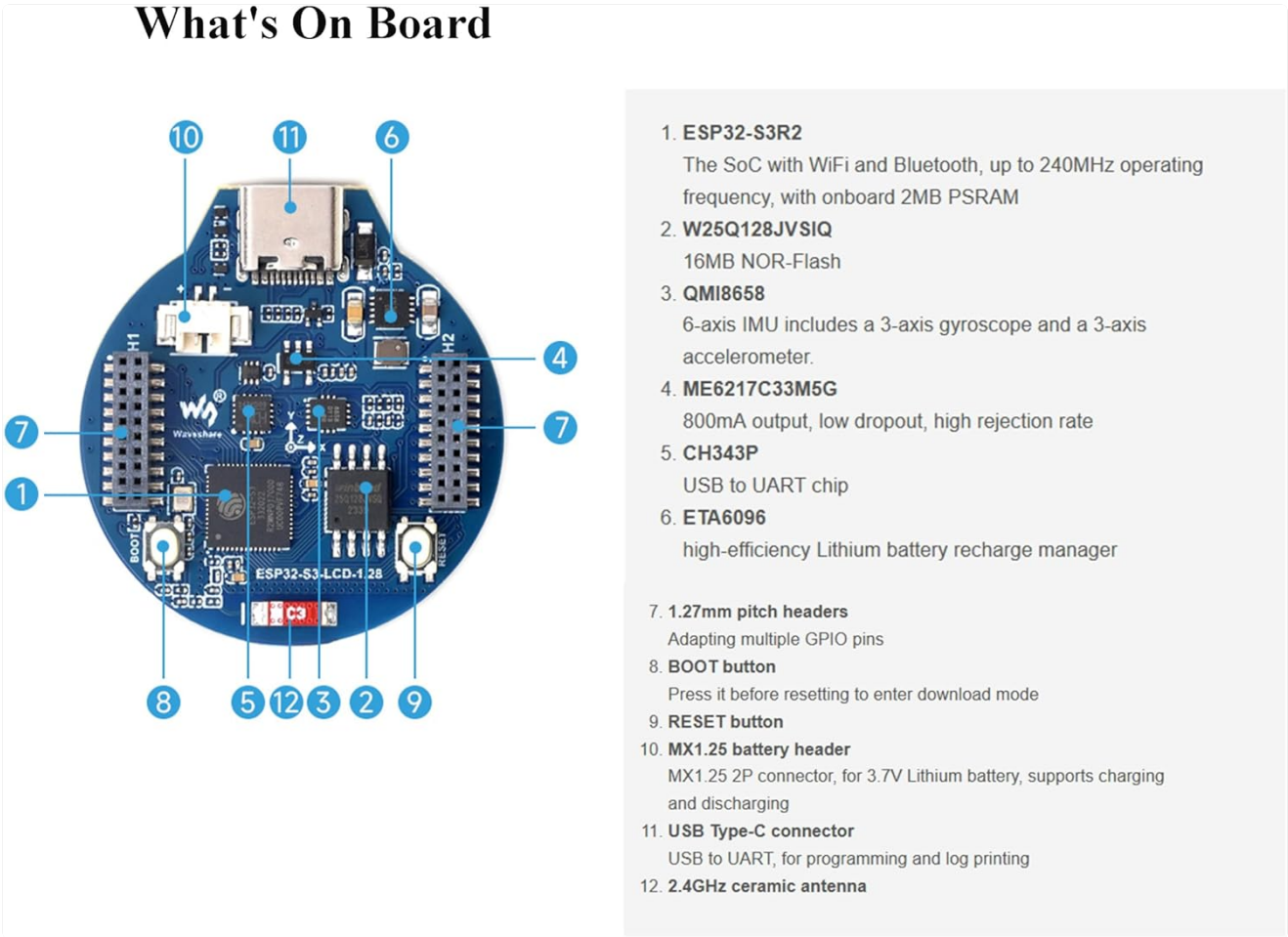

Figure 3: Detailed view of the board's components.

