| Marwadi University | Marwadi University<br>Faculty of Engineering and Technology<br>Department of Information and Communication Technology | |
|---|---|---|
| Subject: MCI | Aim: Keypad Programming | |
| Experiment No: 9 | Date:05-03-2024 | Enrollment No:92200133023 |

# Experiment-9

**Aim:** Hands-on experimentation of 4x4 matrix keyboard interfacing with ATMega32 in C.

**Objectives:** After successfully completion of this experiment students will be able to,

- Use C language for ATMega32 microcontroller programming on AVRStudio.
- Experiment with 4 x 4 keypad matrix on ATMega32 AVR Development Board and learn hand on 4x4 keypad matrix in ATMega32.

**Theory:**

The keypad is used as an input device to read the key pressed by the user and to process it.

4x4 keypad consists of 4 rows and 4 columns. Switches are placed between the rows and columns. A keypress establishes a connection between the corresponding row and column between which the switch is placed.

In order to read the keypress, we need to configure the rows as outputs and columns as inputs. Columns are read after applying signals to the rows in order to determine whether or not a key is pressed and if pressed, which key is pressed.

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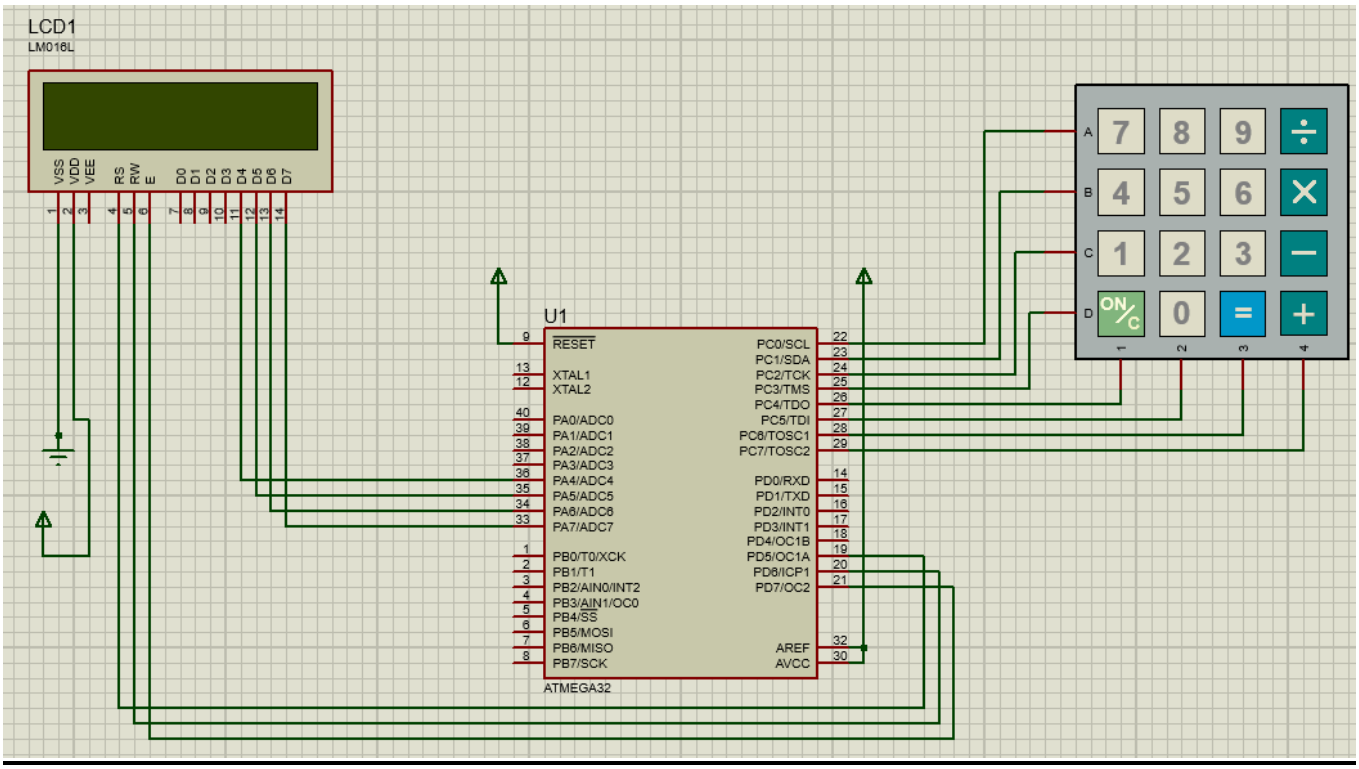
## Circuit:




