LAMPIRAN I
(TAMPILAN PROGRAM)
Program Mikrokontroller
.fullName("This program was produced by the CodeWizardAVR V2.05.3 Standard Automatic Program Generator © Copyright 1998-2011 Pavel Haiduc, HP InfoTech s.r.l. http://www.hpinfotech.com

Project:
Version:
Date: 11/12/2013
Author: user
Company: free
Comments:

Chip type: ATmega16
Program type: Application

Memory model: Small
External RAM size: 0
Data Stack size: 128

#include <mega16a.h>
#include <delay.h>

// Alphanumeric LCD functions
#include <alcd.h>
#include <i2c.h>
#include <stdio.h>
#include <stdlib.h>

// Declare your global variables here

unsigned int bacaNilaiSensorI2C(unsigned char alamatI2C)
{
    unsigned int sensor;
    i2c_start();
    i2c_write(alamatI2C);
    i2c_write(0x41);
    i2c_stop();
    delay_us(10);
    i2c_start();
    i2c_write(alamatI2C|0x01);
    sensor = i2c_read(1);
    sensor = sensor*256 + i2c_read(0);
    i2c_stop();
}
return sensor;
}

void main(void)
{
    // Declare your local variables
    unsigned int sensor;

    // Input/Output Ports initialization
    // Port A initialization
    // Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
    // State7=T State6=T State5=T State4=T State3=T State2=T State1=T
    State0=T PORTA=0x00;
        DDRA=0x00;

    // Port B initialization
    // Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
    // State7=T State6=T State5=T State4=T State3=T State2=T State1=T
    State0=T PORTB=0x00;
        DDRB=0x00;

    // Port C initialization
    // Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
    // State7=T State6=T State5=T State4=T State3=T State2=T State1=T
    State0=T PORTC=0x00;
        DDRC=0x00;

    // Port D initialization
    // Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
    // State7=T State6=T State5=T State4=T State3=T State2=T State1=T
    State0=T PORTD=0x00;
        DDRD=0x00;

    // Timer/Counter 0 initialization
    // Clock source: System Clock
    // Clock value: Timer 0 Stopped
    // Mode: Normal top=0xFF
    // OC0 output: Disconnected
        TCCR0=0x00;
        TCNT0=0x00;
        OCR0=0x00;

    // Timer/Counter 1 initialization
    // Clock source: System Clock
    // Clock value: Timer1 Stopped
    // Mode: Normal top=0xFFFF
    // OC1A output: Discon.
    // OC1B output: Discon.
    // Noise Canceler: Off
    // Input Capture on Falling Edge
    // Timer1 Overflow Interrupt: Off

// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt:
Off TCCR1A=0x00;
TCCR1B=0x00; TCNT1H=0x00;
TCNT1L=0x00; ICR1H=0x00;

ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer2 Stopped
// Mode: Normal top=0xFF
// OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;

// External Interrupt(s) initialization
// INTO: Off
// INT1: Off
// INT2: Off
MCUCR=0x00;
MCUCSR=0x00;

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x00;

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: On
// USART Mode: Asynchronous
// USART Baud Rate: 9600
UCSRA=(0<<RXC) | (0<<TXC) | (0<<UDRE) | (0<<FE) | (0<<DOR) | (0<<UPE) | (0<<U2X) | (0<<MPCM);
UCSRB=(0<<RXCIE) | (0<<TXCIE) | (0<<UDRIE) | (1<<RXEN) | (1<<TXEN) |
(0<<UCSZ2) | (0<<RXB8) | (0<<TXB8);
UCSRC=(1<<URSEL) | (0<<UMSEL) | (0<<UPM1) | (0<<UPM0) | 
(0<<USBS) |
(1<<UCSZ1) | (1<<UCSZ0) | (0<<UCPOL);
UBRRH=0x00;
UBRRL=0x47;

// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
    SFIOR=0x00;

    // ADC initialization
    // ADC disabled
    ADCSRA=0x00;

    // SPI initialization
    // SPI disabled
    SPCR=0x00;

    // TWI initialization
    // TWI disabled
    TWCR=0x00;

