Team 12 Fingerprint Sensor Lock Box Testing

List

Unit Tests

1. **Power Supply Testing**
    - **Verify LM317T regulator provides a stable 3.3V output for ESP32.**
    - **Verify relay module receives 3.3V for actuation.**
    - **Confirm 5V output from the power supply matches specifications.**
2. **ESP32 Microcontroller**
    - **Test ESP32 boot sequence displays proper messages on serial monitor.**
    - **Verify all pins supply correct voltages as per design (e.g., 3.3V, 5V).**
    - **Run the "Blink" program to confirm code upload functionality.**
3. **R307 Fingerprint Sensor**
    - **Test successful enrollment of a fingerprint.**
    - **Verify matching functionality for enrolled fingerprints.**
    - **Test error handling for non-enrolled fingerprints and faulty connections.**
4. **RC522 RFID Module**
    - **Verify pin connections with a multimeter (e.g., continuity testing).**
    - **Test module functionality: scan valid and invalid RFID tags.**
5. **TFT LCD Display**
    - **Verify successful power-on (blank screen).**
    - **Test display functionality for dynamic text changes and color cycling.**
6. **Relay Module and Solenoid Lock**
    - **Verify relay receives appropriate signals from ESP32.**
    - **Confirm solenoid lock actuates correctly when powered.**

Verification Tests

1. **The system boots and displays the correct startup sequence on the LCD.**
2. **The fingerprint sensor successfully enrolls fingerprints and stores them in the database.**
3. **The system matches a scanned fingerprint against the database and grants/denies access appropriately.**
4. **The RFID module correctly identifies valid and invalid tags.**
5. **Solenoid lock unlocks when the correct fingerprint and RFID tag are scanned.**
6. **Solenoid lock relocks after a set timeout duration.**
7. **The LCD updates dynamically during operations (e.g., shows “Access Granted” or “Denied”).**
8. **Error messages display for failed sensor connections or invalid inputs.**
9. **Entire system functions under varying input voltages (e.g., 8V, 12V).**
10. **Database operations work: add, retrieve, delete, and clear fingerprints.**
11. **Relay and solenoid lock function without signal delays or mismatches.**
12. **Overall system integration handles sequential operations without malfunction (e.g., RFID → Fingerprint → Unlock).**

Validation Tests

1. **Requirement: Access Control**
    - **Test that only a valid RFID and fingerprint combination grants access.**
2. **Requirement: Power Reliability**
    - **Validate the system operates consistently at 12V power supply input.**
3. **Requirement: Error Handling**
    - **Test that an error is displayed when a non-enrolled fingerprint is scanned.**
    - **Simulate a disconnected fingerprint sensor and confirm error detection.**
4. **Requirement: User Feedback**
    - **Validate that all user actions (e.g., scanning RFID, placing a fingerprint) are acknowledged with correct LCD output.**
5. **Requirement: Lock Functionality**
    - **Confirm solenoid lock unlocks for 5 seconds and relocks automatically.**
6. **Requirement: Security**
    - **Test that unregistered RFID tags and fingerprints cannot gain access.**
7. **Requirement: Database Management**
    - **Validate addition, retrieval, and deletion of fingerprint records work as specified.**
8. **Requirement: Display Functionality**
    - **Ensure the TFT LCD correctly displays all critical statuses and instructions.**

Matrix Test

Test Author: Felix Moss, Anthony Le				
	Test Case Name:	Varying Input Voltage Test #1	**Test ID #:**	012
	Description:	We will be inputting several different voltages to our circuit and determining if it functions properly.	**Type:**	✅white box □ black box □ _____
Tester Information				
	Name of Tester:	Felix Moss	**Date:**	12/3/24
	HW/SW Version:	V2.3	**Time:**	4:25 PM
	Setup:	Attach Lab 12V DC Power Supply to PCB for testing.		

