Embedded Systems Laboratory

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Blink LED in Assembler

In this lab, we are going to study how to control the digital I/O ports of ATmega328. ATmega328 has three digital ports, namely PORTB, PORTC, PORTD, each has 8 pins. All these pins can be defined to be output or input pins independently. Three I/O registers are used to control each PORTx. They are

- Data Register: ***PORTx*** – contains the current value of the port
- Data Direction Register: ***DDRx*** – control the direction (out or in) of the port
- Port Input Pin Register: ***Pinx*** – contains the input value of the port (read only)

Pre Lab Tasks:

1. Study the datasheet Chapter I/O Ports, find out how to use the above three registers

2. Study the assembly instructions LDI, OUT, SBI, CBI, JMP/RJMP, CALL/RCALL, RET, DEC, BRNE, CLI and try to understand my assembly examples.

3. The CPU clock is 8Mhz (you can check the datasheet system clock chapter), calculate how many CPU clock cycles you need to have 1 second delay. Assume implementing each assembly instruction need one CPU clock cycle, change the code in the last examples such that the Delay subroutine produce 1 second delay.

Lab Assignments:

1. Debug the assembly examples in the simulator and observe how the registers, the program counter (PC) change after implementing each instruction.

2. Write the assembly codes to toggle the PORTD and delay 1 second after toggling.

3. Connect one pin from PORTD, an LED, a resister between 200 Ohm to 500 Ohm to either a 5V power suppler or Ground. An example diagram of the circuit is shown below.

4. Upload your code to the chip, make the LED continuously blink with period of 1 second.

5. Can you modify your code such that it does not need CALL/RCALL?

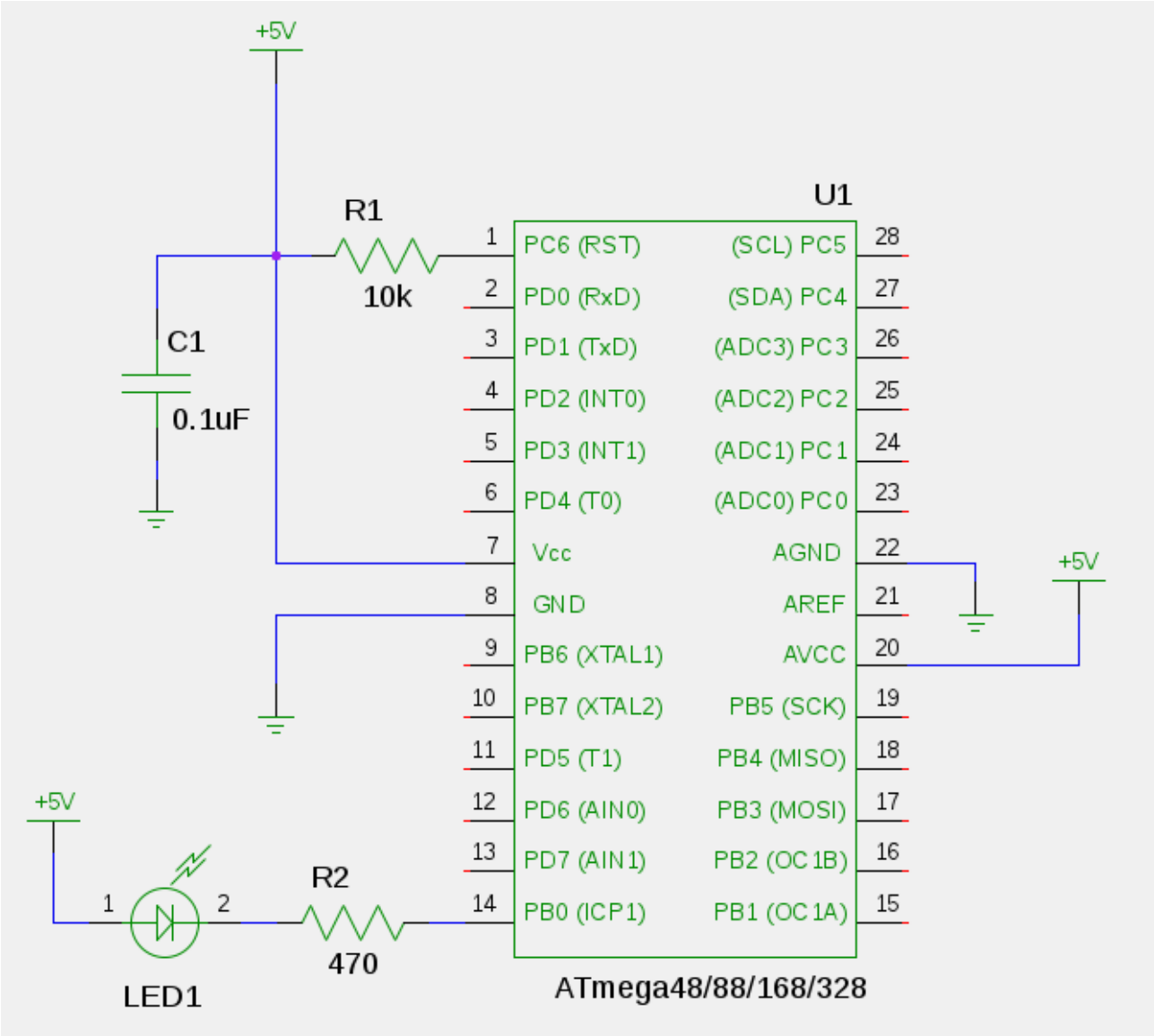
Lab Report:

1. Give your circuit diagram. Explain you circuit design.

2. Give the program codes with comments. Explain your codes, especially how you set each register's bits and what they mean.

3. Answer the questions in the PreLab Tasks and the Lab Assignments, for example how the PC changes after each instruction.

An Example Diagram of the Circuit



Resources:

Atmega328 Datasheet

Atmel-0856-AVR-Instruction-Set-Manual