1. **ESP32-S3R2:** The System-on-Chip (SoC) with Wi-Fi and Bluetooth, operating up to 240MHz, with onboard 2MB PSRAM.
2. **W25Q128JVSIQ:** 16MB NOR-Flash memory.
3. **QMI8658:** 6-axis IMU, including a 3-axis gyroscope and a 3-axis accelerometer.
4. **ME6217C33M5G:** 800mA output, low dropout, high rejection rate.
5. **CH343P:** USB to UART chip for serial communication.
6. **ETA6096:** High-efficiency Lithium battery recharge manager.
7. **1.27mm pitch headers:** Adapting multiple GPIO pins for external connections.
8. **BOOT button:** Press before resetting to enter download mode.
9. **RESET button:** Resets the board.
10. **MX1.25 battery header:** MX1.25 2P connector, for 3.7V Lithium battery, supports charging and discharging.
11. **USB Type-C connector:** USB to UART, for programming and log printing.
12. **2.4GHz ceramic antenna:** Integrated antenna for wireless communication.

4. Specifications

Detailed technical specifications for the ESP32-S3-LCD-1.28 development board.

4.1. General Specifications

- **Brand:** Wonrabai
- **Model Name:** ESP32S3
- **Memory Storage Capacity:** 16 MB (Flash)
- **Connectivity Technology:** USB, Wi-Fi
- **Processor Count:** 2 (Dual-core LX7)
- **Total USB Ports:** 1 (Type-C)
- **Included Components:** ESP32-S3-LCD-1.28 x1

4.2. LCD Parameters

Parameter	Value	Parameter	Value
Display Chip	GC9A01A	Display Interface	SPI
Resolution	240(H)RGB x 240(V)	Display Size	Φ32.4mm
Display Panel	IPS	Pixels	0.135 (H) x 0.135 (V) mm

4.3. IMU Parameters (QMI8658)

Sensor Name	Value
Resolution	16-bit
Accelerometer Measurement Range (Optional)	±2, ±4, ±8, ±16g
Gyroscope Resolution	16 bits
Gyroscope Measurement Range (Optional)	±16, ±32, ±64, ±128, ±256, ±512, ±1024, ±2048°/sec

Parameters

LCD Parameter			
Display Chip	GC9A01A	Display Interface	SPI
Resolution	240(H)RGB x 240(V)	Display Size	Φ32.4mm
Display Panel	IPS	Pixels	0.135 (H) x 0.135 (V) mm

IMU Paramters	
Sensor Name	QMI8658
Accelerator	Resolution: 16-bit Measurement Range (Optional): ±2, ±4, ±8, ±16g
Gyroscope Characteristics	Resolution: 16 bits Measuremnet Range (Optional): ±16, ±32, ±64, ±128, ±256, ±512, ±1024, ±2048°/sec

Notes

- When using the development board, pay attention to the ceramic antenna area and avoid covering the ceramic antenna with PCB boards, metal, or plastic components.
- The board is equipped with an efficient charging and discharging management chip, ETA6096, and an MX1.25 battery interface. The charging current is currently set to 1A, and users can change the charging current by replacing the R15 resistor. Connect a 3.7V single-cell lithium battery, and for more details, please refer to the schematic diagram. It is recommended to use a 3.7V single-cell lithium battery with a capacity of 500mAh or below.
- To prevent overcharging and over-discharging of the battery, stop discharging when the fully charged 4.2V lithium battery discharges to 3.7V.

Figure 4: Technical parameters for the integrated LCD and IMU.

5. Pinout and Hardware Description

The ESP32-S3-LCD-1.28 board provides numerous GPIO pins for flexible connectivity and expansion. Understanding the pinout is crucial for custom applications.

