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Test Project

Module B1- Microcontroller Functionality Module

Electronics

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Introduction to Test Project

This Test Project module consists of the following documentation/files:

- WSC2026_TP16_MB1_actual_en.docx (this file)
- WSC2026_TP16_MB1_Environmental_Schematic.pdf (Environmental system Schematic)
- WSC2026_TP16_MB1_Main_Schematic.pdf (PCPU Board Schematic)
- WSC2026_TP16_DataSheets.zip (Data Sheets)
- WSC2026_TP16_MB1_CompletedCode.hex (Hex file All Tasks completed)
- WSC2026_TP16_MB1_StartingPoint (Programming template for the project)

Programs required on the computer to accomplish the task:

- STM32Cubelde Programming IDE
- STM32CubeProgrammer (Uploading Demo program)

Required hardware:

- ST-LINK/v2 STM32 Microcontrollers Debugging and Programming Device.
- Power Supply 24 V and pair of wires (depend on Power Supply).
- WorldSkills CPU Board (two pcs for each Competitor)
- Test Project Task Board (mother board)
- An oscilloscope can be used to measure signals

Introduction

In Part 1, you need to develop a testing program to verify whether the most important components in the hardware can function properly.

- You have 2 hours to complete Part 1.
- Some tasks are independent of each other, while others may depend on the previous task.
- When you complete Part 1, your CPU board will be collected. Please confirm that your program code has been burned and is working properly. The task board (motherboard) will not be collected.

- There is a demo hex file in the computer that you can burn into the test project hardware. This demonstration program demonstrates the functionality that you need to reproduce in your own program in the first part of the task.
- Start the task from the prepared template file (WSC2026_TP16_ESP_Part1_StartingPoint. zip). In this template, some modules, component interfaces, and initialization have already been implemented. All name definitions related to the task have also been defined.

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Description of Project and Tasks

In modern home scenarios, environmental adaptation and intelligent device linkage are core requirements for improving living comfort and convenience. The smart home environment system model integrates simulated sunlight tracking, photovoltaic simulation power supply, and multi scenario home device linkage functions, building a complete home ecosystem that integrates environmental simulation, energy simulation, and intelligent control.

The system is equipped with a simulated sunlight swing arm component, which is equipped with a lighting source and can rotate periodically from east to west according to preset time parameters, accurately simulating the trajectory of the sun; A solar panel is installed below the swing arm, which can output corresponding voltage according to the actual lighting angle changes. The circuit board is powered by 24V as the total power supply, and the output voltage of the solar panel is replicated through an adjustable power supply to compensate for the insufficient current supply of simulated photovoltaics and achieve stable simulated energy output.

At the same time, the system integrates diversified home execution equipment: semiconductor refrigeration chips with fans to achieve air conditioning cooling function, incandescent lamps simulate air conditioning heating function, DC motors drive electric curtains to achieve opening and closing control, servo motors control electric doors to achieve opening and closing action; Paired with fingerprint recognition module and human body infrared sensing module, it can complete identity verification and human body sensing detection, and support dual mode switching between fully automatic intelligent control and custom manual control of home devices.

The embedded programming (ESP) module adopts the smart home environment system model, and Competitors will write functions to implement core functions such as sunlight trajectory control, simulated energy regulation, intelligent linkage and manual control of home devices.

