

**Ain Shams University – Faculty of Engineering**  
**Computer Engineering and Software Systems Program**



**CSE211 - Introduction to Embedded**

**Home Appliance Control System**

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# 1. Introduction

This project explores the design and implementation of a mobile-based control system that integrates automation features with real-time monitoring capabilities.

The primary objective of this project is to develop a prototype system capable of controlling and monitoring essential household elements such as lights, electrical plugs, and door activity. Additionally, it emphasizes user safety and convenience by incorporating features like temperature monitoring, alarm system, and activity logging.

The prototype utilizes the **TM4C123GH6PM microcontroller**, a versatile and widely used embedded development platform, to execute various control and monitoring tasks. The microcontroller communicates with an application, providing users with a simple interface for appliance control and system monitoring.

Key functionalities include the ability to toggle lights and plugs on and off, display the door's status, monitor room temperature, trigger alarms for abnormal conditions, and maintain logs of door activity.

In summary, the project aims to create a user-friendly home appliance control system that balances technology with practicality. By using the TM4C123GH6PM microcontroller, this prototype provides a step toward smarter and more efficient home automation solutions.

## 2. System Design

This section will show all the hardware and software components used in the project and all the wiring diagrams.

### 2.1 Hardware Components

- TM4C123GH6PM microcontroller.
- 220V lamp and electrical plug.
- Temperature sensor: LM35.
- Limit switch for door status.
- Buzzer for alarm.
- Relay for controlling the lamp and plug.
- Wires.
- Switches.
- Mounting box and hidden wiring implementation.

## 2.2 Software Components

- Embedded C code for the Tiva C board.
- Java application for control.
- Communication protocol: UART.

## 2.3 Wiring Diagrams

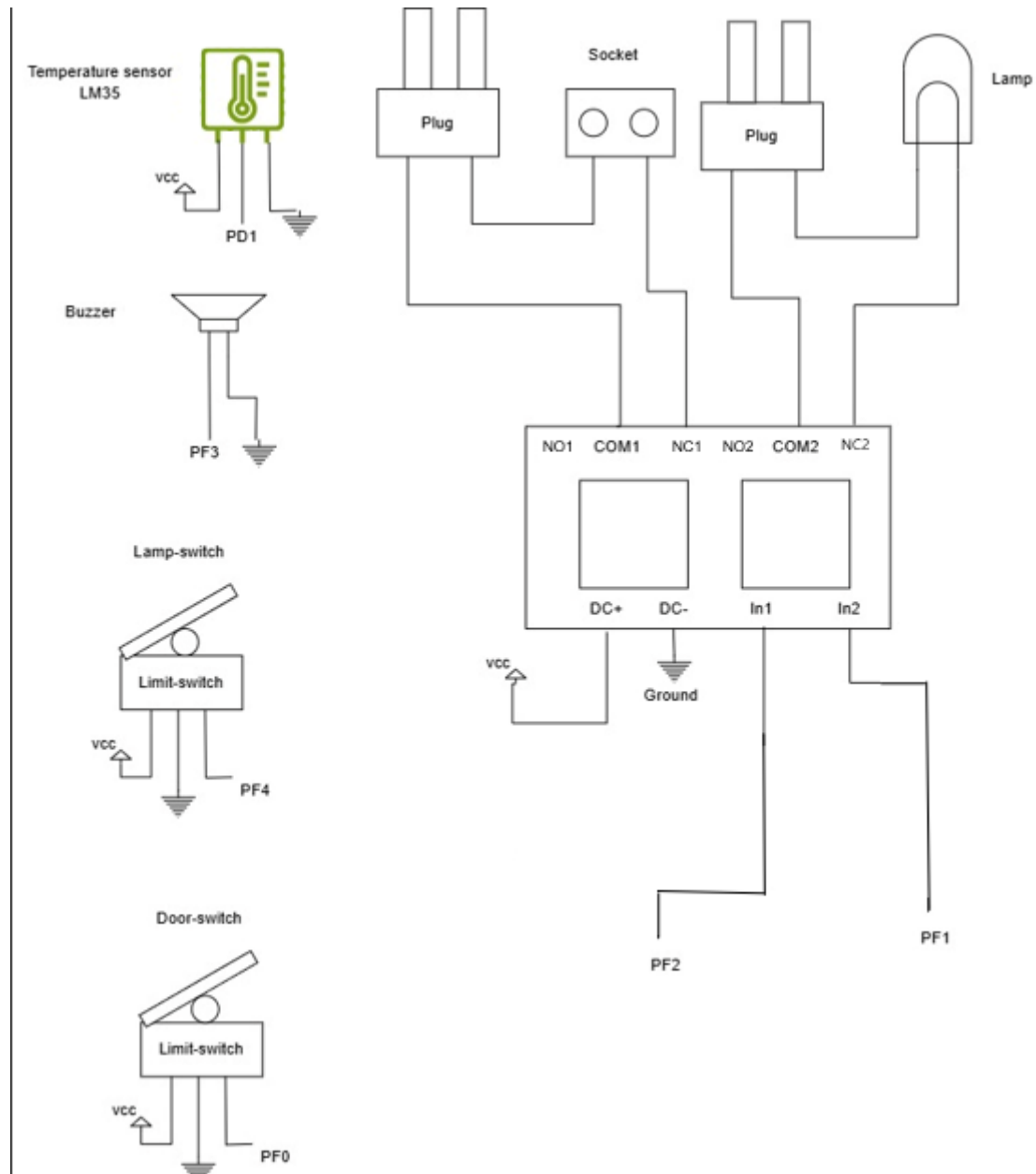


Figure 1 - Wiring Diagram

## 3. Features and Functionalities

### 1. Lamp Control

- On/Off via app and manual switch.