    // Alphanumeric LCD initialization
    // Connections are specified in the
    // Project|Configure|C Compiler|Libraries|Alphanumeric LCD menu:
    // RS - PORTA Bit 7
    // RD - PORTA Bit 6
    // EN - PORTA Bit 5
    // D4 - PORTA Bit 4
    // D5 - PORTA Bit 2
    // D6 - PORTA Bit 1
    // D7 - PORTA Bit 0
    // Characters/line: 16
    i2c_init();
    lcd_init(16);
    lcd_gotoxy(0,0);
    lcd_putsf("maulana Metrologi");
    delay_ms(3000);
    lcd_clear();
    while (1)
    {
        // Place your code here
        sensor = bacaNilaiSensorI2C(0xE0);
        lcd_gotoxy(0,0);
        lcd_putsf("Data = ");
        lcd_putchar(sensor/1000 %10 + 0x30);
        lcd_putchar(sensor/100 %10 + 0x30);
        lcd_putchar(sensor/10 %10 + 0x30);
        lcd_putchar(sensor %10 + 0x30);
        delay_ms(500);
        // printf("data=%.2d",sensor);
        printf("%d \n\r",sensor);
    }
}
LAMPIRAN II
(DATASHEET LCD 16 X 2)
ALPHANUMERIC LCD DISPLAY (16 x 2)

Order Code
LED008 16 x 2 Alphanumeric Display
FRM010 Serial LCD Firmware (optional)

Contents
1 x 16x2 Alphanumeric Display
1 x data booklet

Introduction
Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiern, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

Further Information
Available as an optional extra is the Serial LCD Firmware, which allows serial control of the display. This option provides much easier connection and use of the LCD module. The firmware enables microcontrollers (and microcontroller based systems such as the PICAXE) to visually output user instructions or readings onto an LCD module. All LCD commands are transmitted serially via a single microcontroller pin. The firmware can also be connected to the serial port of a computer.
An example PICAXE instruction to print the text ‘Hello’ using the serout command is as follows:

serout 7,T2400,"Hello"
Outline Dimension and Block Diagram

The tolerance unless classified ±0.3 mm

MECHANICAL SPECIFICATION

<table>
<thead>
<tr>
<th>Overall Size</th>
<th>Module</th>
<th>View Area</th>
<th>W/O B/L</th>
<th>5/9.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Area</td>
<td>61.0 * 15.9</td>
<td>EL 3/L</td>
<td>5/9.7</td>
<td></td>
</tr>
<tr>
<td>Dot Pitch</td>
<td>0.56 * 0.60</td>
<td>LED B/L</td>
<td>9.4 * 4.0</td>
<td></td>
</tr>
</tbody>
</table>

PIN ASSIGNMENT

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vcc</td>
<td>Power supply (GND)</td>
</tr>
<tr>
<td>2</td>
<td>Vdd</td>
<td>Power supply (+5V)</td>
</tr>
<tr>
<td>3</td>
<td>Vs</td>
<td>Contrast Adjust</td>
</tr>
<tr>
<td>4</td>
<td>RS</td>
<td>Register select signal</td>
</tr>
<tr>
<td>5</td>
<td>RW</td>
<td>Data read/write</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
<td>Power signal</td>
</tr>
<tr>
<td>7</td>
<td>DB0</td>
<td>Data bus line</td>
</tr>
<tr>
<td>8</td>
<td>DB1</td>
<td>Data bus line</td>
</tr>
<tr>
<td>9</td>
<td>DB2</td>
<td>Data bus line</td>
</tr>
<tr>
<td>10</td>
<td>DB3</td>
<td>Data bus line</td>
</tr>
<tr>
<td>11</td>
<td>DB4</td>
<td>Data bus line</td>
</tr>
<tr>
<td>12</td>
<td>DB5</td>
<td>Data bus line</td>
</tr>
<tr>
<td>13</td>
<td>DB6</td>
<td>Data bus line</td>
</tr>
<tr>
<td>14</td>
<td>DB7</td>
<td>Data bus line</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>Power supply for LED B/L (+)</td>
</tr>
<tr>
<td>16</td>
<td>C</td>
<td>Power supply for LED B/L (-)</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM RATING

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>U.r.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>Vcc</td>
<td>—</td>
<td>0</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>LCD Driving Supply Voltage</td>
<td>Vcc</td>
<td>—</td>
<td>0</td>
<td>13</td>
<td>V</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>Vin</td>
<td>—</td>
<td>−0.3 Vdd + 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Toper</td>
<td>Nor</td>
<td>0</td>
<td>50</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Tstg</td>
<td>Nor</td>
<td>−50</td>
<td>−70</td>
<td>°C</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS (Vdd = +5V, Ta = 25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>Vin</td>
<td>—</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>Vos</td>
<td>—</td>
<td>9.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td>Icc</td>
<td>—</td>
<td>2</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>LCD Driving Voltage</td>
<td>Vcl</td>
<td>—</td>
<td>4.3</td>
<td></td>
<td>4.8</td>
</tr>
</tbody>
</table>

