Smart Security System — User Manual

1. Overview

This system senses motion, loud noise, flame, and water/rain. On sensing it activates a buzzer, lights a red LED, and shows messages on a 16×2 LCD. This document outlines components, wiring, software installation, calibration, usage, and troubleshooting.

2) Parts & Tools (recommended)

- Electronics
- Arduino UNO (equivalent)
- PIR motion sensor (HC-SR501 preferred)
- Sound sensor module (microphone module with variable pot)
- Flame sensor module (IR/UV flame sensor)
- Raindrop (rain/water) sensor module
- Active buzzer (5V)
- Red LED, Green LED (5mm)
- 220Ω resistors (for LEDs)
- 16×2 LCD (HD44780 compatible) + potentiometer for contrast (10k)
- Breadboard, jumper wires
- USB cable for Arduino
- (Optional) Relay module for actuators; ESP8266/ESP32 for cloud connectivity

Tools

- Computer with Arduino IDE
- Multimeter (for voltages checks)
- Soldering iron (optional for final construction)

3. Wiring (summary)

Digital pins

- PIR OUT → D2
- Flame OUT → D3
- Buzzer + → D8 (second buzzer pin to GND)
- Red LED → D9 through 220Ω to GND
- Green LED → D10 through 220Ω to GND

Analog pins

- Sound module analog out → A0
- Raindrop analog out → A1

LCD wiring example (4-bit mode)

- LCD RS → D12
- LCD E → D11
- LCD D4 → D5
- LCD D5 → D4
- LCD D6 → D7
- LCD D7 → D6
- LCD VSS → GND
- LCD VDD → 5V
- LCD Vo → middle pin of 10k pot (remaining pot pins to 5V and GND for contrast)
- LCD RW → GND

Power

All driven by Arduino 5V and GND. Verify each module's voltage requirements (most are 5V). For some modules, use a separate 5V supply if current is significant.

4. Software Setup

- Get Arduino IDE (latest stable version) from arduino.cc.
- Connect your Arduino via USB.
- Make a new sketch and paste the code supplied.
- Select Board → Arduino Uno (your board) and correct COM port.
- Upload sketch.
- Open Serial Monitor at 9600 baud to view diagnostics.

5. Calibration (optional)

- **Sound sensor**: Calibrate potentiometer of sensor to enable readings from normal room noise to be ~100–300. Set SOUND_THRESHOLD in code or via Serial (type s400 to set it to 400) while watching Serial output to avoid false triggers. Start with threshold = 400.

- **Raindrop sensor**: With dry sensor, note analog reading (e.g., 200–400). Drip water and note reading (e.g., 600–900). Scale RAIN_THRESHOLD accordingly (start ~500).

- **Flame sensor**: Test with light/candle at safe distance and ensure digital read toggles. If module provides inverted signal, invert logic in readFlame() (exchange return (v == HIGH); to return (v == LOW);).

- **PIR sensor**: Adjustable timeout and sensitivity are found on certain PIR modules. Adjust delay and sensitivity according to need.

Calibration process:

- Activate Serial Monitor and read the values displayed.
- Identify expected operating ranges: set values in code, upload, retest.
- Use serial commands (the sketch makes use of s### and r###) to adjust thresholds in real time while testing.

6. Operation

- Power system.
- LCD will show Status: SAFE as a default.
- When sensors detect an event, LCD shows !!! ALERT !!! and which sensor(s) triggered it. Buzzer and red LED are activated.
- System reverts to SAFE when triggers are disarmed and minimum alert time elapses (default 5 seconds).

7. Troubleshooting

- **No LCD text:** Check LCD contrast potentiometer. Check RS/E/D4-D7 wiring. Check LiquidCrystal pins are correct.

- **PIR keeps firing**: Lower PIR sensitivity or turn PIR module. Check for heat sources or pets in field of view.
- **Sound triggers too often**: Increase SOUND_THRESHOLD. Fit a hardware pot to sound module to tune sensitivity.
- **Flame not seen**: Try moving flame closer temporarily. Check module orientation and implement right digital inversion logic.
- **Rain sensor loud**: Perform simple averaging in software (already implemented for sound) or physically shield sensor from condensation.
- **Buzzer/LED not working**: Inspect wiring and location of resistor for LEDs. Inspect pin mapping within software.

8. Safety Notes

- Keep only flames for brief, safe testing; never leave unattended open flame.
- Utilize good insulation and do not power through USB over extended wires.
- For mains-rated actuators (sprinklers, door locks), use relay modules with flyback diodes and mains wiring in skilled hands.

9. Future Extensions (how to add more features)

- **Cloud notifications**: Port to ESP8266/ESP32 and alert Firebase/ThingsBoard through MQTT or HTTP notifications.
- **Mobile app**: Use push notifications (Firebase Cloud Messaging) for remote notifications.
- **Logging**: Log events to SD card module or redirect to remote server for history.
- **Actuators**: Add relays to automatically close windows or lock doors; ensure correct safety and isolation.