

CODE:

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// Program to operate a Vacuum Fluorescent Display
// using an Arduino Uno, Atmega328P microcontroller.
// code: [modified eg 12.5.4-Mazidi, 8 pin 2 ports DON]

#define F_CPU 16000000UL
#include <avr/io.h>
#include <util/delay.h>

#define LCD_DPRT PORTD           // configuring PortD for data
#define LCD_DDDR DDRD
#define LCD_DPIN PIN_D
#define LCD_CPRT PORTB           // utilizing PortB pins for the control.
#define LCD_CDDR DDRB
#define LCD_CPIN PINB
#define LCD_RS 0                 // control pin assignments.
#define LCD_RW 1
#define LCD_EN 2
//*****
void delay_us(unsigned int d)
{
    _delay_us(d);
}
//*****
void lcdCommand( unsigned char cmnd )
{
    LCD_DPRT = cmnd;             // ready data lines
    LCD_CPRT &= ~(1<<LCD_RS);    // RS low to select the command register
    LCD_CPRT &= ~(1<<LCD_RW);    // RW low to write commands.
    LCD_CPRT |= (1<<LCD_EN);    // Enable pin set to latch data on the falling edge.
    delay_us(.02);              // Enable high for 20 ns for LCD module to run a command.
    LCD_CPRT &= ~(1<<LCD_EN);    // LCD_EN pin of PortB is cleared after sending a command.
    delay_us(.23);              // Delay 230 ns between commands sent.
}
//*****
void lcdData( unsigned char data )
{
    LCD_DPRT = data;
    LCD_CPRT |= (1<<LCD_RS);    // RS pin set to select the Data register.
    LCD_CPRT &= ~(1<<LCD_RW);    // RW low to write commands.
    LCD_CPRT |= (1<<LCD_EN);    // Enable pin set to latch data on the falling edge.
    delay_us(.666);             // delay .666us between data sets.
    LCD_CPRT &= ~(1<<LCD_EN);    // LCD_EN pin of PortB is cleared after sending data byte.
    delay_us(.666);             // delay .666us
}
//*****
void lcd_init()                 // Equivalent to void InitializeComputerBoard (void).
{
    // ...exception: the delay btwn clear display and entry mode.
    LCD_DDDR = 0xFF;           // Port D is configured as output.
    LCD_CDDR = 0xFF;           // Port B is configured as output.

    LCD_CPRT &= ~(1<<LCD_EN);    // LCD_EN pin of PortB is cleared in preparation for sending
    delay_us(2000);            // delay of 2ms before sending commands.
    lcdCommand(0x38);          // Function set command for interface data length, display lines and character font.
}
```