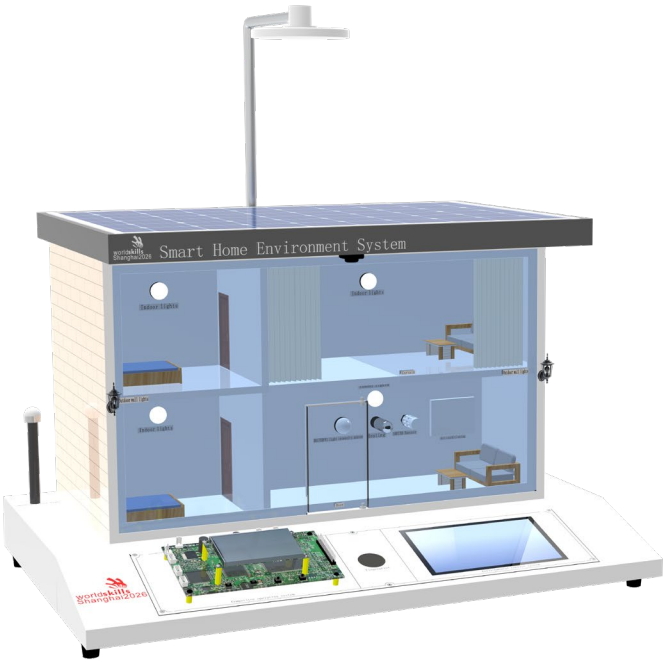


Figure 1 Smart Home Environment System

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Smart Home Environment System Diagram

