CPE301 – SPRING 2019

Design Assignment 6

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Directory: submissions_E/DA/LAB6/

Submit the following for all Labs:

1. In the document, for each task submit the modified or included code (only) with highlights and justifications of the modifications. Also, include the comments.

2. Use the previously create a Github repository with a random name (no CPE/301, Lastname, Firstname). Place all labs under the root folder ESD301/DA, sub-folder named LABXX, with one document and one video link file for each lab, place modified asm/c files named as LabXX-TYY.asm/c.

3. If multiple asm/c files or other libraries are used, create a folder LabXX-TYY and place these files inside the folder.

4. The folder should have a) Word document (see template), b) source code file(s) and other include files, c) text file with youtube video links (see template).

1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

Atmel Studio 7
ATmega328PB Xplained mini

Figure 1-1. ATmega328P Xplained Mini Headers and Connectors

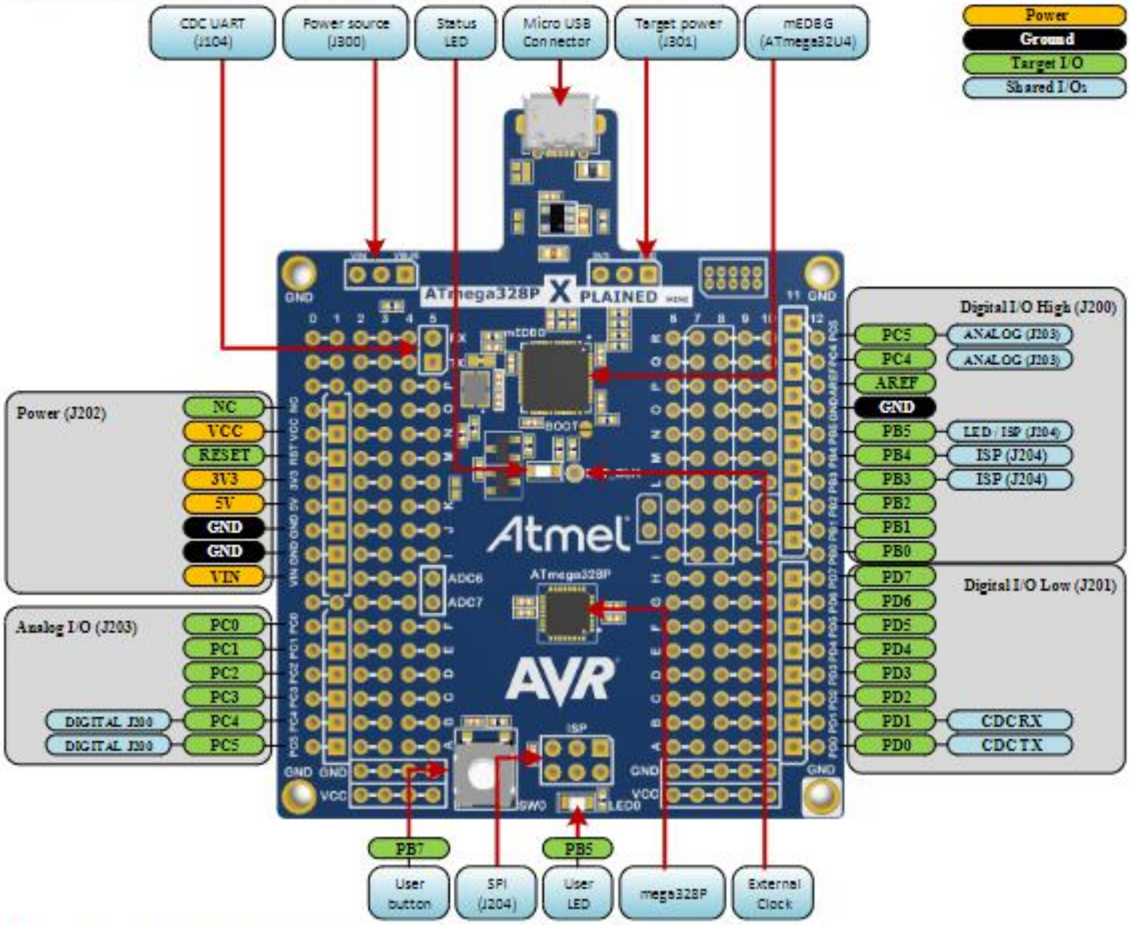
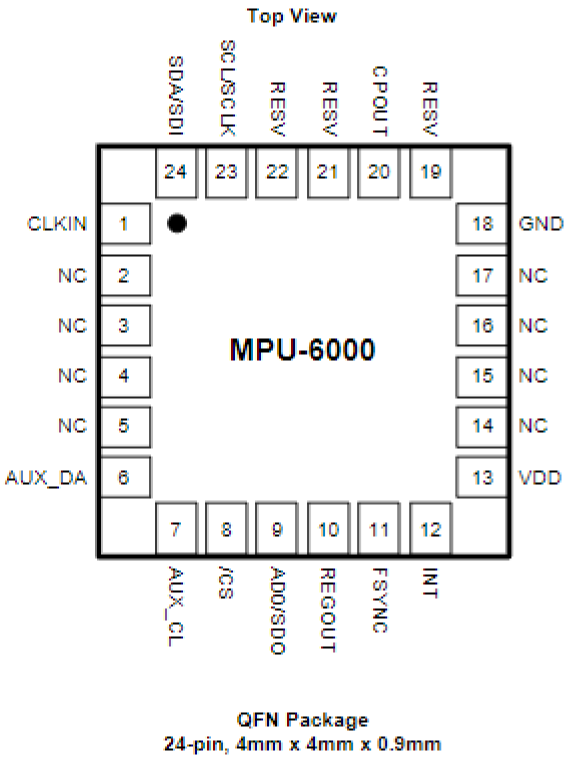