TEST	INPUTS	EXPECTED OUTPUTS	PASS	FAIL	N/A	Comments
1	3V3 Input Voltage	Circuit should perform as expected		❌		No circuit response
2	5V Input Voltage	Circuit should perform as expected		❌		ESP32 barely on, relay on, everything else off
3	8V Input Voltage	Circuit should perform as expected		❌		All circuit elements work except for the solenoid lock.

4	10V Input Voltage	Circuit should perform as expected		❌		All circuit elements work except for the solenoid lock.
5	12V Input Voltage	Circuit should perform as expected	✅			Circuit performs as normal
	Overall test result:		✅			Circuit performed as expected

Test Cases

Test Author: Anthony Le				
	Test Case Name:	ESP32 WROOM Blink Test and pin testing #1	**Test ID #:**	001
	Description:	*Testing the Wroom LED to make sure it can actually upload code and that all the pins that are used are properly working*	**Type:**	✅ white box □ black box □ _____
Tester Information				
	Name of Tester:	Anthony and Felix	**Date:**	12/1/2024
	HW/SW Version:	V2.3	**Time:**	5:31 PM
	Setup:	*Soldered Wroom to PCB and should blink and have all power pins supplying correct voltages*		

STEP	Action	Expected Result	PASS	FAIL	N/A	Comments
1	Power on the Wroom	A Red LED should light up on the board meaning there is power	✅			
2	Blinking LED	A program should run that will blink an led and display message via serial port	✅			
3	Check power test points	Make sure all the power pins are working properly		❌		3.3V was showing 0.7 V but we realized we soldered the Wroom backwards
	Overall test result:			❌		Need to fix the Wroom orientation and fix it again

Test Author: Anthony Le						
	Test Case Name:	ESP32 WROOM Blink Test and pin testing #2			**Test ID #:**	002
	Description:	*Testing the Wroom LED to make sure it can actually upload code and that all the pins that are used are properly working*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Anthony and Felix			**Date:**	12/1/2024
	HW/SW Version:	V2.3			**Time:**	5:31 PM
	Setup:	*Soldered Wroom to PCB and should blink and have all power pins supplying correct voltages*				
STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Power on the Wroom		✅			
2	Blinking LED		✅			
3	Check power test points		✅			
	Overall test result:		✅			After desoldering and resoldering the Wroom, it performed as expected

Test Author: Anthony Le						
	Test Case Name:	Software Fingerprint Sensor R307 Functionalities Test #1			**Test ID #:**	003
	Description:	*This test case evaluates the performance and functionalities of the R307 Fingerprint Sensor, including fingerprint enrollment, verification, database management, and error handling. The goal is to ensure that the sensor operates reliably and meets specified requirements under various conditions.*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Anthony Le			**Date:**	12/01/2024
	HW/SW Version:	V2.3			**Time:**	7:30 PM
	Setup:	*Hardware and software setup required for testing R307 Fingerprint Sensor and the connected AS609 chip.*				

STEP	Action	Expected Result	PASS	FAIL	N/A	Comments
1	Enroll a fingerprint onto the AS609 chip	Place a finger on the sensor, and the system should successfully scan and store the fingerprint. A message confirming the enrollment should be displayed, and the fingerprint data should be added to the database.	✅			ESP initially did not recognize fingerprints. It was identified as a pin connection issue and was quickly rectified.
2	Verify fingerprint	Place the same finger on the sensor. The system should recognize the fingerprint, match it to the stored data, and display a success message.	✅			
3	Display selected fingerprint information	Request details about a specific fingerprint using its ID. The system should retrieve and display relevant information, such as fingerprint ID or storage index.	✅			
4	Display all fingerprints stored on chip	Request a list of all stored fingerprints. The system should output all fingerprint IDs or indexes currently saved in the database.	✅			
5	Delete a selected fingerprint	Specify a fingerprint ID to delete. The system should remove the fingerprint from the database and confirm the deletion with a message.	✅			
6	Clear the fingerprint database	Issue a command to clear the database. The system should	✅			

		delete all fingerprints stored on the chip and display a confirmation message.				
7	Attempt to verify a non-enrolled fingerprint	Place an unregistered finger on the sensor. The system should fail to find a match, display an error message, and deny access.	✅			
8	Simulate a failed sensor connection	Disconnect the sensor or interrupt communication. The system should detect the issue and display an error indicating a failed connection or unavailability.	✅			
	Overall test result:		✅			Fingerprint scanner performed as expected.

