Ultrasonic Humidifier

Name- Sejal Jain

Email- jainsejal307@gmail.com

Objective:

To design and implement a system that allows users to control an **ultrasonic humidifier** both manually (via a push button) and remotely (via Bluetooth using a smartphone). The system provides status indication using an LED and uses a MOSFET for safe and reliable switching of the humidifier power supply.

Introduction

Ultrasonic humidifiers are commonly used in smart homes and greenhouses. This project provides flexible control of a humidifier using:

- Bluetooth (HC-05)
- Manual push button
- Visual feedback (LED)

The controller is built around an **Arduino Uno R3**, which simplifies prototyping and allows easy expansion.

Components Used:

Component	Description	Quantity
Arduino Uno R3	Microcontroller board	1
HC-05 Bluetooth Module	Serial Bluetooth communication	1
Ultrasonic Humidifier	Mist generator	1
IRF540N MOSFET	Power control for humidifier	1
Push Button	Manual ON/OFF switch	1
LED (Red/Green)	Status indicator	1
Resistors (10kΩ, 220Ω)	Pull-up/down and current limiting	3
Capacitor (100nF)	Decoupling (optional but recommended)	1–2
DC Barrel Jack	12V input to Arduino	1
Screw Terminal (2-pin)	Humidifier and power connection	2
Male Header (1x6)	HC-05 interface	1
PWR_FLAG (KiCad symbol)	Required for ERC compliance	2

Control Logic:

Input Sources:

- Bluetooth commands ("ON", "OFF")
- Button press (toggle)

Processing:

- Software checks input from serial and button
- Maintains state in humidifier_state variable

Output Control:

- Sets humidifier ON/OFF via MOSFET
- Mirrors the same status to LED

System Architecture and Working

- **Power Supply**: 12V DC adapter powers both Arduino and humidifier.
- **MOSFET Control**: IRF540N is driven by a digital pin from the Arduino to switch the humidifier.
- **HC-05 Bluetooth Module**:
    - Communicates with Arduino via UART.
    - Accepts commands like 'ON' or 'OFF'.
- **Push Button**:
    - Toggles the humidifier state manually.
- **Status LED**:
    - Turns ON when humidifier is ON, OFF otherwise.

Circuit Overview:

The circuit includes:

- **Arduino Uno R3** for control logic.
- **HC-05** connected to RX/TX pins (D0, D1).
- **MOSFET Gate** connected to D4 (humidifier control).
- **LED** connected to D3 via 220Ω resistor.
- **Button** connected to D2 with a pull-down resistor.
- **Power Supply** connected to both Arduino VIN and the humidifier via screw terminal.

- **PWR_FLAGs** connected to GND and 5V to clear ERC errors in KiCad.

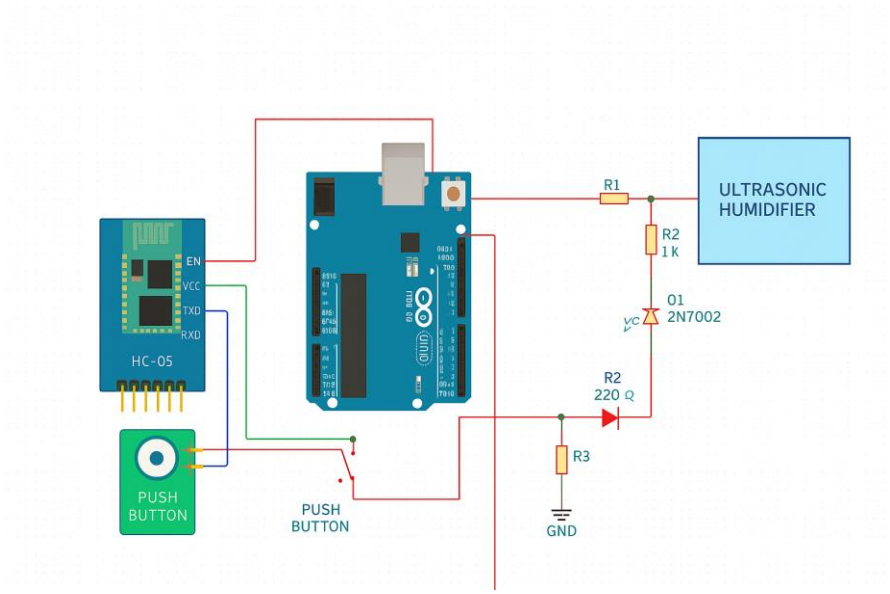

Figure 1 Circuit diagram of a Ultrasonic humidifier for reference

Anticipated Challenges & Solutions:

Challenge	Proposed Solution
Signal Interference (Bluetooth)	Use short wires, add 100nF decoupling capacitor near HC-05
Voltage Level Shifting (TX to HC-05)	Add voltage divider (1kΩ + 2kΩ) to step down Arduino TX to 3.3V
Powering Humidifier Safely	Use logic-level N-channel MOSFET with proper heatsinking if needed
Button Debouncing	Add software delay after button press detection
Incorrect ERC in KiCad	Add PWR_FLAG symbols to 5V, GND to satisfy Electrical Rules Check
PCB Trace Overheating	Use wider traces for power lines (>40 mils for humidifier trace)
Reverse Polarity / Overcurrent	Add diode protection and fuse (optional for production models)

Production Optimization Recommendations

Aspect	Optimization
Microcontroller	Replace Arduino Uno with ATmega328P standalone + minimal components
PCB Size	Reduce PCB area by using SMD components and integrating regulator if needed
Connectivity	Add screw terminal blocks for secure external power/humidifier connection
Power Regulation	Add onboard 5V regulator (AMS1117 or similar) for microcontroller if not using Arduino
App Control	Integrate Blynk or custom app for a better GUI experience
Enclosure Design	Add mounting holes in PCB and consider heat dissipation vents

Conclusion

This project successfully demonstrates a dual-mode (manual and Bluetooth) control system for an ultrasonic humidifier using Arduino Uno. It integrates embedded programming, power electronics, and PCB design into a compact and production-ready solution.