## Code:

```
#define F_CPU 16000000UL

#include <avr/io.h>
#include <util/delay.h>

#define LCD PORTA

// LCD data port connected to PORTC

#define EN 7
#define RW 6
#define RS 5
```

```
unsigned char keypad();

void lcdcmd(unsigned char cmd)
{
   PORTD &= ~(1 << RS); // RS=0 for command
   PORTD &= ~(1 << RW); // RW=0 for write
   LCD = cmd & 0xF0;   // send upper nibble
   PORTD |= (1 << EN); // EN=1 for H to L pulse
   _delay_ms(1);
   PORTD &= ~(1 << EN); // EN=0 for H to L pulse
   LCD = cmd << 4;      // send low nibble
   PORTD |= (1 << EN); // EN=1 for H to L pulse
   _delay_ms(1);
   PORTD &= ~(1 << EN);
}

void lcddata(unsigned char data)
{
   PORTD |= (1 << RS); // RS=1 for data //RW=0 for write
   PORTD &= ~(1 << RW);

   LCD = data & 0xF0;   // send upper nibble
   PORTD |= (1 << EN); // EN=1 for H to L pulse
   _delay_ms(1);
   PORTD &= ~(1 << EN); // EN=0 for H to L pulse
   LCD = data << 4;      // send low nibble
   PORTD |= (1 << EN); // EN=1 for H to L pulse
   _delay_ms(1);
   PORTD &= ~(1 << EN);
}

void lcd_init()
```

```
{
   DDRA = 0xFF; // define output LCD port
   DDRD = 0xFF; // define RS,EN and RW pin as output
   PORTD &= ~(1 << EN); // initialize en = 0

   lcdcmd(0x33);
   lcdcmd(0x32);
   lcdcmd(0x28); // LCD in 4 bit mode
   lcdcmd(0x0E); // display on cursor on
   lcdcmd(0x01); // clear LCD
   _delay_ms(2);
}

int main(void)
{
   unsigned char x;
   DDRC = 0x0F; // Make PCO to PC3 = O/P and PC4 to PC7 = 1/P
   _delay_ms(1);
   PORTC = 0xF0;

   lcd_init();

   while (1)
   {
      PORTC = 0xF0; // Make all 4 columns 1 and all 4 rows 0
      _delay_ms(25);

      if (PINC != 0xF0)
      {
         x = keypad();
         lcddata(x);
      }
```

```
    }

    return 0;
}

unsigned char keypad()
{
    PORTC = 0b11111110; // make first row 0

    if ((PINC & (1 << PINC4)) == 0)
    {
        _delay_ms(125);
        return '7';
    }
    else if ((PINC & (1 << PINC5)) == 0)
    {
        _delay_ms(125);
        return '8';
    }
    else if ((PINC & (1 << PINC6)) == 0)
    {
        _delay_ms(125);
        return '9';
    }
    else if ((PINC & (1 << PINC7)) == 0)
    {
        _delay_ms(125);
        return '/';
    }

    PORTC = 0b11111101; // make second row 0
```

```
if ((PINC & (1 << PINC4)) == 0)
{
   _delay_ms(125);
   return '4';
}
else if ((PINC & (1 << PINC5)) == 0)
{
   _delay_ms(125);
   return '5';
}
else if ((PINC & (1 << PINC6)) == 0)
{
   _delay_ms(125);
   return '6';
}
else if ((PINC & (1 << PINC7)) == 0)
{
   _delay_ms(125);
   return '*';
}

PORTC = 0b11111011; // make third row 0

if ((PINC & (1 << PINC4)) == 0)
{
   _delay_ms(125);
   return '1';
}
else if ((PINC & (1 << PINC5)) == 0)
{
   _delay_ms(125);
   return '2';
```

```
}
else if ((PINC & (1 << PINC6)) == 0)
{
   _delay_ms(125);
   return '3';
}
else if ((PINC & (1 << PINC7)) == 0)
{
   _delay_ms(175);
   return '-';
}

PORTC = 0b11110111; // make forth row 0

if ((PINC & (1 << PINC4)) == 0)
{
   _delay_ms(125);
   return 'C';
}
else if ((PINC & (1 << PINC5)) == 0)
{
   _delay_ms(125);
   return '0';
}
else if ((PINC & (1 << PINC6)) == 0)
{
   _delay_ms(125);
   return '=';
}
else if ((PINC & (1 << PINC7)) == 0)
{
   _delay_ms(125);
```

