Project Title

Design and Construction of a Keypad/Password-Based Electronic Door Access System with Automatic Attendance Tracking Using LPC2148

Contributers

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PROBLEM STATEMENT

The use of traditional metallic keys for accessing door locks presents security risks and lacks efficient attendance tracking. Key loss and unauthorized key duplication compromise security, while manual attendance tracking is time-consuming and prone to errors.

To address these challenges, there is a need for an integrated solution. The objective is to design and construct a keypad/password-based electronic door access system with an automatic attendance system. This solution aims to enhance security, eliminate the reliance on physical keys, and streamline attendance tracking processes in residential, commercial, or office environments.

ABSTRACT

The aim of this project is to design and construct a keypad/password-based electronic door access system integrated with an automatic attendance system, offering significant advantages over traditional lock systems. The specific objectives are as follows:

- Elimination of Physical Keys: Develop a keyless entry solution that replaces the need for physical keys with a secure and user-friendly keypad/password system, ensuring convenient and efficient access control.
- Enhanced Security: Implement a robust security mechanism inspired by ATM machines, where authorized individuals can gain access by entering a secret combination of numbers, ensuring protection against unauthorized entry.
- Prevention of Key Misplacement: Create a reliable and convenient alternative to physical keys to eliminate the risk of key misplacement, reducing inconvenience and costs associated with lost keys.
- Reduced Key Duplication: Design a system that minimizes the need for excessive key duplication by assigning unique access codes to authorized individuals, ensuring efficient access control without the logistical challenges of managing multiple physical keys.
- Easy Code Change: Enable users to easily change the access codes to the keypad door lock, providing flexibility and heightened security, especially in cases where the existing code might have been compromised.
- Smooth Transition for New Occupants: Facilitate a seamless transition for new occupants by allowing property owners to provide access codes instead of physically handing over keys, ensuring efficient access management during property transfers or rentals.
- Increased Difficulty for Break-ins: Enhance the security of the premises by developing a keypad door lock system that deters break-ins and makes unauthorized entry more challenging, thus safeguarding the property and its occupants.
- Automatic Attendance System: Integrate an automatic attendance system that registers and records the entry and exit times of authorized individuals, streamlining attendance tracking processes for residential or office environments.

INTRODUCTION

In today's increasingly security-conscious world, protecting our homes and offices is of utmost importance. Traditional security measures, such as using simple sleeping mats or mechanical locks, are no longer sufficient to deter modern threats like burglary and unauthorized access. As a result, the need for advanced security systems has become paramount.

This project focuses on the design and construction of a keypad/password-based electronic door access system. By leveraging digital technology, specifically microcontrollers, we aim to create a compact and efficient solution that enhances security while offering convenience and ease of use.

Unlike traditional lock systems, the proposed electronic access system eliminates the need for physical keys. Instead, authorized individuals can gain entry by entering a secret combination of numbers on a keypad, similar to using ATMs. This keyless entry system provides several advantages, including the prevention of key misplacement, reduced key duplication, and easy code changes if security is compromised.

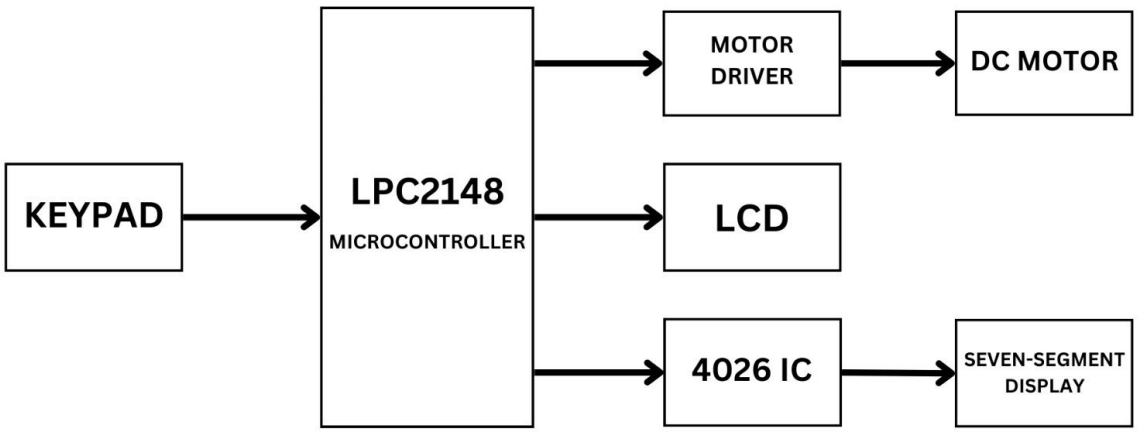
Furthermore, the integration of an automatic attendance system adds an additional layer of functionality to the project. By automatically registering the entry and exit times of authorized individuals, the system streamlines attendance tracking processes in residential or office environments.

