Project Name: Sleep Health-Oriented Environmental Monitoring System

Problem Definition: Sleep quality is strongly influenced by environmental factors, especially temperature and humidity. These parameters fluctuate throughout the night, and since the user cannot adjust them while asleep, deviations from the comfortable range may lead to discomfort and interruptions in sleep.

Objective: This project aims to develop a control system that monitors temperature and humidity in real time and automatically intervenes when values fall outside the appropriate range. Additionally, all measurement data is transferred to the computer via USB–UART, allowing the user to view the temperature and humidity changes recorded throughout the night upon waking up in the morning.

System Architecture: The overall structure of the system consists of four main sections: the sensor block, control block, actuator block, and user interface/data communication block:

1) **Sensor Block**
   The DHT22 sensor measures ambient temperature and humidity and transmits the data digitally to the microcontroller.
2) **Control Block (STM32F107VC)**
   Processes sensor values, performs threshold control, and makes fan–heater decisions.
3) **Actuator Block**
   The heater operates via GPIO, while the fan is operated via a PWM signal to regulate environmental conditions. The status LED provides alerts via PWM.
4) **User Interface and Data Communication Block**
   The OLED display shows real-time values via I²C; measurements are transferred to the computer via UART.

Component	**Function**	**Communication Interface**	**MCU Pins**
DHT22 Sensor	Temperature and humidity measurement	Single-Wire Digital (GPIO-based)	PA12
PTC Heater	Increases ambient temperature	GPIO Output	PA13
DC Fan	Reduces humidity, temperature	PWM (Timer based)	PA0
Status LED	Status LED shows: OFF (normal), ~50% brightness (1 parameter out of range), 100% brightness (2 parameters out of range)	PWM (Timer based)	PD12
OLED Display	Shows temperature, humidity, system status	I2C	PB6(SCL), PB7(SDA)
PC	Transfer logged data to computer	UART	UART(USB) (PA8-TX, PA9-RX)