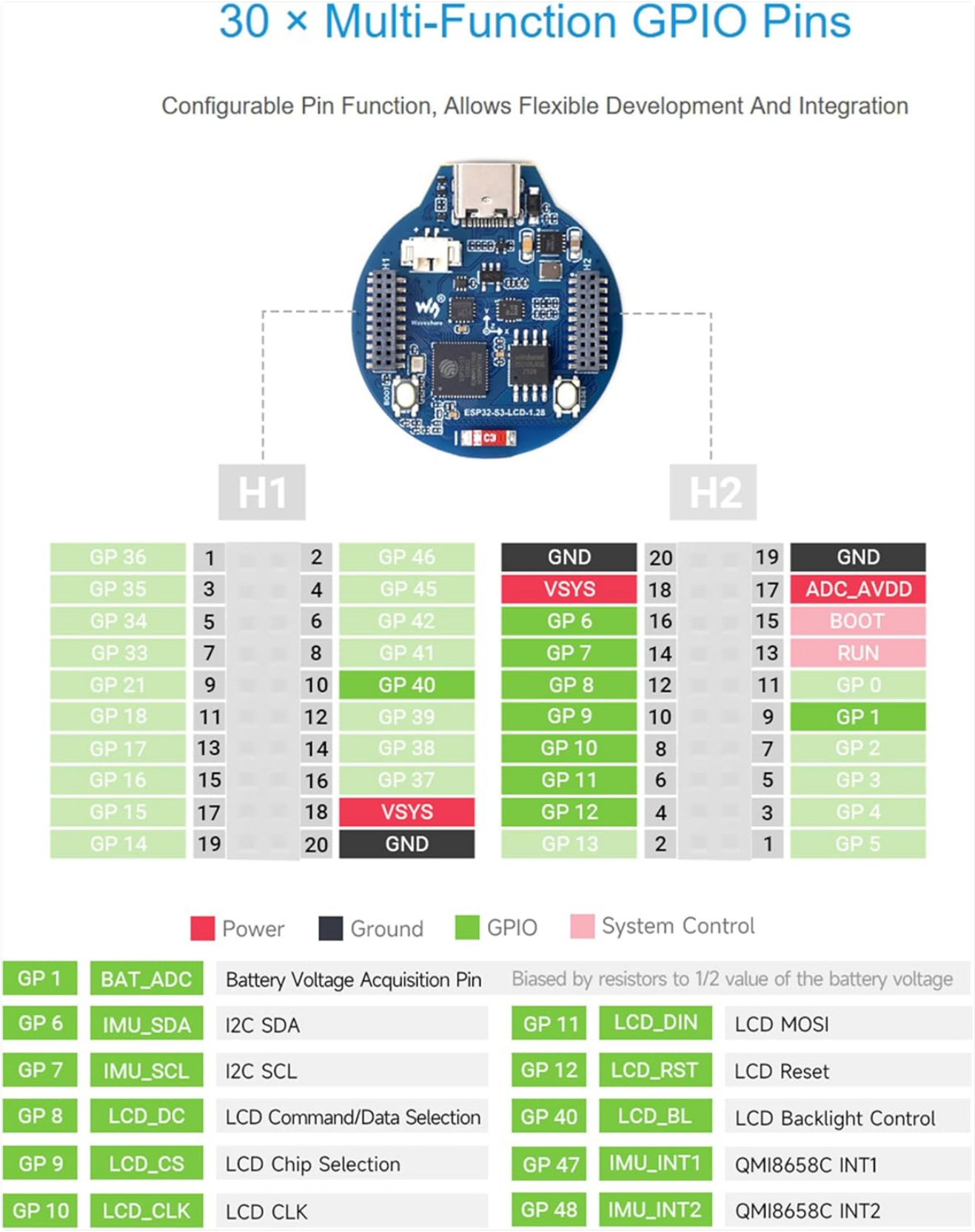

Figure 5: GPIO pin assignments and functions.

5.1. Hardware Interfaces

- **Type-C Interface:** The development board uses the CH343P chip for USB to UART communication. Connect the UART_TXD (GPIO43) and UART_RXD (GPIO44) of ESP32-S3 for programming and log printing. Automatic download circuit allows firmware to be downloaded directly after connecting the Type-C cable.
- **1.27mm Pitch Headers:** These headers expose most of the GPIOs for external connection. GPIOs can be configured for I2C, SPI, and other peripheral functions. VSYS can directly input 5V to power the development board.