Main significances of this project can be listed as follows,

1. Enhanced Security: The electronic access system is pick-proof, providing robust protection against break-ins and unauthorized access.
2. Keyless Convenience: Users no longer need to carry physical keys, reducing the risk of loss or duplication.
3. Access Control: The system allows precise control over who can enter specific areas, improving security in residential and commercial settings.
4. Flexibility: Access codes can be easily changed, providing dynamic control over entry permissions.
5. Improved Safety: The system benefits the elderly and disabled by eliminating physical key challenges and providing easier access to doors.

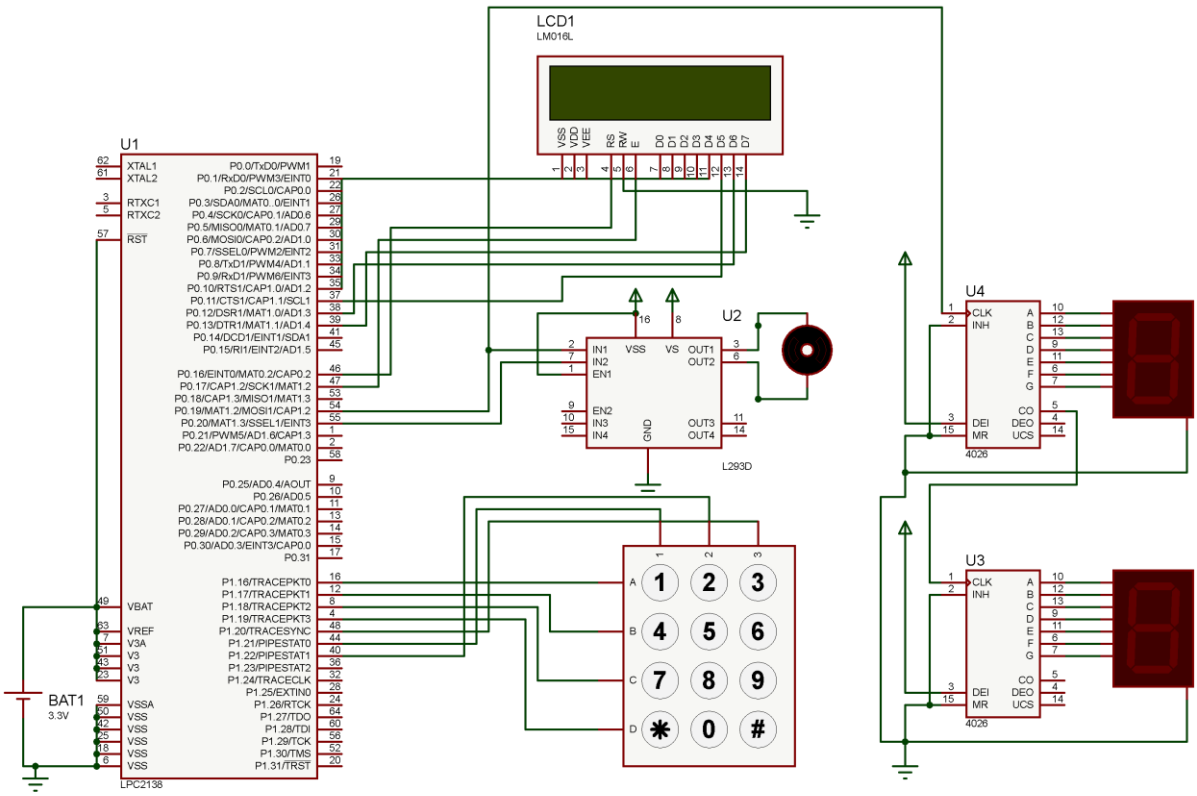
Through a comprehensive review of existing works, careful material selection, hardware and software design, and rigorous testing, this project aims to create a reliable and secure electronic door access system. By doing so, we strive to contribute to the ongoing evolution of security systems, providing individuals and organizations with an advanced solution that offers enhanced protection and peace of mind.