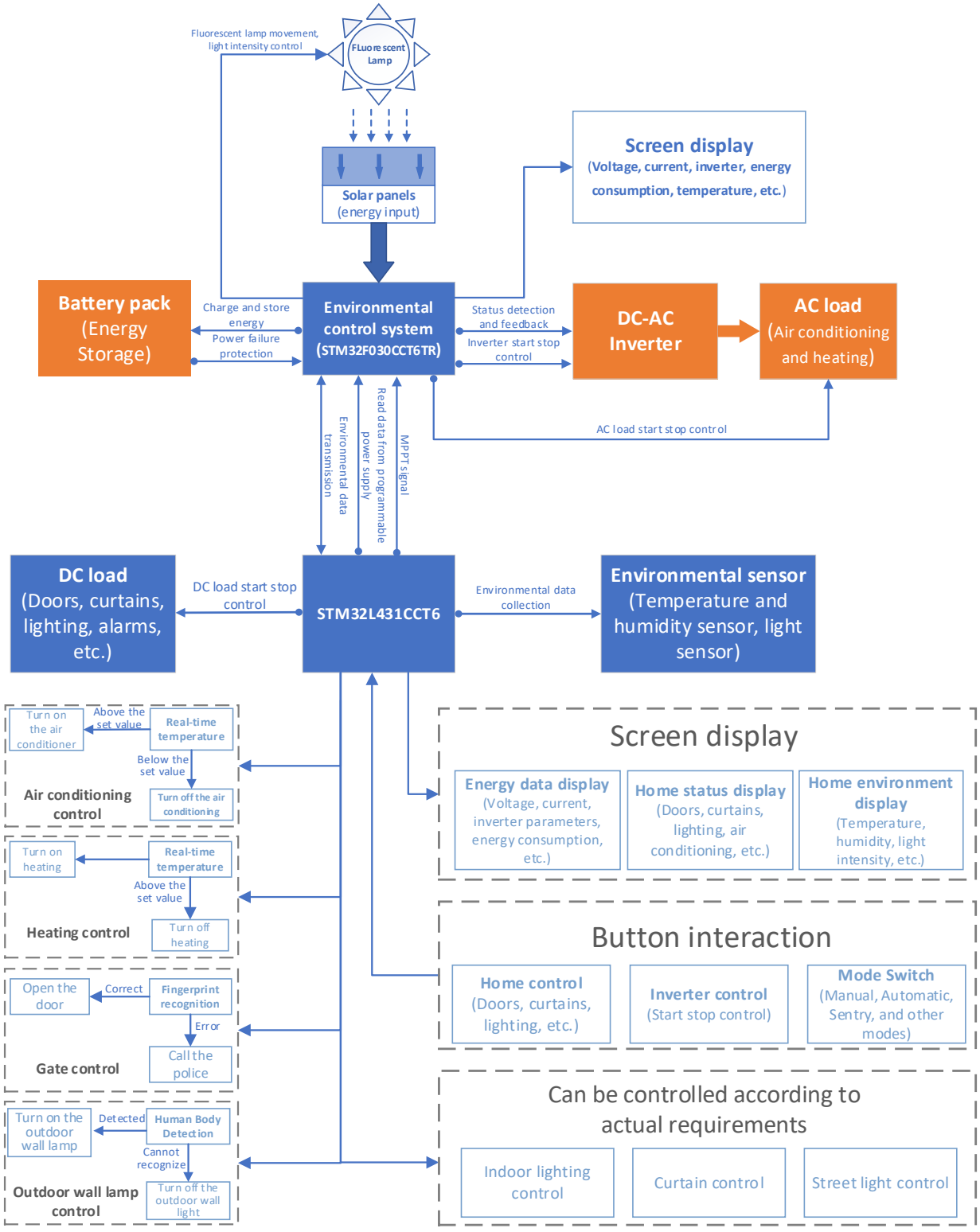


Figure 2 Smart Home Environment System Block Diagram

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Serial port screen firmware serial number diagram