### 2. Plug Control

- On/Off via app and manual switch.

### 3. Door Status

- Real-time display, close/open through a limit switch.

### 4. Room Temperature

- Displayed in real-time and used for triggering alarms.

### 5. Temperature Alarm

- Software and hardware alarm mechanisms.

### 6. Door Activity Logging

- Time-stamped log for opening and closing events.

## 4. Application

### 4.1 Inputs

- a: Lamp off.
- b: Lamp on.
- c: Close Door.
- d: Open Door.
- e: Temperature Alarm off.
- f: Temperature Alarm on.

### 4.2 Outputs

- 0: Lamp off
- 1: Lamp on
- 8: Plug off
- 9: Plug on

## 5. Flowcharts

### 5.1 Main Program Flow

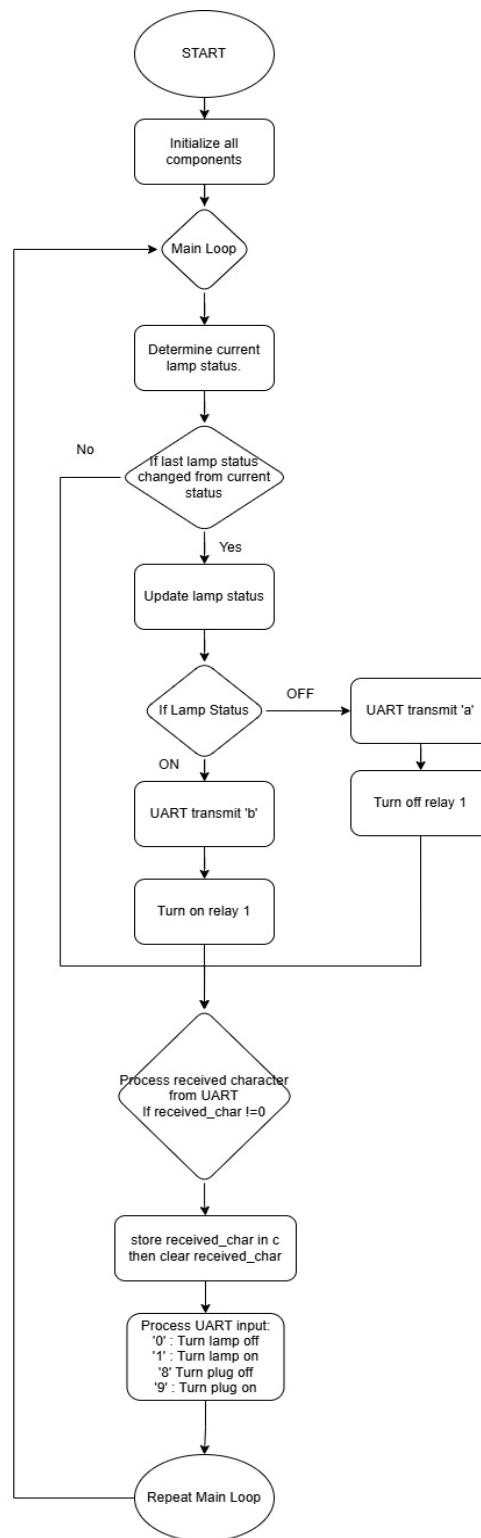


Figure 2 - Main Function

## 5.2 Buzzer SysTick Callback Function

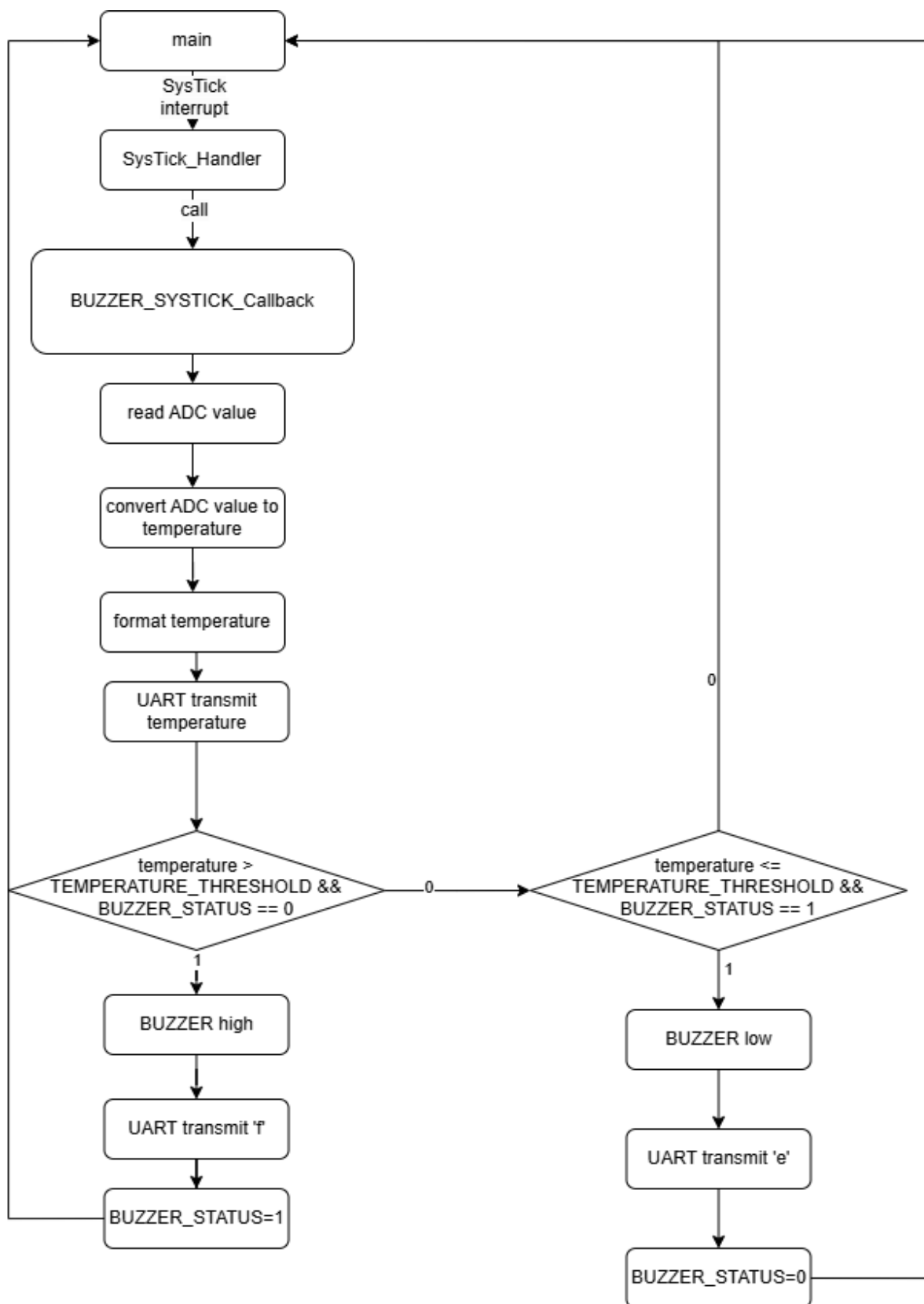


Figure 3 - SYSTICK interrupt handling for temperature and buzzer flowchart