BLOCK DIAGRAM



COMPONENT USED		
SL. NO.	COMPONENT	DISCRIPTION
1	Microcontroller	Controls the system's operation and receives input from the keypad
2	Keypad	Allows users to enter passwords or commands.
3	LCD	Displays system status and attendance count.
4	DC Motor	Opens and closes the door based on control signals from the microcontroller
5	Motor Driver	Drives the DC motor.
6	Seven-Segment Display	Show the live-updated attendance count
7	4026 IC	A decade counter integrated circuit (IC) with decoded outputs for driving a common-cathode seven-segment LED display

CIRCUIT SIMULATION



User Authentication and Door Access:

- Upon initialization, the LCD display welcomes the user and prompts them to enter the password using the keypad.
- The user enters the password, and the LPC2148 microcontroller verifies its correctness.
- If the entered password matches the stored one in the LPC2148, access is granted, and the door is opened by activating the motor to rotate in the clockwise direction.
- Simultaneously, the Seven-Segment Display increments by 1, indicating successful attendance tracking.
- Then the door automatically closes after sometime when the motor rotates anticlockwise.

Attendance Tracking:

- The system automatically keeps track of attendance for each entry into the premises as you enter the password.
- After successful access, the LPC2148 sends a pulse signal to updates the attendance.
- The Seven-Segment Display shows the latest incremented attendance count for reference.

Working Principle

Microcontroller

In the project "Design and Construction of a Keypad/Password-Based Electronic Door Access System with Automatic Attendance Tracking Using LPC2148," the microcontroller (LPC2148) plays a central role in controlling and coordinating the different components of the system. Here's how the microcontroller interfaces with the various parts of the project:

Keypad Interface:

The microcontroller interfaces with a keypad through GPIO (General Purpose Input/Output) pins. The keypad is connected to the microcontroller, and when a user enters the password, the microcontroller reads the key presses and processes them.

LCD Display Interface:

The microcontroller interfaces with an LCD display through GPIO pins. It sends commands and data to the LCD to display messages or prompts to the user. The LCD display provides visual feedback to the user, such as asking them to enter the password or displaying messages like "Access Granted" or "Access Denied."

Motor Control:

The microcontroller controls the motor that opens and closes the door. It uses GPIO pins to interface with a motor driver or motor control circuit, which rotates the motor clockwise to open the door and anticlockwise to close it. The microcontroller triggers the motor rotation based on the correct password entry.

Seven-Segment Display Interface:

The microcontroller interfaces with the seven-segment display through GPIO pins. It increments the seven-segment display to keep track of the number of times the door is opened successfully, indicating attendance tracking.

Password Verification:

When the user enters the password through the keypad, the microcontroller reads the input, compares it with the pre-set correct password, and verifies if it matches. If the entered password is correct, the microcontroller activates the motor to open the door.

Attendance Tracking:

After successful verification of the password and opening the door, the microcontroller increments the seven-segment display to track the number of times the door is opened successfully. This feature provides automatic attendance tracking for each time the door is accessed.

Keypad:

The keypad is an essential input device in the electronic door access system, allowing users to enter their passwords for authentication and gain access. It serves as the primary means of user interaction with the system.

The LPC2148 microcontroller interfaces with the keypad to receive user input. The keypad is typically arranged in a matrix format, with rows and columns of buttons. The microcontroller configures the necessary GPIO (General Purpose Input/Output) pins to scan the keypad matrix for button presses.

