

PRINCIPLES AND APPLICATION OF MICROCONTROLLERS

AVR C Lab5: Button Display

Introduction

In this lab, you are required to design and build a button display using an AVR ATmega328P microcontroller. The display will use buttons as the input peripheral and a 7-segment LED as the output peripheral. The display has 10 keys, including digits 0 to 9. The display will show the character of a key on the 7-segment LED if the key is pressed. After completing this lab you should be able to master in AVR I/O programming

Parts List

- A breadboard
- An AVR ATmega328P MCU
- Resistors
- A 7-segment LED
- Buttons or switches

Procedure

Use Ports C and D as the input from the buttons. Connect the buttons to Ports C and D as shown in Fig. 1. Note that this connection only works when the pull-up resistors are enabled. Use Port B as the output to the 7-segment LED. Connect the pins of Port B to the 7-segment display. Place appropriate resistors when wiring the display to the microcontroller to prevent burnout. Write a C program that displays the number on the 7-segment LED when a corresponding button is pressed.

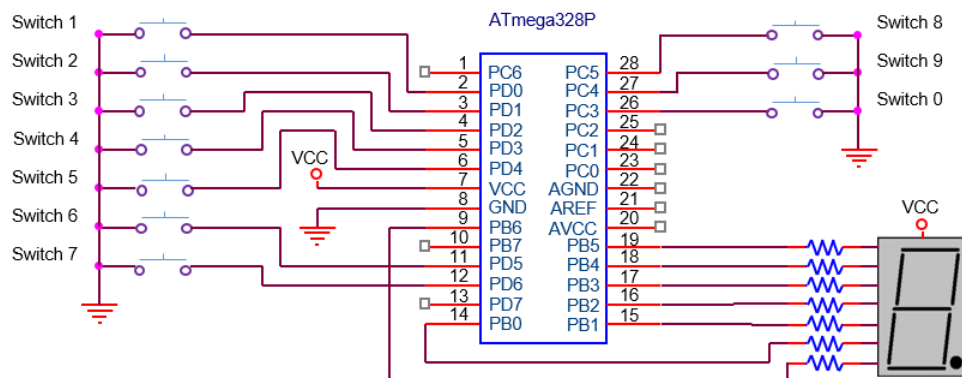


Figure 1: Circuit schematic diagram of button display

Deliverables

Basic + advanced points (100%):

Demo the result to the TAs, or record it in a video. Upload the followings to ceiba: 1) your C program source code, 2) a photo of your physical circuit, and 3) contributions from each teammate to the lab. The contributions must include the information of the tasks each teammate has done and the contributions in percentage. The total percentage should be 100%. All the teammates have to agree with the contributions before they are uploaded.

Bonus Points (20%): Keypad Display

Introduction

In this lab, you are required to design and build a keypad display using an AVR ATmega328P microcontroller (Fig. 1). The display will use a matrix keypad as the input peripheral and a 7-segment LED as the output peripheral. The keypad has 16 keys, including digits 0 to 9 and letters A to F. The display will display the character of a key on the 7-segment LED if the key is pressed. After completing this lab you should be able to:

- Master in AVR I/O programming
- Implement matrix keypads

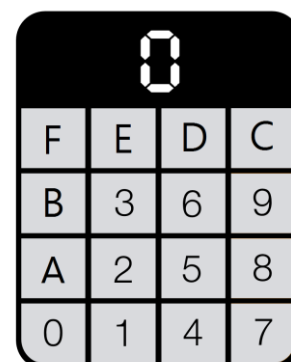


Figure 1: Keypad display

Parts List

- A breadboard
- An AVR ATmega328P MCU
- Resistors
- A 7-segment LED
- A matrix keypad

Matrix Keypad

Matrix keypad is a very useful input device. It is often used for applications such as calculator, telephone, etc. Matrix keypad is made by arranging push button switches in rows and columns (Fig. 2). This arrangement reduces the wires and pins needed to read the status of the buttons.

Pressed keys can be detected by scanning. Assume all column connections (Col1 through Col4) are connected to input pins of a MCU, and all row connections (Row1 through Row4) are connected to output pins of a MCU. Initially all the inputs pins of the MCU are set to logic LOW (GND). To check the keys of the first column in Fig. 2, a logic HIGH signal (5V) is given to the pin connected to Col1. Each pin connected to Row1 through Row4 is then scanned one by one. If any of the key of the first column is pressed, the logic HIGH signal from the Col1 will pass to that row. This process is repeated for all the columns.

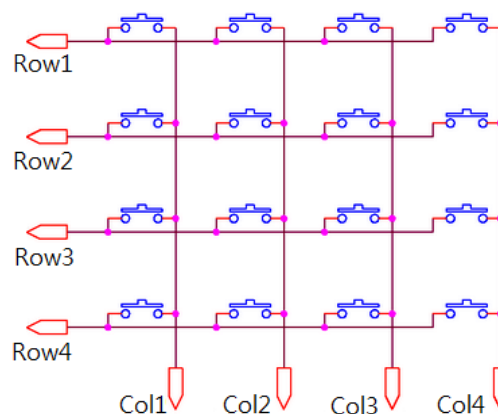


Figure 2: Matrix keypad

Calculator

The display you will build displays a digit or a letter. The 7-segment flash once when powered on. The display displays a digit or a letter when the corresponding key on the keypad is pressed. The digit or letter will then be kept displaying until the next key is pressed.