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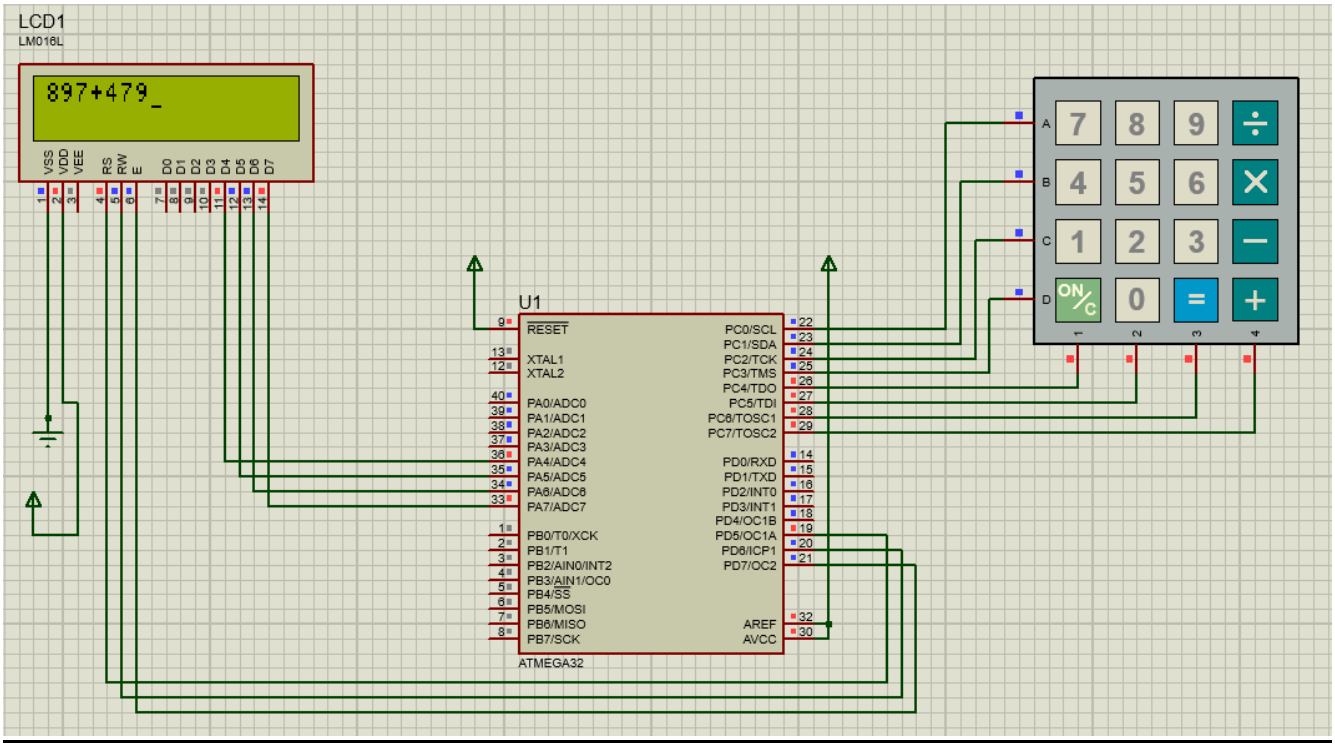
```
        return '+';
    }

    return 0;
}
```

**OUTPUT:**




**CONCLUSION:**

In simple terms, a 4x4 keypad is an input device with 4 rows and 4 columns, and buttons are placed at the intersections of rows and columns. To identify which button is pressed, the microcontroller sequentially grounds each row and checks the columns. If a column reads as 0, a key in that row is pressed. This process is repeated for each row until the pressed key is identified. Using just one wire, called a voltage divider network, we can interface the keypad with a microcontroller, simplifying the wiring setup.