- Matrix Configuration: The keypad is arranged in a matrix format, where the rows and columns form a grid. Each key corresponds to a specific row-column intersection.
- Connection: The row pins of the keypad are connected to the output pins of the microcontroller, while the column pins are connected to the input pins
- Pull-Up Resistors: The column pins are usually pulled up to a high logic level (e.g., 5V) using internal or external pull-up resistors. This ensures that when no key is pressed, the column pins remain in a high state.
- Scanning Process: The scanning process begins by selecting one row at a time and setting it to a low logic level (e.g., GND) while keeping the other rows high (pulled up). For example, Row1 is set to low, and Row2-Row4 are set to high.
- Column Scanning: With one row set to low, the microcontroller scans the state of each column. It does this by sequentially setting each column pin as an input and checking its logic level. If any key in the selected row-column intersection is pressed, the corresponding column pin will be pulled down to a low logic level.
- Key Detection: By analyzing the state of the column pins, the microcontroller can detect which key in the selected row is pressed. The specific row and column combination determines the pressed key's identification.
- Repeating the Process: The scanning process is repeated for all rows. Each row is sequentially set low while the rest remain high, and the column scanning is performed to detect key presses.

LCD:

The LCD (Liquid Crystal Display) is a crucial component in the electronic door access system that provides real-time feedback and instructions to the user during the authentication process and attendance tracking. It serves as the user interface, displaying prompts, messages, and the current system status.

- Display Initialization: Upon system startup, the LPC2148 microcontroller initializes the LCD display. This process involves configuring the necessary control pins and setting the display parameters such as character size, cursor settings, and backlight control.
- User Instructions and Prompts: The LCD display presents welcoming messages and instructions for the user. It prompts the user to enter the password using the keypad to gain access.

- Password Input Display: As the user enters the password through the keypad, the LCD display shows asterisks or other symbols to mask the actual characters for security purposes. This ensures that the password remains hidden from any onlookers.
- Authentication Feedback: After the user submits the password, the LPC2148 microcontroller verifies its correctness. The LCD display then provides feedback to the user based on the authentication result:
    - If the password is correct, a success message is displayed, and the door access is granted.
    - If the password is incorrect, an error message is shown, and the user may be prompted to retry.

MOTOR CONTROL:

The motor control process involves the following steps:

- Motor Driver Interface: The microcontroller interfaces with a motor driver circuit through GPIO (General Purpose Input/Output) pins. The motor driver acts as an interface between the microcontroller and the electric motor. It receives control signals from the microcontroller and regulates the power supplied to the motor, enabling precise control over its rotation.
- Clockwise Rotation (Door Opening): When a user enters the correct password on the keypad, the microcontroller processes the input and verifies its authenticity. Once the password is verified, the microcontroller triggers the motor driver to rotate the electric motor in the clockwise direction. The motor, in turn, opens the door to allow access to the authorized user.
- Anticlockwise Rotation (Door Closing): After a specific time period or when the user manually closes the door, the microcontroller signals the motor driver to rotate the electric motor in the anticlockwise direction. This action causes the motor to close the door securely.

Seven-Segment Display Interface using 4026IC:

The 4026IC is a decade counter and 7-segment display driver. It can be used to drive a common-cathode seven-segment display, which is a type of display that can show numeric digits from 0 to 9.

Here's how the Seven-Segment Display Interface with the 4026IC works:

- Display Connections: Each segment of the seven-segment display is connected to one output of the 4026IC. The connections are made such that the microcontroller can control which segments should be turned on to display a specific digit.
- Counting: The 4026IC acts as a counter and can count from 0 to 9. It has a clock input (CLK) and a reset input (RESET). The microcontroller provides the clock signal to the CLK input to advance the count. When the count reaches 9, it automatically resets to 0.

- Displaying Numbers : The microcontroller determines the number to be displayed on the seven-segment display. For example, if the microcontroller wants to display the number 5, it will provide the appropriate count to the 4026IC. The 4026IC will then activate the necessary segments to display the number 5 on the seven-segment display.

- Incrementing Attendance: In the context of automatic attendance tracking, the microcontroller can increment the count on the 4026IC each time a new person enters the correct password and gains access through the door. This count represents the number of people who have entered, effectively tracking attendance.

- Multiplexing : To display multiple digits (e.g., two or more digits of the count), the microcontroller can use a technique called multiplexing. In multiplexing, the microcontroller rapidly switches between different digits, giving the illusion of multiple digits being displayed simultaneously.