## 5.3 Door & Switch Lamp Callback Functions

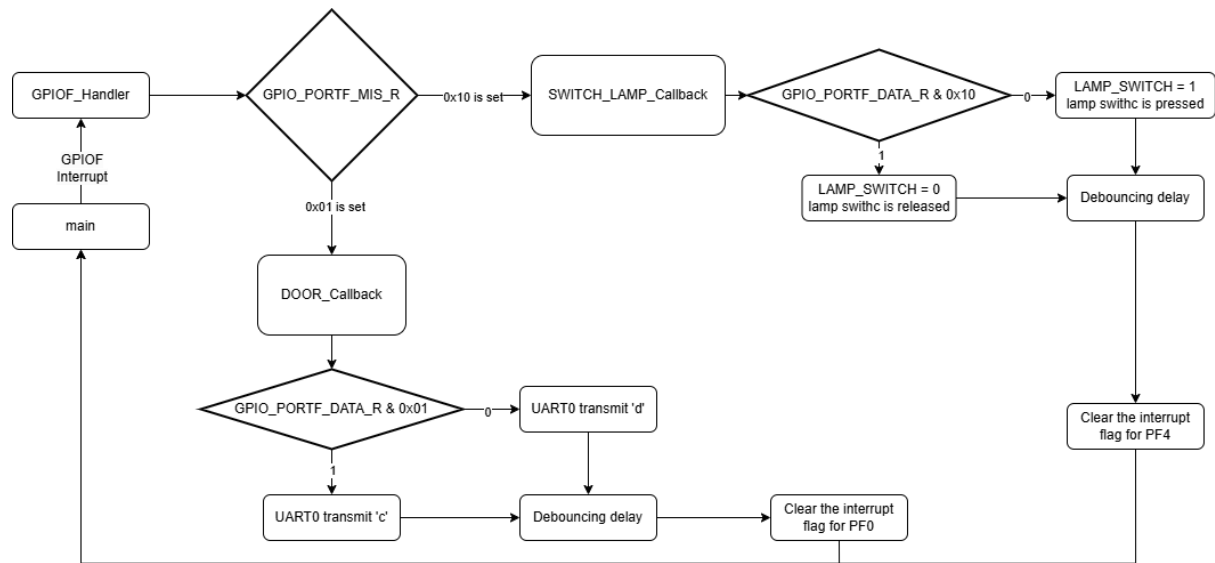


Figure 4 GPIO PORTF interrupt handling for door and lamp switch flowchart

## 5.4 UART0 Callback RX Function

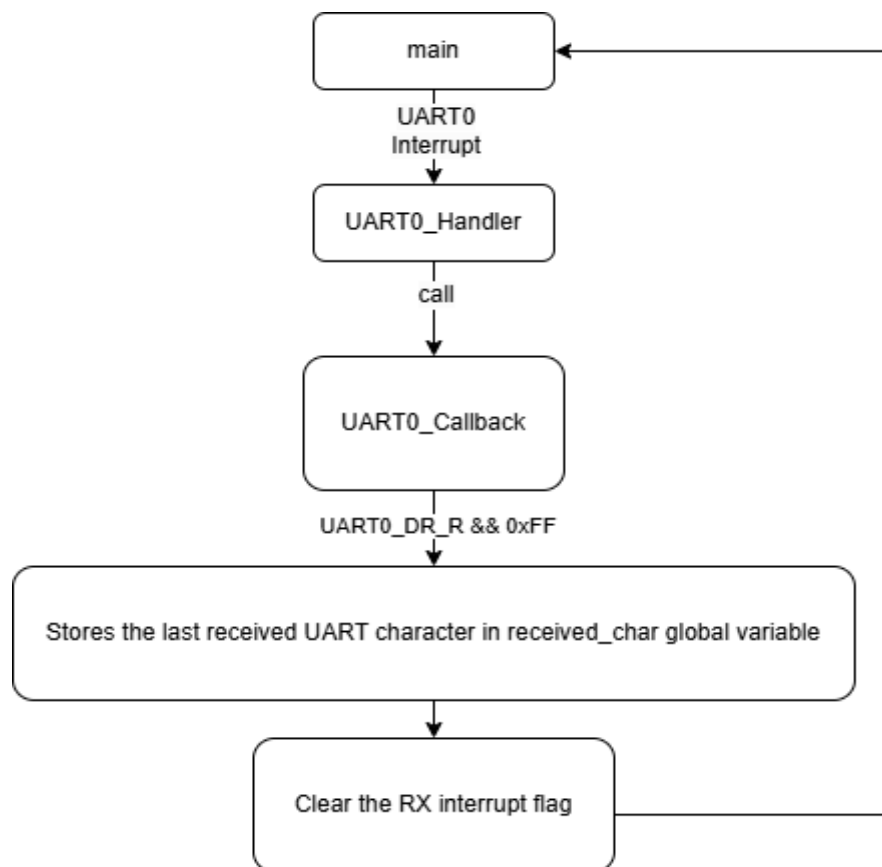
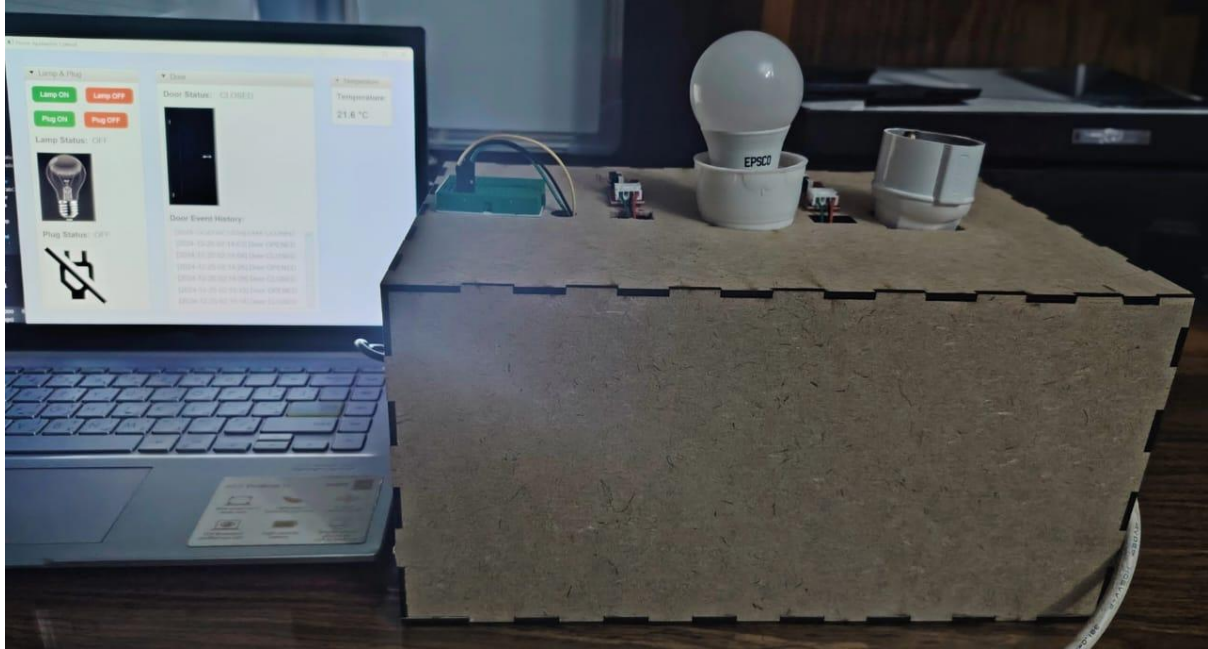


Figure 5 UART0 RX interrupt handling for receiving commands from user application flowchart

## 6. Prototype Photos

This section will show all prototype hardware and software photos.