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## Experiment-9 Post Lab Exercise

**Student Name:** Fenil Vadher

**Enrollment No:** 92200133023

**Answer the following questions:**

**1) In reading the columns of a matrix, if no key is pressed we should get all in binary notation?**

(a) 0
(b) 1
(c) F
(d) 7

**Ans:-** (A) - 0

When a key is pressed, it connects the row and column, pulling the voltage level down to 0 (low). So, if no key is pressed in a keyboard matrix, we should generally get all 1s (high).

**2) To identify that which key is being pressed, we need to:**

a) ground all the pins of the port at a time

b) ground pins of the port one at a time

c) connect all the pins of the port to the main supply at a time

d) none of the mentioned

**Ans:-**

(b) ground pins of the port one at a time

## 3) Which is the application for keypad interfacing?

**Security Systems:** Keypads are often used in security systems to enter access codes or passwords.

**Electronic Door Locks**: Keypads are integrated into electronic door locks for secure entry.

**ATMs (Automated Teller Machines):** Keypads on ATMs allow users to input their PINs for transactions.

**Industrial Control Panels:** Keypads are used in industrial settings for machine control and parameter input.

**Calculator and Numeric Entry Devices:** Keypads are essential components in calculators and other numeric entry devices.

**Menu Navigation in Electronic Devices:** Keypads are used in consumer electronics for menu navigation and user input.

**Home Automation:** Keypads are employed in home automation systems for controlling various devices.

**POS (Point of Sale) Systems:** Keypads are used in POS terminals for entering transaction amounts and other details.

**Telecommunication Devices:** Keypads are found in telephones and other communication devices for dialing numbers and inputting information.

**Educational Kits:** Keypads are used in educational kits for learning about microcontroller programming and interfacing.

## 4) What is the use of 4x4 keypad?

**User Input**: The primary purpose of a 4x4 keypad is to allow users to input information easily by pressing the keys corresponding to specific characters, numbers, or functions.

**Password Entry:** 4x4 keypads are commonly used for entering passwords or access codes in security systems, electronic locks, and other secure applications.

**Menu Navigation**: In electronic devices or systems with menus, a 4x4 keypad can be used to navigate through different options and make selections.

**Numeric Entry:** The keypad provides a convenient interface for entering numeric values,

making it useful in calculators, cash registers, and other devices that require numerical input.

**Control Interfaces:** 4x4 keypads are often integrated into control panels for industrial machines or systems, allowing operators to input commands or parameters.

**DIY Electronics Projects:** Hobbyists and electronics enthusiasts often use 4x4 keypads in do-it-yourself (DIY) projects for various applications, such as home automation or robotics.

**Educational Purposes:** 4x4 keypads are used in educational settings to teach students about microcontroller programming, interfacing, and digital input methods.

## 5) What was the use of LCD in this experiment?

**User Feedback:** The LCD displays information to provide feedback to the user about the key they pressed or the result of the keypad input. This visual feedback enhances the user interface and makes the system more user-friendly.

**Displaying Characters**: The LCD can be used to display characters, numbers, or symbols corresponding to the keys pressed on the keypad. This is particularly useful when entering passwords, codes, or any other alphanumeric information.

**Output Presentation:** If the 4x4 keypad is used for controlling a system or entering commands, the LCD can be employed to show the current status, menu options, or any relevant information regarding the system's operation.

**Debugging and Testing:** The LCD can be used for debugging and testing purposes. It allows the programmer or user to visualize intermediate results or debug information during the development phase.

**Enhancing User Interaction:** The combination of a 4x4 keypad and an LCD enhances the overall interaction with the system. Users can see and confirm their input, making the system more intuitive and responsive.

**Educational Purposes:** When used in educational projects, integrating an LCD provides a tangible and visible output, aiding students in understanding the connection between keypad inputs and displayed information.