CONCLUSION

In conclusion, this project implemented a password-protected lock system with attendance counting using an LPC214x microcontroller, an LCD display, a keypad, and two counters (Seven Segment Display by Using IC 4026). The system allowed the user to set a password and keep track of the number of people entering.

The project utilized the LPC214x microcontroller to control the overall functionality. The LCD display was used to provide user prompts, display messages, and show the attendance count. The keypad enabled the user to enter the password for unlocking the system and accessing the attendance count.

Two counters were incorporated into the system to keep track of the attendance count. These counters were incremented each time a person entered the premises. The seven-segment display was used to visually represent the count and provide real-time feedback to the user.

The main functionality of the lock system involved verifying the entered password with the set password. If the passwords matched, the user was granted access, and the attendance count was displayed on the LCD and seven-segment display. Each time a person entered, the counters were incremented, reflecting the updated count.

The project demonstrated a practical application of a password-protected lock system with attendance counting. It provided a secure way to monitor the number of people entering a specific area while maintaining access control. The system can be further enhanced by integrating features such as data storage, connectivity options, or integrating with a database for advanced attendance management. This project has also exposed the fact that metallic keys can possibly be phased out with zero to minimal effect on the old and/or sick people.

LIMITATIONS & FUTURE SCOPE

Limitations:

- Password-based authentication only, without advanced biometric options.
- Limited built-in security features, potentially requiring additional components or software.
- Constraints on processing power and memory capacity of the LPC2148 microcontroller.

Scope:

- Convenient keyless entry system, eliminating the need for physical keys.
- Customizable access codes for flexible access management.
- Basic security enhancement over traditional locks.
- Suitable for embedded system applications like home automation and industrial control.
- Real-time control and communication capabilities.
- Potential for customization and expansion to enhance functionality and security.

REFERENCES

1. Password Based Door Open System Using LPC2148 by EmbeTronicx
2. Design And Construction Of An Electronic Door Access Key by TAMUNOWARI MINA
3. Password Based Door Lock System using 8051 Microcontroller by ELECTRONICS HUB
4. 4x4 Keypad interfacing with LPC2148 by ELECTRONIC WINGS

APPENDICES

```c
#include<lpc214x.h>
#include<string.h>
#include"timerdelay.h"
#include"lcd.h"
#include"keypad.h"
#define bit(x) (1<<x)
char flag=0;
char pwd[]="3333";
void lock(void);
int main(void)
{
 char key[5];
 int con=0;
 lcd_init();
 lcd_cmd(0x01);
 lcd_string("press 1 to cha-");
 lcd_cmd(0x01);
 lcd_string("nge password");
 flag=get_key();
 if(flag=='1')
 {
  lcd_cmd(0x01);
  lcd_string("New pwd : ");
  for(con=0;con<4;con++){
  pwd[con]=get_key();
  lcd_string("*");}
     pwd[con]=0;
   }
  while(1){
 lcd_cmd(0x01);
 lcd_string("password:");
 //lcd_cmd(0xc0);
 for(con=0;con<4;con++){
  key[con]=get_key();
  lcd_string("*");}
  key[con]=0;
  if(strcmp(key,pwd)!=0)
  {
  lcd_cmd(0x20);
    lcd_cmd(0x01);
  lcd_string("Wrong password");
 }
 else {
  lock();
 }
}

}
void lock(void)
{
 IO0DIR|=bit(19)|bit(20);
 lcd_cmd(0x01);
 lcd_string("lock is opening");
 IO0SET|=bit(19);
 timemdel(50);
 IO0CLR|=bit(19);
 timemdel(100);
 lcd_cmd(0x01);
 lcd_string("lock is closing");
 IO0SET|=bit(20);
 timemdel(50);
 IO0CLR|=bit(20);
}