### 6.1 Hardware Components



*Figure 6- System with Application*



*Figure 7- Lamp on with application*

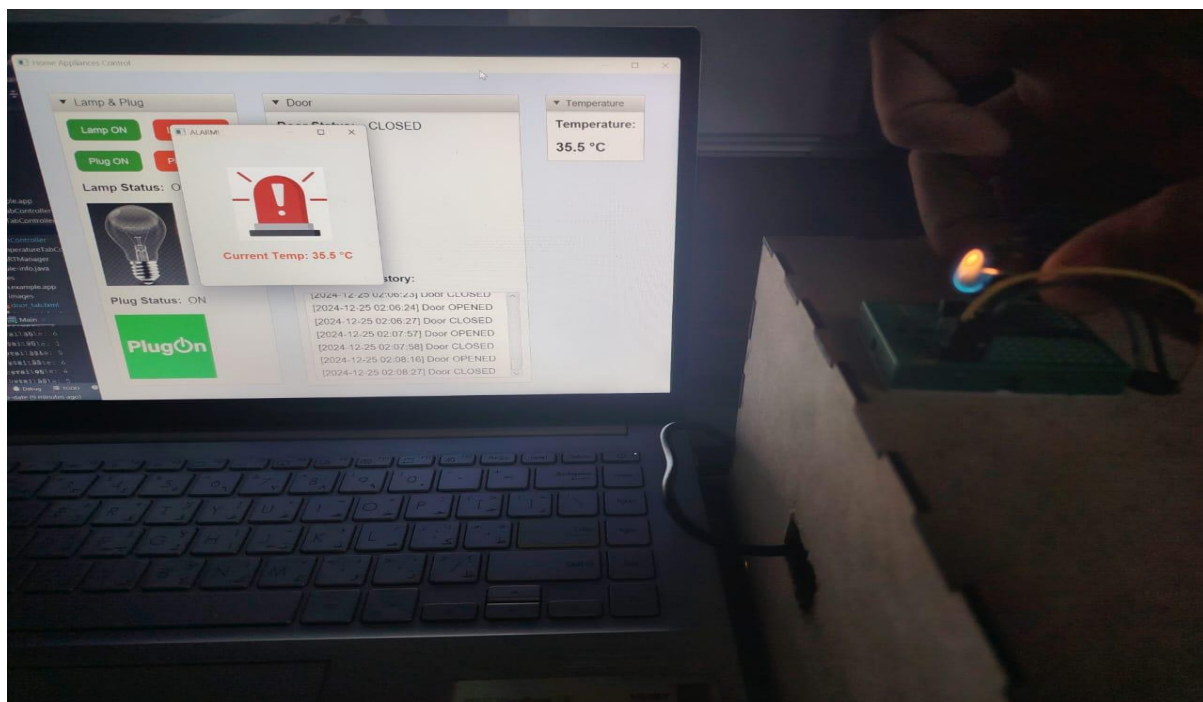


Figure 8 - Temperature Sensor

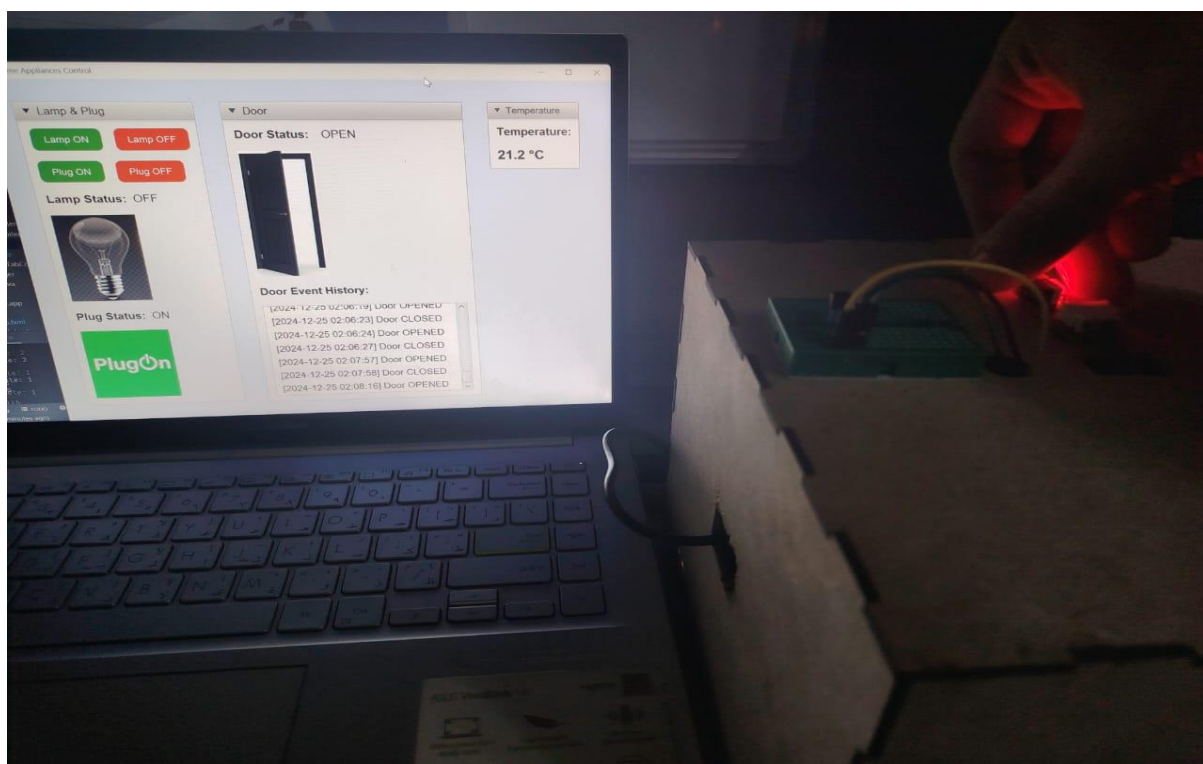


Figure 9 - Door Status with limit switch



Figure 10 - Plug on



Figure 11- Lamp on with limit switch