- **LCD Interface:** The onboard 1.28-inch screen uses 4-wire SPI communication. SPI rate can be increased to 80MHz. I2C communication (development board using GPIO2) controls the backlight brightness. GPIO4 and GPIO5 can be soldered on their own with small-current devices such as vibration motors.
- **I2C Interface:** ESP32-S3 provides multiple hardware I2C interfaces. GPIO6 (SDA) and GPIO7 (SCL) pins are used for I2C bus. The onboard QMI8658 six-axis inertial measurement unit and LCD touch control chip are integrated via I2C.
- **MX1.25 Connector:** GPIO1 of the development board is used to measure the battery voltage. The battery voltage is connected to GPIO1 using a 200K and 100K series voltage divider. The ESP32-S3 series has two 12-bit SAR ADC measurement units. The source code converts the voltage to the formula 3.3 / (1+2) * AD_Value.

Hardware Description

Onboard Interface

- **Type-C Interface**: The development board uses the CH343P chip for USB to UART, connecting the UART_TXD (GPIO43) and UART_RXD (GPIO44) of ESP32-S3 for firmware programming and log printing. With the automatic download circuit, the firmware can be downloaded directly after connecting the Type-C cable.
- **1.27mm Pitch Headers**: The development board leads to most of the GPIOs for external connection, GPIOs can be configured to I2C, SPI, and other peripheral functions, VSYS can directly input 5V to power the development board.
- **LCD Interface**: Development board on-board 1.28-inch screen with 4-wire SPI communication, SPI rate can be increased to 80MHz, touch using I2C communication (development board using GPIO2 to control the brightness of the backlight, in addition to lead out of the two MOS tubes to control the switching contacts around the battery holder, respectively, connected to the GPIO4, GPIO5, can be welded on their own with small-current devices such as vibration motors, etc., for more information, please see the Schematic).
- **I2C Interface**: ESP32-S3 provides multiple hardware I2C, currently using GPIO6 (SDA) and GPIO7 (SCL) pins for I2C bus. Onboard the QMI8658 six-axis inertial measurement unit and LCD touch control chip. For more information, please see the Schematic.
- **MX1.25 Connector**: GPIO1 of the development board is used to measure the battery voltage pin, the battery voltage is connected to GPIO1 using 200K and 100K series voltage divider, the ESP32-S3 series has two 12Bit SAR ADC measurement units, the source code is converted to the voltage formula is 3.3 / (1<<12) * 3 * AD_Value.

PINOUT

ESP32-S3R2	LCD	MX1.25	QMI8658	other
GPIO0				BOOT0
GPIO1		ADC		
GPIO5	TP_INT			
GPIO6			SDA	
GPIO7			SCL	
GPIO8	LCD_DC			
GPIO9	LCD_CS			
GPIO10	LCD_CLK			
GPIO11	LCD_MOSI			
GPIO12	LCD_RST			
GPIO40	LCD_BL			
GPIO47			INT1	
GPIO48			INT2	

Figure 6: Detailed hardware interface descriptions and pin mapping table.

5.2. Pinout Table

Pin	ESP32-S3R2	LCD	MX1.25	QMI8658	Other
GPIO0	GPIO0				BOOT0
GPIO1	GPIO1		ADC		
GPIO5	GPIO5	TP_INT			
GPIO6	GPIO6			SDA	

Pin	ESP32-S3R2	LCD	MX1.25	QMI8658	Other
GPIO7	GPIO7			SCL	
GPIO8	GPIO8	LCD_DC			
GPIO9	GPIO9	LCD_CS			
GPIO10	GPIO10	LCD_CLK			
GPIO11	GPIO11	LCD_MOSI			
GPIO12	GPIO12	LCD_RST			
GPIO40	GPIO40	LCD_BL			
GPIO47	GPIO47			INT1	
GPIO48	GPIO48			INT2	

6. Setup Guide

6.1. Initial Connection

To begin using your ESP32-S3-LCD-1.28 development board, connect it to your computer using a USB Type-C cable. The board will power on and establish a serial communication link via the integrated CH343P USB to UART chip. This connection is used for both power and data transfer, including programming and debugging.

6.2. Software Environment Setup

For programming the ESP32-S3, you will typically use the Espressif IoT Development Framework (ESP-IDF) or Arduino IDE with ESP32 board support.

- **Drivers:** Ensure your operating system has the necessary drivers for the CH343P USB-to-UART chip. These are usually installed automatically, but may require manual installation on some systems.
- **Development Environment:** Install your preferred ESP32 development environment. Refer to the official Espressif documentation or community guides for detailed setup instructions.
- **Online Resources:** For comprehensive tutorials and documentation, refer to the online resources provided by the manufacturer. A common resource link is n9.cl/grkoe.