Table 1-1. Default Configurations



MPU Pin Diagram

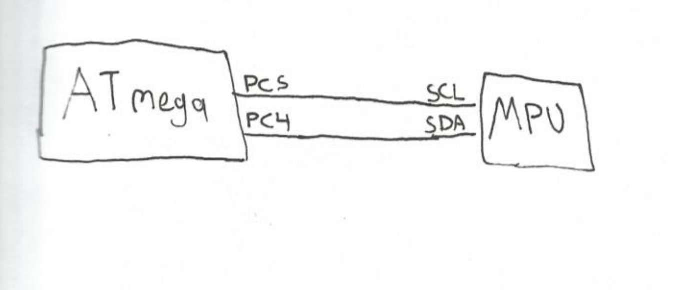
2. MODIFIED CODE OF TASK 1

```
#ifndef F_CPU
#define F_CPU 16000000UL
#endif

#include <avr/io.h>
#include <util/delay.h>
#include <math.h>
#include <stdlib.h>                                                                          /*
Include standard library file */
#include <stdio.h>                                                                           /*
Include standard library file */
#include "MPU6050_def.h"                                                       /* Include MPU6050
register define file */
#include "i2c_master.h"                                                        /* Include I2C
Master header file */
#include "uart.h"                                                       /* Include USART header
file */

#define MPU6050_WRITE 0xD0
#define MPU6050_READ 0xD1

float Acc_x, Acc_y, Acc_z, Temp_out, Gyro_x, Gyro_y, Gyro_z;

void init_uart(uint16_t baudrate){

	uint16_t UBRR_val = (F_CPU/16)/(baudrate-1);
```

```
    UBRR0H = UBRR_val >> 8;
    UBRR0L = UBRR_val;

    UCSR0B |= (1<<TXEN0) | (1<<RXEN0) | (1<<RXCIE0); // UART TX (Transmit - senden)
einschalten
    UCSR0C |= (1<<USBS0) | (3<<UCSZ00); //Modus Asynchron 8N1 (8 Datenbits, No Parity,
1 Stopbit)
}

void uart_putc(unsigned char c){

    while(!(UCSR0A & (1<<UDRE0))); // wait until sending is possible
    UDR0 = c; // output character saved in c
}

void uart_puts(char *s){
    while(*s){
        uart_putc(*s);
        s++;
    }
}

void init_MPU6050(void){
    _delay_ms(150);
    /* Power up time >100ms */
    i2c_start(MPU6050_WRITE); // Set Gyroscope Sample Rate = 1 KHz, Accelerometer
Sample Rate = 1 KHz (default)
    i2c_write(SMPLRT_DIV); // Sample Rate is generated by dividing the gyroscope
output rate by SMPLRT_DIV
    i2c_write(0x07); // Gyroscope Output Rate = 8kHz, Sample Rate = Gyroscope Output
Rate / (1 + SMPLRT_DIV)
    i2c_stop();

    i2c_start(MPU6050_WRITE);
    i2c_write(PWR_MGMT_1);
    i2c_write(0x01); // PLL with X axis gyroscope reference
    i2c_stop();

    i2c_start(MPU6050_WRITE);
    i2c_write(CONFIG); //Frame Synchronization & Digital Low Pass Filter (DLPF)
setting
    i2c_write(0x00);
    i2c_stop();

    i2c_start(MPU6050_WRITE);
    i2c_write(GYRO_CONFIG); //gyroscopes’ scale range = FS_SEL selects = 11 = ± 2000
°/s
    i2c_write(0x18);            // accelerometer range = ± 2g (default)
    i2c_stop();

    i2c_start(MPU6050_WRITE);
    i2c_write(INT_ENABLE); // DATA_RDY_EN = 1
    i2c_write(0x01);
    i2c_stop();
}

void getreading(void){
    i2c_start(MPU6050_WRITE);
    i2c_write(ACCEL_XOUT_H); // set pointer
    i2c_stop();

    i2c_start(MPU6050_READ);
    Acc_x = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Acc_y = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Acc_z = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Temp_out = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Gyro_x = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Gyro_y = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    Gyro_z = (((int)i2c_read_ack()<<8) | (int)i2c_read_ack());

    i2c_stop();
}

int main(void){
    char buffer[20], float_[10];
    float Ax, Ay, Az, Gx, Gy, Gz;
    init_uart(9600);
    i2c_init();
    init_MPU6050();

    while(1){
        getreading();
        Ax = Acc_x/16384.0;                                                  /*
Divide raw value by sensitivity scale factor to get real values */
        Ay = Acc_y/16384.0;
        Az = Acc_z/16384.0;
        Gx = Gyro_x/16.4;
        Gy = Gyro_y/16.4;
        Gz = Gyro_z/16.4;

        USART_SendString("\n-----------------------\n");

        dtostrf( Ax, 3, 2, float_ );                                 /* Take
values in buffer to send all parameters over USART */
        sprintf(buffer,"Ax = %s g, ",float_);
        USART_SendString(buffer);

        dtostrf( Ay, 3, 2, float_ );
        sprintf(buffer,"Ay = %s g, ",float_);
        USART_SendString(buffer);

        dtostrf( Az, 3, 2, float_ );
        sprintf(buffer,"Az = %s g\n\n",float_);
        USART_SendString(buffer);

        dtostrf( Gx, 3, 2, float_ );
        sprintf(buffer,"Gx = %s degrees/s, ",float_);
        USART_SendString(buffer);
```

