**Project 1- Smart Home Security System using Arduino**

**Smart Home Security System** project using a **Keypad**, **Servo motor**, **LCD**, and **Buzzer** with Arduino. The system allows users to enter a **PIN code** using the keypad, and if the correct code is entered, the servo motor unlocks (simulating a door unlocking), the LCD displays the status, and the buzzer sounds if the wrong code is entered.

**Components:**

* Arduino Uno
* 4x4 Keypad (Matrix Keypad)
* 16x2 LCD (with I2C adapter)
* Servo motor (SG90 or similar)
* Buzzer
* Jumper wires
* Breadboard
* Power supply

**Concept:**

1. The user enters a PIN code using the 4x4 keypad.
2. The LCD displays “Enter PIN” and shows the digits being typed (hidden as “\*” for security).
3. If the correct PIN is entered, the servo motor rotates, unlocking the door, and the LCD displays “Access Granted.”
4. If the wrong PIN is entered, the buzzer sounds, and the LCD displays “Access Denied.”
5. After a short delay, the system resets, waiting for the next input.

**Circuit Connections:**

1. **Keypad**:
   * Connect the 4x4 keypad pins to Digital Pins 2-9 on the Arduino (depending on the model of the keypad, you may need to check the pinout).
2. **LCD with I2C Adapter**:
   * VCC → 5V
   * GND → GND
   * SDA → A4
   * SCL → A5
3. **Servo Motor**:
   * Signal pin → Digital Pin 10
   * Power pin → 5V
   * Ground pin → GND
4. **Buzzer**:
   * Positive pin → Digital Pin 11
   * Negative pin → GND

**Arduino Code:**

#include <Wire.h>

#include <LiquidCrystal\_I2C.h>

#include <Servo.h>

#include <Keypad.h>

// Initialize LCD with I2C address 0x27 and 16x2 dimensions

LiquidCrystal\_I2C lcd(0x27, 16, 2);

// Define Servo motor

Servo myServo;

// Define Buzzer pin

const int buzzerPin = 11;

// Set the correct PIN code for the system

String correctPIN = "1234";

String enteredPIN = "";

// Create the Keypad

const byte ROWS = 4; // Four rows

const byte COLS = 4; // Four columns

char keys[ROWS][COLS] = {

{'1', '2', '3', 'A'},

{'4', '5', '6', 'B'},

{'7', '8', '9', 'C'},

{'\*', '0', '#', 'D'}

};

// Connect keypad to pins on Arduino

byte rowPins[ROWS] = {9, 8, 7, 6};

byte colPins[COLS] = {5, 4, 3, 2};

Keypad keypad = Keypad(makeKeymap(keys), rowPins, colPins, ROWS, COLS);

void setup() {

// Initialize LCD and Servo

lcd.init();

lcd.backlight();

myServo.attach(10);

myServo.write(0); // Servo in locked position (0 degrees)

// Set buzzer pin as output

pinMode(buzzerPin, OUTPUT);

// Display initial message on LCD

lcd.setCursor(0, 0);

lcd.print("Security System");

delay(2000);

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Enter PIN:");

}

void loop() {

char key = keypad.getKey();

if (key) {

// If the user presses the # button, validate the entered PIN

if (key == '#') {

checkPIN();

}

// If the user presses the \* button, clear the entered PIN

else if (key == '\*') {

enteredPIN = "";

lcd.setCursor(0, 1);

lcd.print(" "); // Clear the second line

}

// Otherwise, add the key to the entered PIN

else {

enteredPIN += key;

lcd.setCursor(0, 1);

lcd.print(String(enteredPIN.length(), '\*')); // Display '\*' for each entered digit

}

}

}

// Function to check if the entered PIN is correct

void checkPIN() {

if (enteredPIN == correctPIN) {

// If the PIN is correct, unlock the door

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Access Granted");

myServo.write(90); // Unlock the door by moving the servo to 90 degrees

delay(3000); // Keep the door unlocked for 3 seconds

// Lock the door again

myServo.write(0); // Lock position

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Enter PIN:");

enteredPIN = ""; // Reset entered PIN

} else {

// If the PIN is incorrect, trigger the buzzer

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Access Denied!");

tone(buzzerPin, 1000); // Sound the buzzer

delay(2000);

noTone(buzzerPin);

// Reset the system

lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Enter PIN:");

enteredPIN = ""; // Reset entered PIN

}

}

**How the Code Works:**

1. **Keypad Input**:
   * The user enters the PIN code using the 4x4 keypad. Each entered digit is shown as a “\*” on the LCD for security reasons.
   * If the user presses #, the entered PIN is checked against the predefined correct PIN ("1234" in this case).
   * If the user presses \*, the entered PIN is cleared.
2. **PIN Verification**:
   * If the entered PIN matches the correct PIN, the LCD displays “Access Granted,” the servo motor rotates to 90 degrees (simulating unlocking a door), and then after 3 seconds, the door locks again.
   * If the wrong PIN is entered, the LCD displays “Access Denied,” and the buzzer sounds for 2 seconds.
3. **LCD Display**:
   * The LCD provides feedback during the entire process, showing “Enter PIN” when waiting for input, and either “Access Granted” or “Access Denied” based on the input.
4. **Servo Control**:
   * The servo motor simulates the unlocking and locking of a door by rotating between 0 degrees (locked) and 90 degrees (unlocked).
5. **Buzzer Alarm**:
   * The buzzer sounds when the wrong PIN is entered, providing an audible alert for security purposes.

**How to Use:**

1. **Enter PIN**: Start by typing a 4-digit PIN code on the keypad. It will be displayed as “\*” on the LCD.
2. **Submit PIN**: Press # to check if the entered PIN is correct.
3. **Clear PIN**: Press \* to clear the PIN and start over.
4. **Correct PIN**: If the correct PIN (1234) is entered, the servo motor unlocks the door.
5. **Wrong PIN**: If the wrong PIN is entered, the buzzer sounds, and the system resets.

**Applications:**

* **Home Security**: Can be used for securing doors with a PIN entry system.
* **Safe Locks**: Ideal for lock boxes or safes that require PIN-based access.
* **Office Entry**: Can be implemented in offices to control access with a security PIN system.

This is a simple yet effective security system that integrates both visual (LCD), audible (buzzer), and physical (servo motor) feedback. It can be easily expanded with features like wireless monitoring, RFID, or fingerprint sensors for enhanced security.