6.3. Battery Connection (Optional)

The board supports a 3.7V single-cell lithium battery via the MX1.25 2P connector. This allows for portable operation and battery management.

- Connect a 3.7V single-cell lithium battery (e.g., 500mAh or below) to the MX1.25 battery header (component 10 in Figure 3).
- The integrated ETA6096 chip manages battery charging and discharging.
- *Note:* The board is equipped with an efficient charging and discharging management chip, ETA6096, and an MX1.25 battery interface. The charging current is set to 1A. Users can change the charging current by replacing the R15 resistor. It is recommended to use a 3.7V single-cell lithium battery with a capacity of 500mAh or below.

7. Operating Instructions

7.1. Powering On and Display

Once connected via USB or battery, the board will power on. The integrated 1.3-inch round IPS LCD will activate. You can program the ESP32-S3 to display various information, graphics, or user interfaces on this screen.

Figure 7: Example of the onboard LCD display in use.

7.2. Programming and Development

The ESP32-S3-LCD-1.28 is designed for flexible programming.

- **Firmware Upload:** Connect the board to your computer via the Type-C USB port. Use your chosen

development environment (e.g., ESP-IDF, Arduino IDE) to compile and upload your code. The automatic download circuit simplifies this process.

- **GPIO Usage:** Utilize the 30 multi-functional GPIO pins (exposed via 1.27mm pitch headers) to connect external sensors, actuators, or other modules. Refer to the pinout diagram (Figure 5) and pinout table for specific assignments.
- **IMU Integration:** The integrated QMI8658 6-axis IMU can be accessed via I2C (GPIO6/SDA, GPIO7/SCL) to detect motion gestures, acceleration, and angular velocity.
- **Wi-Fi and Bluetooth:** Leverage the integrated 2.4 GHz Wi-Fi and Bluetooth 5 (BLE) capabilities for wireless communication in your projects.

7.3. Low Power Operation

The ESP32-S3 supports various low-power modes. You can configure flexible clocking and independent power supply settings for different modules to optimize power consumption, making it suitable for battery-powered applications.

8. Maintenance and Care

- **Antenna Care:** When using the development board, pay attention to the ceramic antenna area. Avoid covering the ceramic antenna with PCB boards, metal, or plastic components, as this can degrade wireless performance.
- **Battery Management:** To prevent overcharging and over-discharging of the battery, stop discharging when the fully charged 4.2V lithium battery discharges to 3.7V. Always use appropriate battery protection circuits if not relying solely on the onboard manager.
- **Cleaning:** Keep the board clean and free from dust and debris. Use a soft, dry brush or compressed air for cleaning. Avoid using liquids.
- **Storage:** Store the board in a dry, anti-static environment when not in use.

9. Troubleshooting

- **Board Not Powering On:**
  - Ensure the USB Type-C cable is securely connected to both the board and your computer/power source.
  - If using a battery, verify it is charged and correctly connected to the MX1.25 header.
  - Try a different USB cable or port.
- **Firmware Upload Failure:**
  - Check if the correct COM port is selected in your development environment.
  - Ensure the necessary USB-to-UART drivers (CH343P) are installed.
  - Press and hold the BOOT button (component 8) while pressing and releasing the RESET button (component 9) to enter download mode, then release BOOT.
  - Verify your code compiles without errors.
- **Display Not Working:**
  - Confirm that your code initializes the LCD correctly and sends data to it.
  - Check for any physical damage to the display or its connections.
  - Ensure the backlight (LCD_BL) is enabled in your software.
- **Wi-Fi/Bluetooth Connectivity Issues:**

- Ensure the ceramic antenna area is not obstructed.
- Verify your code correctly configures and initializes the Wi-Fi or Bluetooth module.
- Check for correct network credentials or pairing procedures.

10. Warranty and Support

For warranty information, technical support, and further assistance, please refer to the official Wonrabai website or contact their customer service directly. Online documentation and community forums often provide valuable resources for development boards like the ESP32-S3-LCD-1.28.