

# Password-Protected Security System Using Arduino

## Project Overview

This project is a **Password-Protected Security System** that employs an **Arduino Uno**, a **4x4 Keypad**, **LEDs**, and a **Piezo Buzzer**. The system allows users to enter a **4-character password**, which is automatically validated upon entry. If the input matches the predefined password, access is granted (indicated by a green LED and a short buzzer beep). If incorrect, access is denied (indicated by a red LED and a long buzzer beep). This system enhances security for doors, lockers, or other restricted areas.

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## Components Used

### 1. Arduino Uno

- A microcontroller board based on the **ATmega328P** with **14 digital I/O pins**, **6 analog inputs**, and a **16 MHz quartz crystal**.
- Features **USB connectivity** for programming and serial communication.
- Uses the **Arduino IDE** for coding and can interact with various sensors and modules.
- Processes input from the keypad and triggers output components accordingly.

### 2. 4x4 Keypad

- A **matrix keypad** with **16 keys** (0-9, A-D, \*, and #).
- Used to enter the password.
- Works by detecting the row-column short-circuit when a key is pressed.
- Requires **pull-down resistors or built-in pull-up configuration** to stabilize inputs.
- Communicates with Arduino using **digital pins** in a matrix scanning method.

### 3. LEDs (Red & Green)

- **Green LED** signals successful authentication.
- **Red LED** signals incorrect password entry.
- **Low power consumption** with a forward voltage of around **2V (Red)** and **3V (Green)**.
- Requires **current-limiting resistors** to prevent burnout.

### 4. Piezo Buzzer

- Provides **audible feedback** based on authentication results.
- Uses the **piezoelectric effect** to generate sound upon receiving an electrical signal.
- Can be controlled using **PWM (Pulse Width Modulation)** for different sound patterns.
- Operates at a typical voltage of **3V-12V**.

### 5. Resistors (220Ω)

- Used to **limit current** to the LEDs, preventing damage.
- Ensures stable operation by reducing excessive current draw.
- Calculated using **Ohm's Law ( $V = IR$ )** to determine the correct resistance.

## 6. Breadboard

- A tool for **prototyping** the circuit without soldering.
- Enables easy component connections.
- Has a **grid-like structure** with interconnected rows and columns for placing electronic components.
- Helps in **circuit debugging and modifications** before permanent soldering.

## 7. Jumper Wires

- Used for connecting different components to the Arduino board.
  - Available in **male-to-male, male-to-female, and female-to-female** types.
  - Essential for making quick connections between the **Arduino, keypad, and other components**.
  - Typically made from **copper wires** with plastic insulation to ensure flexibility and durability.
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## Working Principle

1. The user enters a **4-character password** via the **4x4 Keypad**.
  2. Each keypress is detected and sent to the **Arduino Uno**.
  3. Once **four characters** are entered, the Arduino automatically compares them to the predefined password.
  4. **If the password is correct:**
    - The **green LED** turns on.
    - The **buzzer emits a short beep**.
    - (Optional) A relay or servo motor can be triggered to unlock a door.
  5. **If the password is incorrect:**
    - The **red LED** turns on.
    - The **buzzer emits a long beep**.
    - The system resets and allows a new attempt.
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## Applications

- **Home security systems** (Door locks, safes, cabinets)
- **Industrial security** (Restricted access zones)
- **Educational projects** (Learning microcontrollers and embedded systems)

This project demonstrates a practical **access control mechanism** using an Arduino and basic electronic components. It can be extended to include **LCD displays, RFID authentication, or IoT connectivity** for enhanced security features.