## 6.2 Application

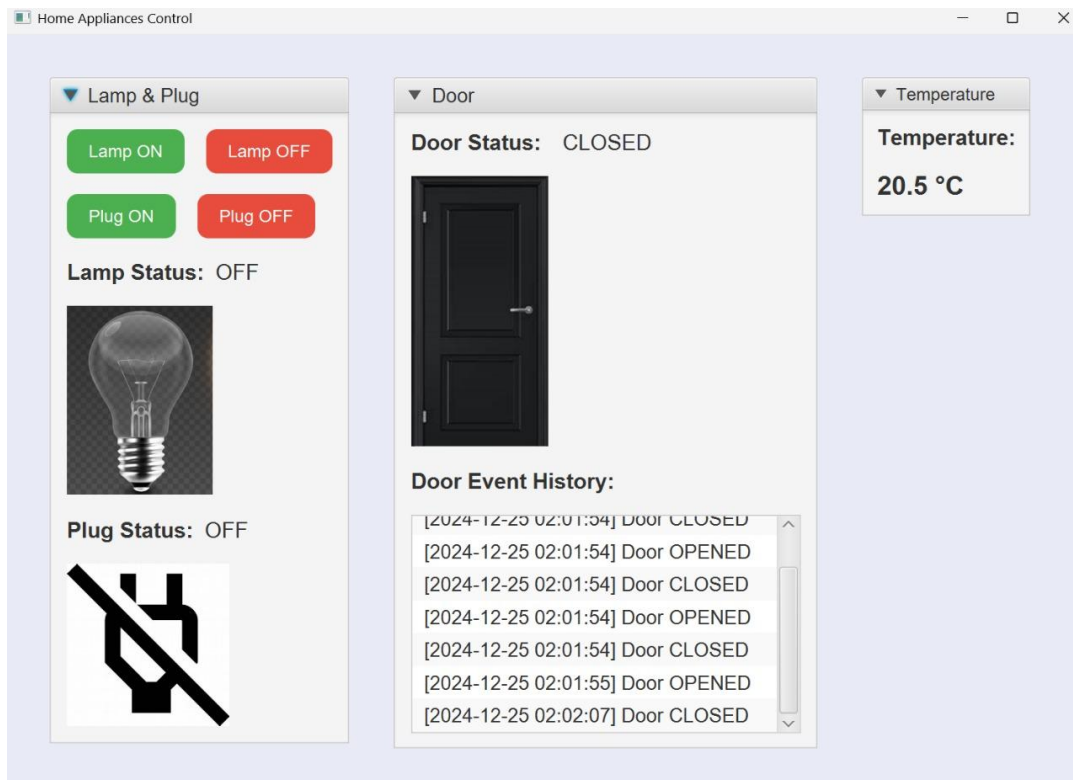


Figure 12 - All components off

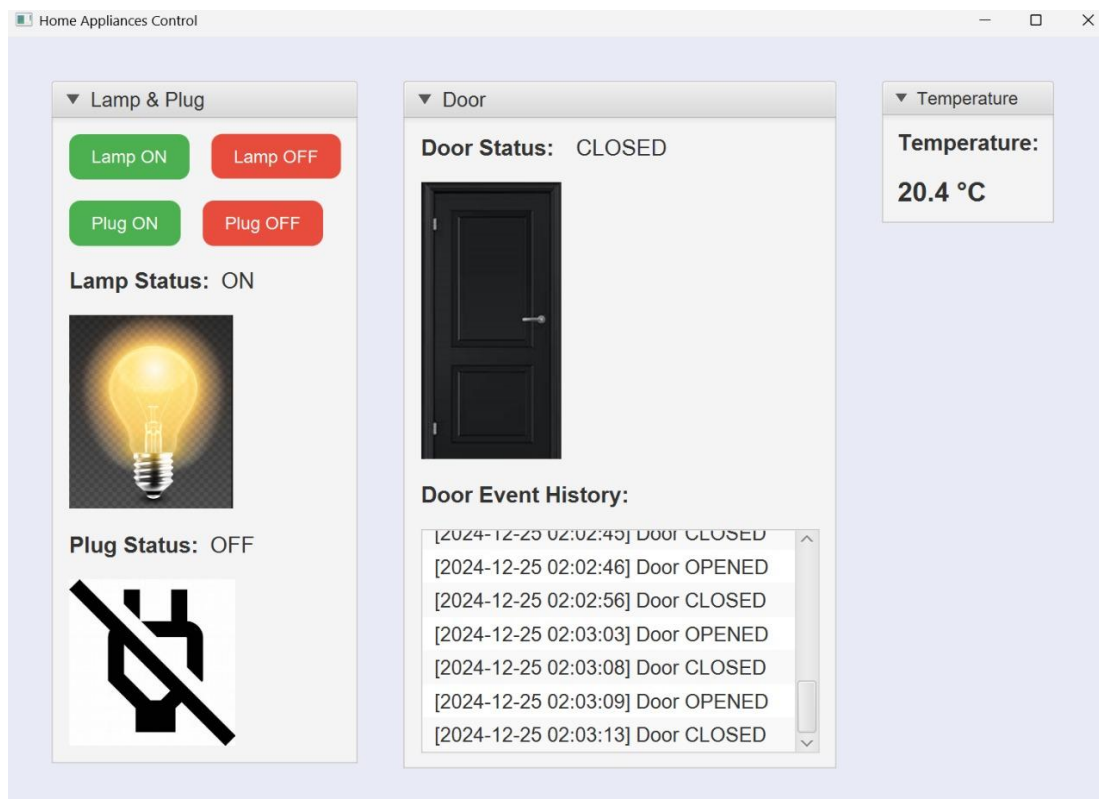


Figure 13- Lamp On

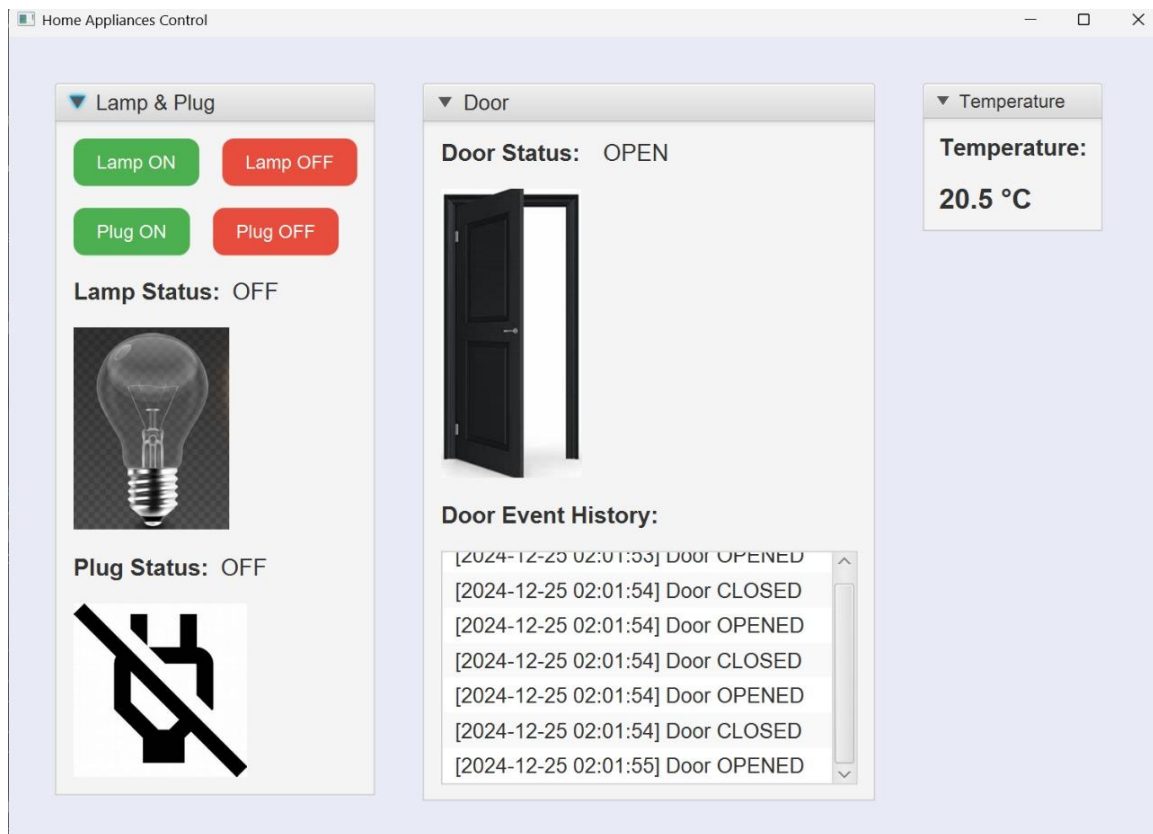


Figure 14 - Door Open

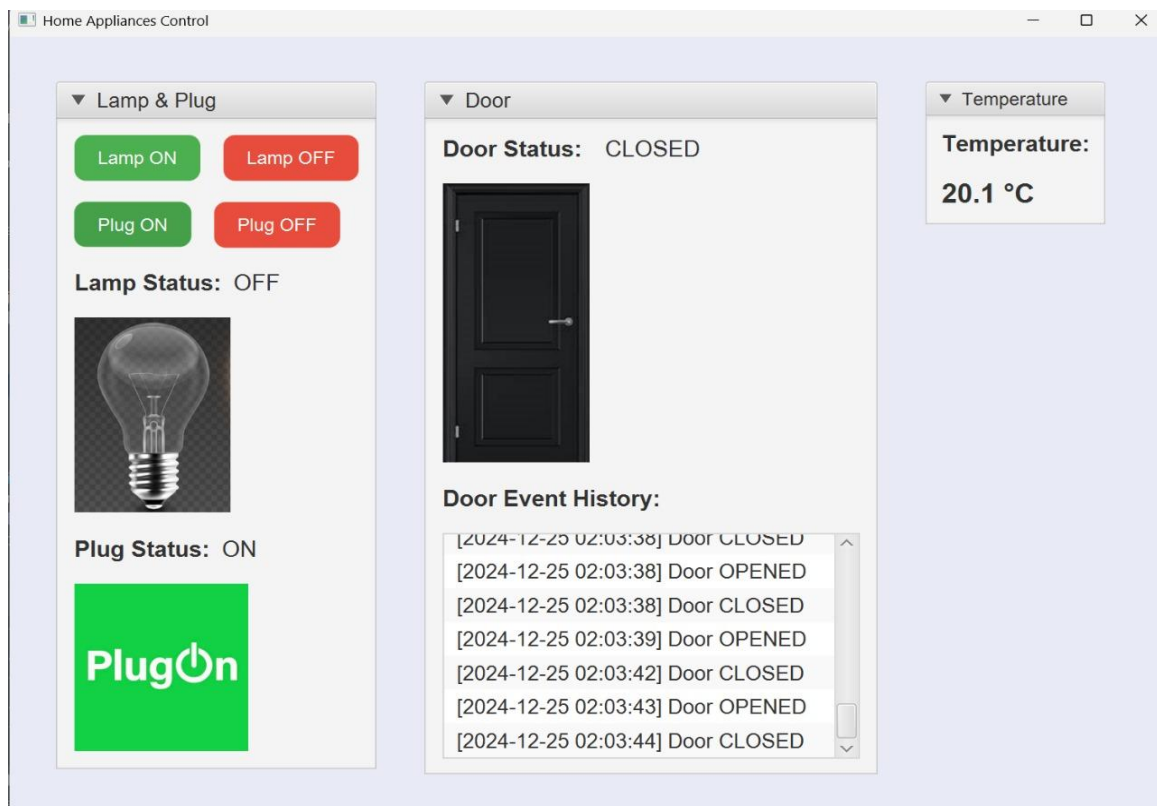


Figure 15 - Plug On