Test Author: Anthony Le						
	Test Case Name:	ESP32 Power Testing #3			**Test ID #:**	004
	Description:	*Testing all power connections from ESP32 to external modules*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss, Anthony Le			**Date:**	12/1/24
	HW/SW Version:	V2.3			**Time:**	6:55 PM
	Setup:	*Multimeter with alligator clips used on different pins and test points*				

STEP	Action	Expected Result	PASS	FAIL	N/A	Comments
1	3V3 Test Point	Should display ~3.3V	✅			
2	5V Test Point	Should display ~5V	✅			
3	R307 VIN + GND	Should display ~3.3V	✅			
4	RC522 RFID 3V3 + GND	Should display ~3.3V	✅			
5	Relay Module DC+ + GND	Should display ~3.3V	✅			
6	ST7735 OLED VCC + GND	Should display ~3.3V	✅			
	Overall test result:		✅			All power connections matched expectations

Test Author: Felix Moss, Anthony Le							
	Test Case Name:	Software TFT LCD Display #1				**Test ID #:**	005
	Description:	*Testing software on the TFT LCD Display*				**Type:**	✅ white box □ black box □ _____
Tester Information							
	Name of Tester:	Felix Moss, Anthony Le				**Date:**	12/1/24
	HW/SW Version:	1.0				**Time:**	7:45 PM
	Setup:	*Connect all pins of LCD to appropriate pins on PCB*					
STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**	
1	Turn on display	Should display blank screen	✅				
2	Send signal from ESP32	Should display “Hello World” text and cycle through colors		❌			
	Overall test result:			❌		LCD only turned on, nothing displayed on screen.	

Test Author: Felix Moss, Anthony Le						
	Test Case Name:	Software TFT LCD Display Test #2			**Test ID #:**	006
	Description:	*Testing software on the TFT LCD Display*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss, Anthony Le			**Date:**	12/1/24
	HW/SW Version:	1.2			**Time:**	7:45 PM
	Setup:	*Connect all pins of LCD to appropriate pins on PCB*				

STEP	Action	Expected Result	PASS	FAIL	N/A	Comments
1	Turn on display	Should display blank screen	✅			
2	Send signal from ESP32	Should display “Hello World” text and cycle through colors	✅			
	Overall test result:		✅			Display performed as expected. Problem was determined to be a pin connection issue.

Test Author: Felix Moss, Anthony Le						
	Test Case Name:	RC522 RFID Pin Connections and Software Testing #1			**Test ID #:**	007
	Description:	*Testing the pin connections and the software for the RC522 RFID scanner by verifying connections and running test code.*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss, Anthony			**Date:**	12/1/24
	HW/SW Version:	V2.3			**Time:**	8:15 PM
	Setup:	*Attach probes to Multimeter. Attach RC522 to appropriate pins.*				
STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Test all RC522 pin connections	When touching the pin on the PCB to the corresponding pin on the ESP32, a beep should be heard	✅			
2	Turn on RC522	Should turn on red LED on scanner	✅			
3	Upload software	Scans for RFID card and UID. Displays “Access Granted” on serial monitor if ID is correct. Displays “Access Denied” on serial monitor if ID is incorrect	✅			
	Overall test result:		✅			RC522 performed as expected

Test Author: Felix Moss, Anthony Le						
	Test Case Name:	Relay Module and Solenoid Lock Test #1			**Test ID #:**	008
	Description:	*Testing the pin connections and the software for the Relay Module and Solenoid Lock*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss, Anthony			**Date:**	12/1/24
	HW/SW Version:	V2.3			**Time:**	8:45 PM
	Setup:	*Attach probes to Multimeter. Attach Relay Module and Solenoid Lock to appropriate pins.*				

STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Test all pin connections	When touching the pin on the PCB to the corresponding pin on the ESP32, a beep should be heard.		❌		Pin NO incorrectly routed. Fixed by connecting NO on the module directly to ground and leaving NO on the PCB unconnected.
2	Turn on Relay Module	A red LED should light up on the Relay Module when the ESP32 is powered on	✅			
3	Upload software	Solenoid lock should open and close	✅			
	Overall test result:		✅			The relay performed as expected. However, since the NO pin on the PCB is wired incorrectly, the NO pin on the relay had to be directly wired to ground.

Test Author: Felix Moss, Anthony Le						
	Test Case Name:	Full Integrated Test #1			**Test ID #:**	009
	Description:	*Testing the entire mechanism with all modules attached.*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss, Anthony			**Date:**	12/1/24
	HW/SW Version:	V2.3			**Time:**	9:30 PM
	Setup:	*Attach all modules to PCB. Run test software*				

STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Run startup software	Display should show text saying, “Booting up System…”, “Fingerprint Sensor And RFID Scanner Initializing…”, “Access Control System”, and Finger Sensor Ready”	✅			
2	Scan incorrect RFID	Display should show text saying, “Access Denied” and then return to “Scan RFID…”	✅			
3	Scan correct RFID	Display should show text saying, “RFID Valid” and then show, “Place finger”	✅			
4	Scan incorrect fingerprint	Display should show text saying, “Finger No Match” and then return to “Scan RFID”	✅			
5	Scan correct RFID	Display should show text saying, “Access Granted” and then show, “Place finger”	✅			
6	Scan correct fingerprint	Display should show text saying, “Access Granted, ID [User ID Number]”	✅			
7	Solenoid Unlocks	Solenoid should unlock and display should say, “ Unlocked”. The lock should close after 5 seconds.	✅			
8	Solenoid Locks	Solenoid should re-lock. The display should say, “ Locked”,	✅			

		then return to “Scan RFID…”				
	Overall test result:		✅			Mechanism performed as expected

Test Author: Felix Moss						
	Test Case Name:	LM317T Testing #1			**Test ID #:**	010
	Description:	*Testing the LM317T voltage regulator to see if it can power the ESP32 with a 12V source.*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss			**Date:**	12/3/2024
	HW/SW Version:	V2.3			**Time:**	12:30 PM
	Setup:	*Solder LM317T to board. Set DC power supply to 12V and attach to board. Attach probes to Multimeter.*				
STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Test LM317T pin connections	When touching the pin on the PCB to the corresponding pin on the ESP32, a beep should be heard.	✅			
2	Turn on 12V power	A Red LED should light up on the ESP32 meaning there is power		❌		No light appeared and the power supply showed signs of a short.
	Overall test result:			❌		Check all pin connections and rerun test

Test Author: Felix Moss						
	Test Case Name:	LM317T Testing #2			**Test ID #:**	011
	Description:	*Testing the LM317T voltage regulator to see if it can power the ESP32 with a 12V source.*			**Type:**	✅ white box □ black box □ _____
Tester Information						
	Name of Tester:	Felix Moss			**Date:**	12/3/2024
	HW/SW Version:	V2.3			**Time:**	12:30 PM
	Setup:	*Solder LM317T to board. Set DC power supply to 12V and attach to board. Attach probes to Multimeter.*				
STEP	**Action**	**Expected Result**	**PASS**	**FAIL**	**N/A**	**Comments**
1	Test LM317T pin connections	When touching the pin on the PCB to the corresponding pin on the ESP32, a beep should be heard.	✅			
2	Turn on 12V power	A Red LED should light up on the ESP32 meaning there is power	✅			
	Overall test result:		✅			Problem was determined to be a short of some kind and was quickly rectified.