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Electrical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Standard value</th>
<th>Unit</th>
<th>Applicable terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power voltage</td>
<td>Vdd</td>
<td></td>
<td>Min. 4.5 Typ. 5.00 Max. 5.5</td>
<td>V</td>
<td>Vdd</td>
</tr>
<tr>
<td>Input H - level voltage</td>
<td>VIH</td>
<td></td>
<td>2.2</td>
<td>V</td>
<td>RS, R/W, E</td>
</tr>
<tr>
<td>Input L - level voltage</td>
<td>VIL</td>
<td></td>
<td>−0.3</td>
<td>V</td>
<td>DO0−D37</td>
</tr>
<tr>
<td>Output H - level voltage</td>
<td>VOH</td>
<td>− IOH = 0.205 mA</td>
<td>2.4</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Output L - level voltage</td>
<td>VOL</td>
<td>1OL = 1.2 mA</td>
<td></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>I/O leakage current</td>
<td>IIL</td>
<td>Vin = 0− Vdd</td>
<td>−1</td>
<td>μA</td>
<td>RS, R/W, E</td>
</tr>
<tr>
<td>Supply current</td>
<td>Idd</td>
<td>Vdd = 5V</td>
<td>2</td>
<td>mA</td>
<td>Vdd</td>
</tr>
<tr>
<td>LCD operating voltage</td>
<td>VLCD</td>
<td>Vdd−V0</td>
<td>3.0</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

Timing Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable cycle time</td>
<td>TCYCLE</td>
<td>500</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Enable pulse width</td>
<td>PWEL</td>
<td>220</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Enable rise / fall time</td>
<td>TEI, TEF</td>
<td>—</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>Set-up time</td>
<td>TAS</td>
<td>40</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Address hold time</td>
<td>TAH</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Data set-up time</td>
<td>TDOSH</td>
<td>60</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Data delay time</td>
<td>TDER</td>
<td>60</td>
<td>120</td>
<td>ns</td>
</tr>
<tr>
<td>Data hold time (writing)</td>
<td>TH</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Data hold time (reading)</td>
<td>TDHR</td>
<td>20</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Clock oscillating frequency</td>
<td>TOSC</td>
<td>270(Typ)</td>
<td></td>
<td>KHz</td>
</tr>
</tbody>
</table>

Timing Chart

*FIG.1 WRITE OPERATION

*FIG.2 READ OPERATION
LAMPIRAN III
(DATASHEET ATMEGA 16A)
8-bit Microcontroller with 16K Bytes In-System Programmable Flash

DATASHEET SUMMARY

Features

1. High-performance, Low-power Atmel AVR 8-bit Microcontroller

2. Advanced RISC Architecture
   - 131 Powerful Instructions – Most Single-clock Cycle Execution
   - 32 x 8 General Purpose Working Registers
   - Fully Static Operation
   - Up to 16MIPS Throughput at 16MHz
   - On-chip 2-cycle Multiplier

3. High Endurance Non-volatile Memory segments
   - 16KBytes of In-System Self-programmable Flash program memory
   - 512Bytes EEPROM
   - 1KByte Internal SRAM
   - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
   - Data retention: 20 years at 85°C/100 years at 25°C
   - Optional Boot Code Section with Independent Lock Bits
   - In-System Programming by On-chip Boot Program
   - True Read-While-Write Operation

4. Programming Lock for Software Security

5. JTAG (IEEE std. 1149.1 Compliant) Interface
   - Boundary-scan Capabilities According to the JTAG Standard
   - Extensive On-chip Debug Support
   - Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface

Peripheral Features

6. Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes

7. One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode

8. Real Time Counter with Separate Oscillator

9. Four PWM Channels

10. 8-channel, 10-bit ADC
    - 8 Single-ended Channels
    - 7 Differential Channels in TQFP Package Only
    - 2 Differential Channels with Programmable Gain at 1x, 10x, or 200x

11. Byte-oriented Two-wire Serial Interface

12. Programmable Serial USART

13. Master/Slave SPI Serial Interface

14. Programmable Watchdog Timer with Separate On-chip Oscillator

15. On-chip Analog Comparator
1. Pin Configurations

Figure 1-1. Pinout ATmega16A

NOTE:
Bottom pad should be soldered to ground
1. Overview

The ATmega16A is a low-power CMOS 8-bit microcontroller based on the Atmel AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16A achieves throughputs approaching 1MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

2.1 Block Diagram

Figure 2-1. Block Diagram
LAMPIRAN IV
(GAMBAR ALAT)