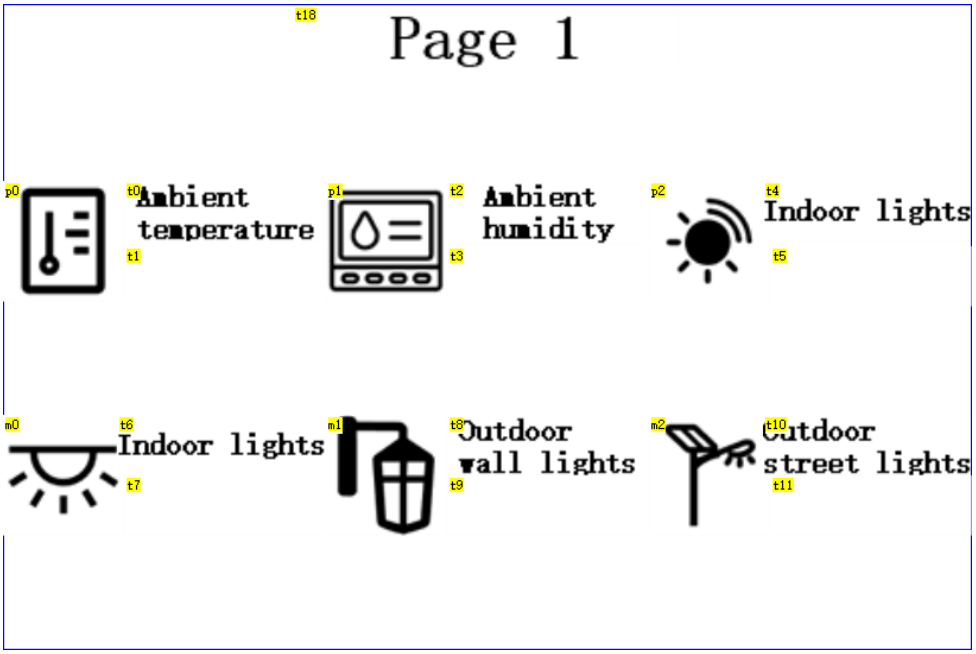


Figure 3 Serial Port Screen Page 1 Firmware Serial Number Indication Diagram

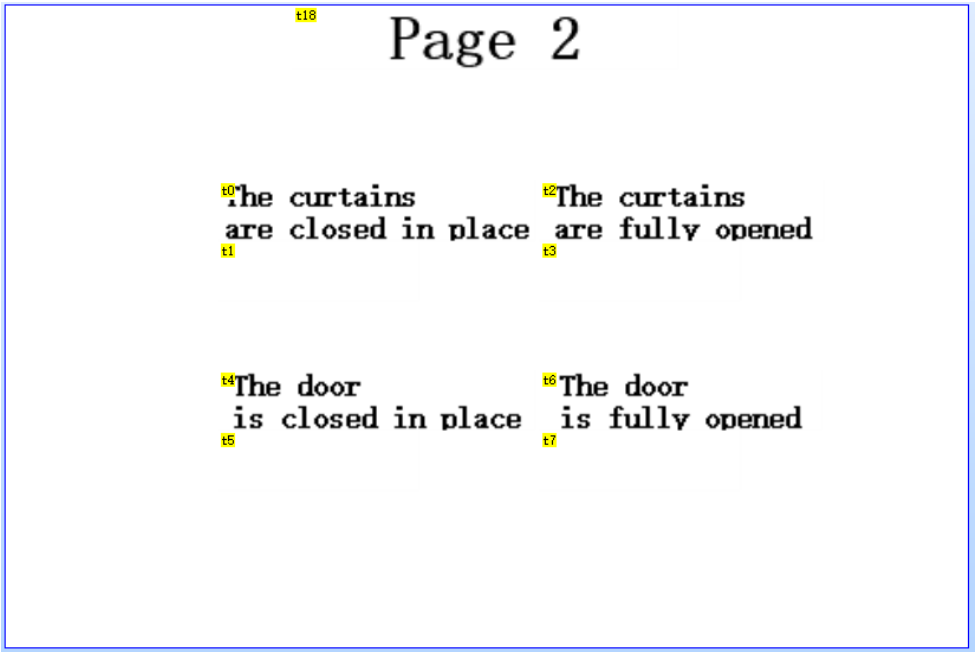


Figure 4 Serial Port Screen Page 2 Firmware Serial Number Indication Diagram

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CPU board connection and name

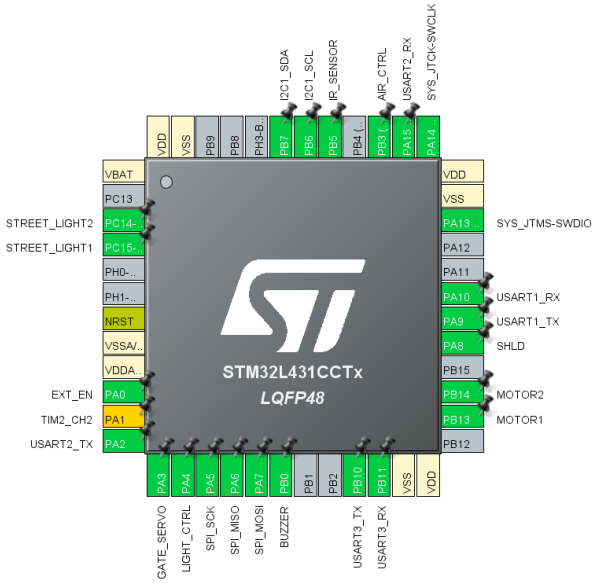


Figure 5: CPU Pin Connection Indicator Diagram

CPU PIN	GPIO MODE	PULL-UP/PULL DOWN	USER LABEL
PA0	Output Push Pull	No pull-up and -down	EXT_EN
PA1	/	/	/
PA2	Alternate Function Push Pull	No pull-up and -down	USART2_TX
PA3	Alternate Function Push Pull	No pull-up and -down	GATE_SERVO(TIM15CH2)
PA4	Output Push Pull	No pull-up and -down	LIGHT_CTRL
PA5	Output Push Pull	No pull-up and -down	SPI_SCK
PA6	Input mode	Pull-up	SPI_MISO
PA7	Output Push Pull	No pull-up and -down	SPI_MOSI
PB0	Output Push Pull	No pull-up and -down	BUZZER
PB10	Alternate Function Push Pull	No pull-up and -down	USART3_TX
PB11	Alternate Function Push Pull	No pull-up and -down	USART3_RX
PB13	Alternate Function Push Pull	No pull-up and -down	MOTOR1(TIM1CH1N)
PB14	Alternate Function Push Pull	No pull-up and -down	MOTOR2(TIM1CH2N)