```

```c
/*----LCD Header File------*/
#define RS (1<<16)
#define E (1<<17)
#define D4 (1<<10)
#define D5 (1<<11)
#define D6 (1<<12)
#define D7 (1<<13)
//void delay(void);
void lcd_init(void);
void lcd_cmd(int );
void lcd_string(char *str);
void lcd_conv(char );
void lcd_cmd(int cmd)
{
 IOCLR0|=RS;
 lcd_conv(cmd);
 IOCLR0|=RS;
 timeudel(1000);
}
void lcd_init(void)
{
 IODIR0|=D4|D5|D6|D7;
  IODIR0|=RS|E;
  IOCLR0|=D4|D5|D6|D7;
  IOCLR0|=RS|E;
 lcd_cmd(0x02);
 lcd_cmd(0x28);
 lcd_cmd(0x0E);
 lcd_cmd(0x01);
 lcd_cmd(0x06);
}
void lcd_string(char *str)
{
 while(*str!=0)
 {
  IOSET0|=RS;
  lcd_conv(*str);
  str++;
 }
 timeudel(1000);
}
void lcd_conv(char data)
{
 int recv;
 IOCLR0|=D4|D5|D6|D7;
 recv=data>>4;
 IOSET0=recv<<10;
 IOSET0|=E;
 timeudel(1000);
 IOCLR0|=E;
 timeudel(1000);
 IOCLR0|=D4|D5|D6|D7;
 recv=data;
 IOSET0|=(recv<<10);
 IOSET0|=E;
 timeudel(1000);
 IOCLR0|=E;
 IOCLR0|=D4|D5|D6|D7;
}

```

```c
/*----Keypad Header File------*/
#define c1 (1<<20)
#define c2 (1<<21)
#define c3 (1<<22)
#define r1 (1<<16)
#define r2 (1<<17)
#define r3 (1<<18)
#define r4 (1<<19)

char get_key(void)
{
 IO1DIR=0x0f<<16;
  IO1CLR|=0xFF<<16;
 IO1SET|=0xFF<<16;
 while(1)
 {
   IO1CLR|=r1;
  IO1SET|=0x0E<16;
   if((IO1PIN&c1)==0)
   {
     while((IO1PIN&c1)==0);
  return '1';
   }
   else if((IO1PIN&c2)==0)
   {
     while((IO1PIN&c2)==0);
  return '2';
   }
   else if((IO1PIN&c3)==0)
   {
     while((IO1PIN&c3)==0);
  return '3';
   }
    IO1CLR|=r2;
  IO1SET|=0x0D<<16;
    if((IO1PIN&c1)==0)
   {
     while((IO1PIN&c1)==0);
  return '4';
   }
  else if((IO1PIN&c2)==0)
   {
     while((IO1PIN&c2)==0);
  return '5';
   }
  else if((IO1PIN&c3)==0)
   {
     while((IO1PIN&c3)==0);
  return '6';
   }
   IO1CLR|=r3;
  IO1SET|=0x0B<<16;
    if((IO1PIN&c1)==0)
   {
     while((IO1PIN&c1)==0);
  return '7';
   }
  else if((IO1PIN&c2)==0)
   {
     while((IO1PIN&c2)==0);
  return '8';
   }
  else if((IO1PIN&c3)==0)
   {
     while((IO1PIN&c3)==0);
  return '9';
   }
  IO1CLR|=r4;
   IO1SET|=0X07<<16;
       if((IO1PIN&c1)==0)
   {
     while((IO1PIN&c1)==0);
  return '*';
   }
  else if((IO1PIN&c2)==0)
   {
     while((IO1PIN&c2)==0);
  return '0';
   }
  else if((IO1PIN&c3)==0)
   {
     while((IO1PIN&c3)==0);
  return '#';
   }
 }
}

```

```c
/*----Timerdelay Header File------*/
void timemdel(unsigned int con)
{
 T0CTCR=0X0;
 T0PR=59999;
 T0MR0=con;
 T0MCR|=1<<2;
 T0TCR=0X02;
 T0TCR=0X01;
 while(T0TC!=T0MR0);
 T0TC=0;
 T0TCR=0;
}
void timeudel(unsigned int con)
{
 T1CTCR=0X0;
 T1PR=59;
 T1MR0=con;
 T1MCR|=1<<2;
 T1TCR=0X02;
 T1TCR=0X01;
 while(T1TC!=T1MR0);
 T1TC=0;
 T1TCR=0;
}
```