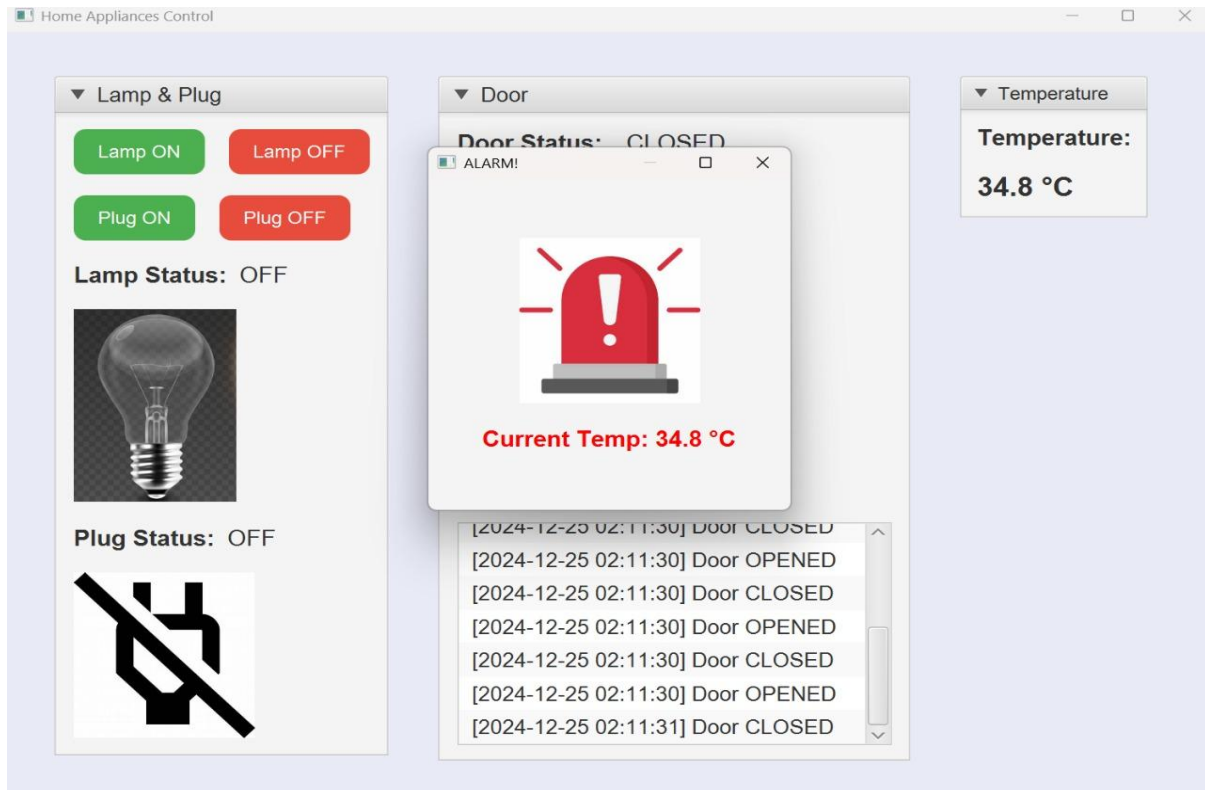


Figure 16 - Temperature Alarm

## 7. Problems Faced

- Problem 1: Data Loss in UART

Description: Data sent or received over UART is lost when the buffer overflows.

Solution: Only one command is sent to the UART until any change is made.

- Problem 2: Power Supply Instability

Description: The system resets randomly or fails to power up due to insufficient or unstable power supply.

Solution: Add two 5v adaptors to ensure stable power supply to the components.

## 8. Contribution of Each Member

Code and Report: Youssef Hany, Adham Osama.

Application and Report: Youssef Adel, Ahmed Tarek, Mark Saleh.