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CPU PIN	GPIO MODE	PULL-UP/PULL DOWN	USER LABEL
PA8	Output Push Pull	No pull-up and -down	SHLD
PA9	Alternate Function Push Pull	No pull-up and -down	USART1_TX
PA10	Alternate Function Push Pull	No pull-up and -down	USART1_RX
PA15	Alternate Function Push Pull	No pull-up and -down	USART2_RX
PB3	Output Push Pull	No pull-up and -down	AIR_CTRL
PB5	Input mode	Pull-up	IR_SENSOR
PB6	Alternate Function Open Drain	No pull-up and -down	I2C1_SCL
PB7	Alternate Function Open Drain	No pull-up and -down	I2C1_SDA
PC14	Output Push Pull	No pull-up and -down	STREET_LIGHT2
PC15	Output Push Pull	No pull-up and -down	STREET_LIGHT1

Table 1: Pin connections and user labels of the CPU in the task

Programming

Task 1: Reading and Display of SHT30 Sensor Data

The Competitor needs to complete the reading of SHT30 sensor data and display it on the serial port screen. The sensor processing function SHT30, Handle has been called in the main loop. The Competitor needs to read the code and use the completed code and related display functions on the serial port screen to display temperature and humidity data in the t1 and t3 text firmware on Page 1. The temperature unit is ℃ and the humidity unit is%.

Task 2: Reading and Display of Light Intensity Sensor Data

Competitors need to read the data manual of the BH1750FVI light intensity sensor and write its relevant drivers. After reading the relevant light intensity data, call the relevant display function of the serial screen, and complete the update display of the light intensity data in the t5 text firmware of Page 1 interface. The light intensity display unit is Lx.

Task 3: Driver Programming for 74HC595

The Competitor needs to write a driver program for 74HC595 to control the on and off status of indoor lights and outdoor wall lights. The outdoor street lights are controlled by PC14 and PC15 of STM32L4. After completing the driver, the Competitor can make the indoor lights, outdoor wall lights, and outdoor street lights blink at a frequency of 1Hz (500ms ON, 500ms OFF) for testing.

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Task 4: Handling of touch on serial port screen

The Competitor needs to complete the processing of touch events on the serial port screen. The code for receiving and parsing touch data on the serial port screen has been completed. The Competitor needs to control the indoor lights, outdoor wall lights, and outdoor street lights in the corresponding parts, so that every time the indoor light icon is pressed on the serial port screen, the status of the indoor lights will be reversed, and the outdoor wall lights and outdoor street lights will be controlled in the same way.

Tips: At this stage, indoor lights, outdoor wall lights, and outdoor street lights do not need to flash at 1Hz. The flashing state is only used for Task 3 testing.

Task 5: Driver Programming for 74HC165

At this stage, the Competitor needs to write a driver program for 74HC165, which is used to read back the status of 4 buttons and 4 position switches (door open position signal, door close position signal, Curtain close position signal, Curtain open position signal) and achieve the following functions.

1. Press the SW2 button to switch to the serial port screen Page 2 page.
2. Press the SW1 button to switch to the serial port screen Page 1 page.
3. Press the SW3 button to control the curtain to complete a full opening and closing process.
4. Press the SW4 button to control the door to complete a full opening and closing process.
5. When the serial port screen is on Page 2, it is necessary to update the sensor signals for the curtain closing position, curtain opening position, door closing position, and door opening position in real-time on the t1, t3, t5, and t7 text firmware of the screen. When the sensor signal is 3.3V, you need to display 1 in the text firmware, and when the sensor signal is 0V, you need to display 0 in the text firmware.

Competitor Notice

You can download the completed code hex file your MCU if you want to verify your understanding of how the task should function. It is important that you save your last downloaded code to the competition directory. If your last download to the L431 is the completed code hex file, you will obtain 0 points for programming.

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