Procedure

Use Port D as the input from the keypad and Port B as the output to the 7-segment LED. The keypad has 8 pinouts (Fig. 2). Connect the pins to Port D as shown in Fig. 3. A 7-segment display is composed of 7 LEDs. Connect the pins of Port B to the 7-segment display. Place appropriate resistors when wiring the display to the microcontroller to prevent burnout. Write a C program that displays the number on the 7-segment LED when a corresponding button is pressed.

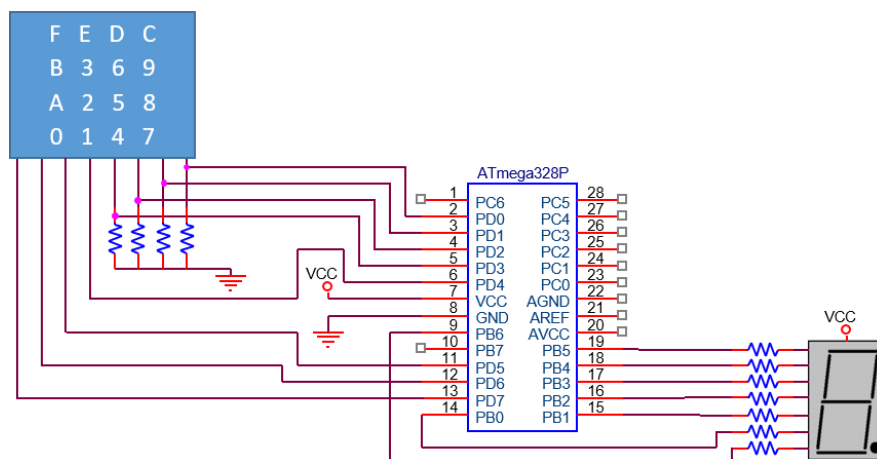


Figure 3: Circuit schematic diagram of keypad display

Appendix – Circuit Diagram

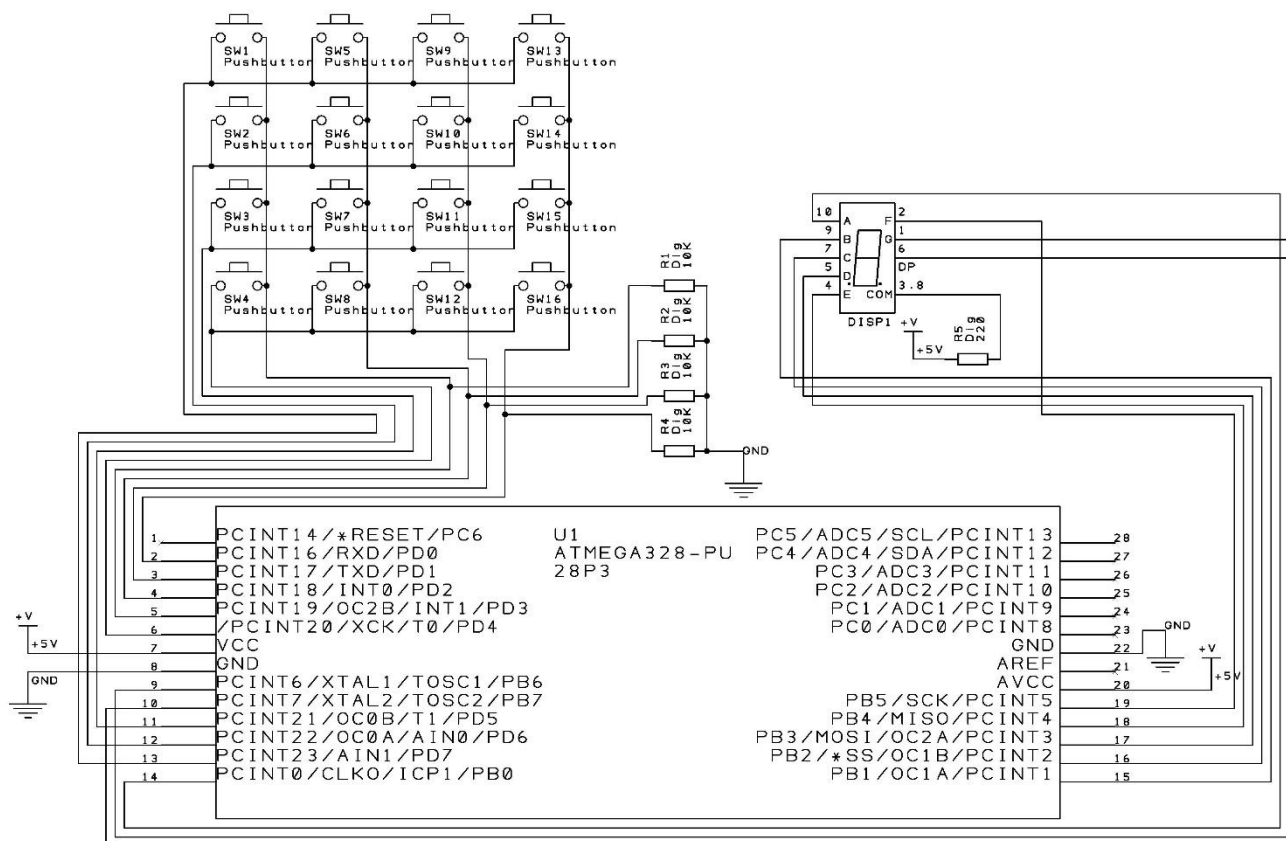


Figure 4: Circuit diagram of keypad display