
GREENHOUSE MONITORING SYSTEM USING RASPBERRY PI PICO

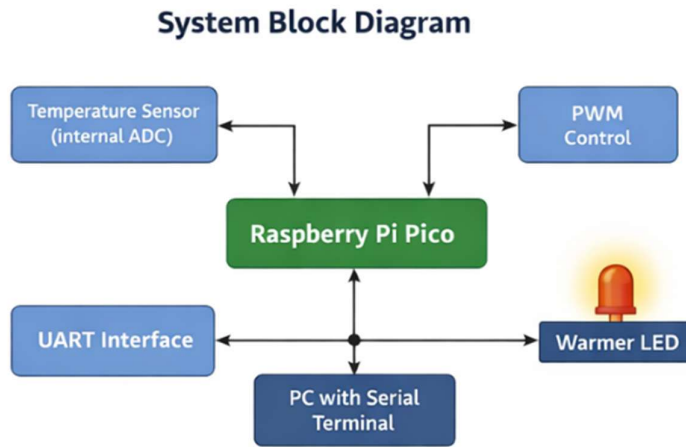
1. Objectives

The objectives of this project are:

1. To monitor greenhouse temperature using the internal temperature sensor.
 2. To control the warmer LED intensity based on temperature thresholds.
 3. To provide manual and automatic control through a UART-based menu.
 4. To display temperature and LED intensity on a serial terminal.
-

2. Block Diagram

The block diagram shows the interaction between the Raspberry Pi Pico, temperature sensor, LED, PWM module, and UART interface.



3. Hardware Requirements

- Raspberry Pi Pico
- External LED (Warmer LED)
- 220Ω / 330Ω resistor
- USB cable / USB-TTL converter
- PC with PuTTY terminal

4. Software Requirements

- Raspberry Pi Pico SDK
 - C programming language
 - PuTTY terminal
 - CMake & GCC toolchain
-

5. Circuit Connections

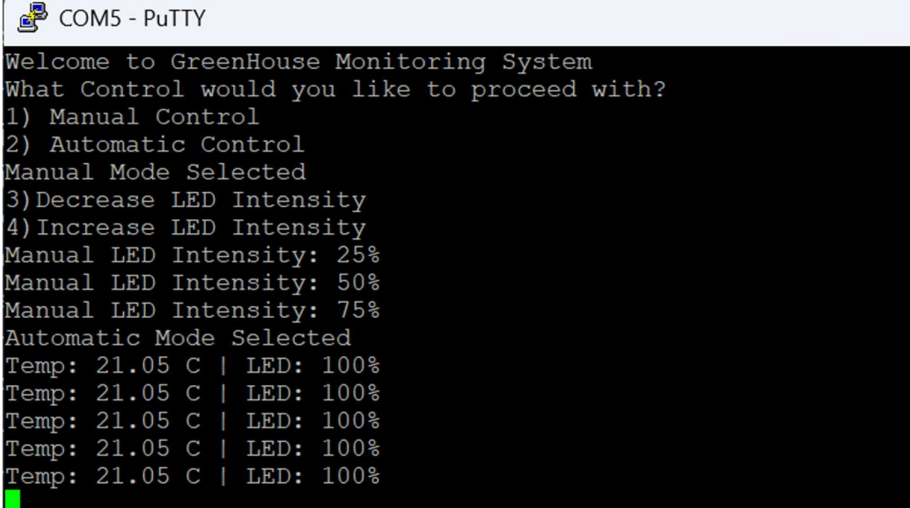
The LED is connected to GPIO pin 6 of the Raspberry Pi Pico through a current-limiting resistor. UART communication is established using USB CDC or hardware UART.

6. Working Principle

6.1 Temperature Measurement

- Internal temperature sensor accessed using ADC channel 4.
- ADC value is converted into voltage.
- Voltage is converted into temperature using the formula:

[
Temperature ($^{\circ}\text{C}$) = $27 - \frac{(\text{Voltage} - 0.706)}{0.001721}$
]



```
COM5 - PuTTY
Welcome to GreenHouse Monitoring System
What Control would you like to proceed with?
1) Manual Control
2) Automatic Control
Manual Mode Selected
3) Decrease LED Intensity
4) Increase LED Intensity
Manual LED Intensity: 25%
Manual LED Intensity: 50%
Manual LED Intensity: 75%
Automatic Mode Selected
Temp: 21.05 C | LED: 100%
Temp: 21.05 C | LED: 100%
Temp: 21.05 C | LED: 100%
Temp: 21.05 C | LED: 100%
Temp: 21.05 C | LED: 100%
```

6.2 LED Intensity Control using PWM

PWM is used to control LED brightness.

Temperature Range LED Intensity Duty Cycle

Below 25°C	100%	65535
25°C – 27°C	50%	32768
Above 27°C	25%	16384

7. Modes of Operation

7.1 Automatic Mode

- System continuously reads temperature.
- LED intensity is adjusted automatically.
- Temperature and LED intensity are displayed on the terminal.

7.2 Manual Mode

- User manually increases or decreases LED intensity.
- LED intensity changes in fixed steps.

8. UART Menu Interface

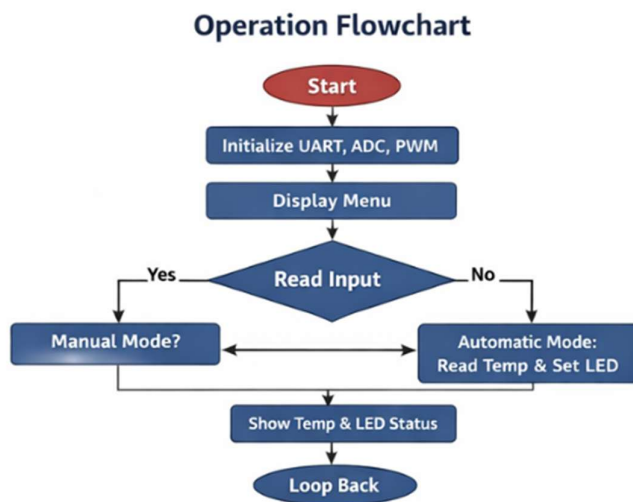
The system uses UART serial communication to interact with the user.

Menu Options

- 1) Manual Control
 - 2) Automatic Control
 - 3) Decrease LED Intensity
 - 4) Increase LED Intensity
-

9. Algorithm

1. Start the program.
2. Initialize UART, ADC, and PWM.
3. Display the menu.
4. Read user input through UART.
5. Select manual or automatic mode.
6. Control LED intensity accordingly.
7. Display temperature and LED status.
8. Repeat continuously.



10. Source Code

The program is written in Embedded C using Raspberry Pi Pico SDK.

Refer the code in the github project repo.

11. Conclusion

This project successfully demonstrates temperature monitoring and LED intensity control using Raspberry Pi Pico. The system supports both manual and automatic modes using UART communication and provides a strong foundation for future greenhouse automation systems.

12. References

- [Raspberry Pi Pico Datasheet](#)
 - [Raspberry Pi Pico SDK Documentation](#)
-