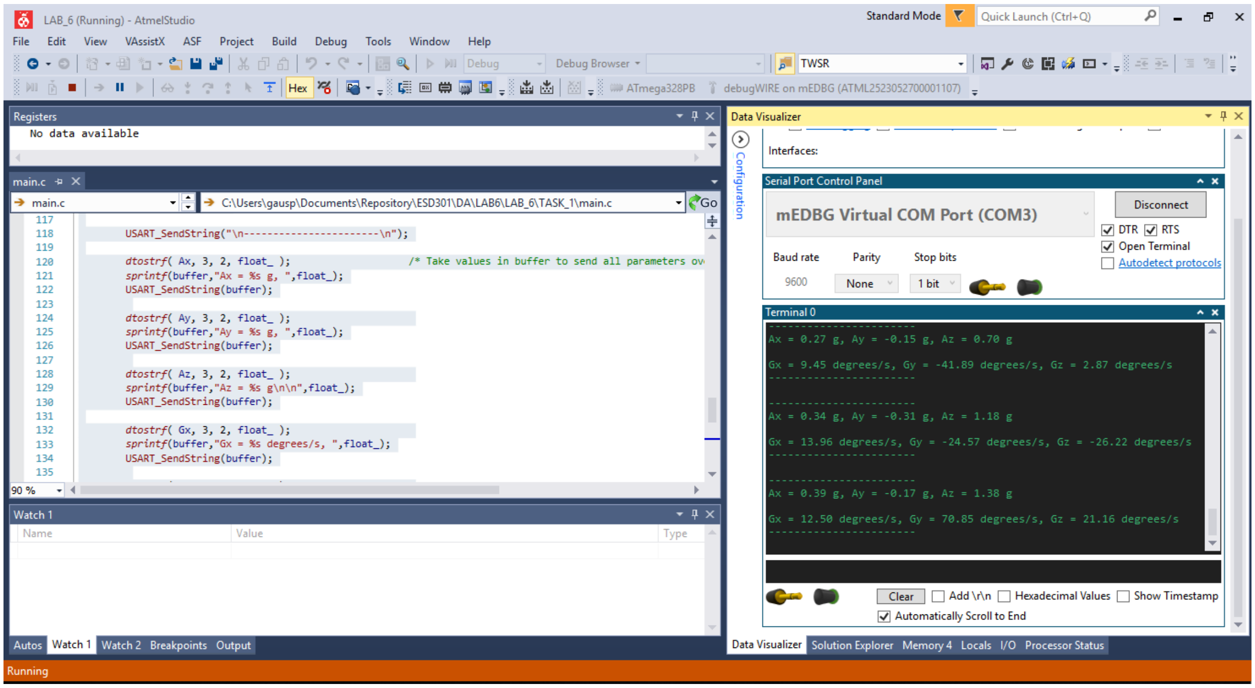
```
            dtostrf( Gy, 3, 2, float_ );
            sprintf(buffer,"Gy = %s degrees/s, ",float_);
            USART_SendString(buffer);

            dtostrf( Gz, 3, 2, float_ );
            sprintf(buffer,"Gz = %s degrees/s",float_);
            USART_SendString(buffer);

            USART_SendString("\n----------------------\n");
            _delay_ms(2000);
        }

        return 0;
}
```

3. SCHEMATICS



Task 1 Schematic

4. SCREENSHOTS OF EACH TASK OUTPUT


LAB_6 (Running) - AtmelStudio
Standard Mode
Quick Launch (Ctrl+Q)
File Edit View VAssistX ASF Project Build Debug Tools Window Help
Debug
Debug Browser
TWSR
Hex
ATmega328PB
debugWIRE on mEDBG (ATML2523052700001107)
Registers
main.c
Go
90 %
Watch 1
Name
Value
Type
Autos Watch 1 Watch 2 Breakpoints Output
Running
Data Visualizer
Configuration
Interfaces:
Serial Port Control Panel
Disconnect
Terminal 0
Clear
Data Visualizer Solution Explorer Memory 4 Locals I/O Processor Status

No data available

main.c — C:\Users\gausp\Documents\Repository\ESD301\DA\LAB6\LAB_6\TASK_1\main.c

```
            USART_SendString("\n----------------------\n");

            dtostrf( Ax, 3, 2, float_ );                    /* Take values in buffer to send all parameters ov
            sprintf(buffer,"Ax = %s g, ",float_);
            USART_SendString(buffer);

            dtostrf( Ay, 3, 2, float_ );
            sprintf(buffer,"Ay = %s g, ",float_);
            USART_SendString(buffer);

            dtostrf( Az, 3, 2, float_ );
            sprintf(buffer,"Az = %s g\n\n",float_);
            USART_SendString(buffer);

            dtostrf( Gx, 3, 2, float_ );
            sprintf(buffer,"Gx = %s degrees/s, ",float_);
            USART_SendString(buffer);
```

mEDBG Virtual COM Port (COM3)

☑ DTR ☑ RTS
☑ Open Terminal
☐ Autodetect protocols

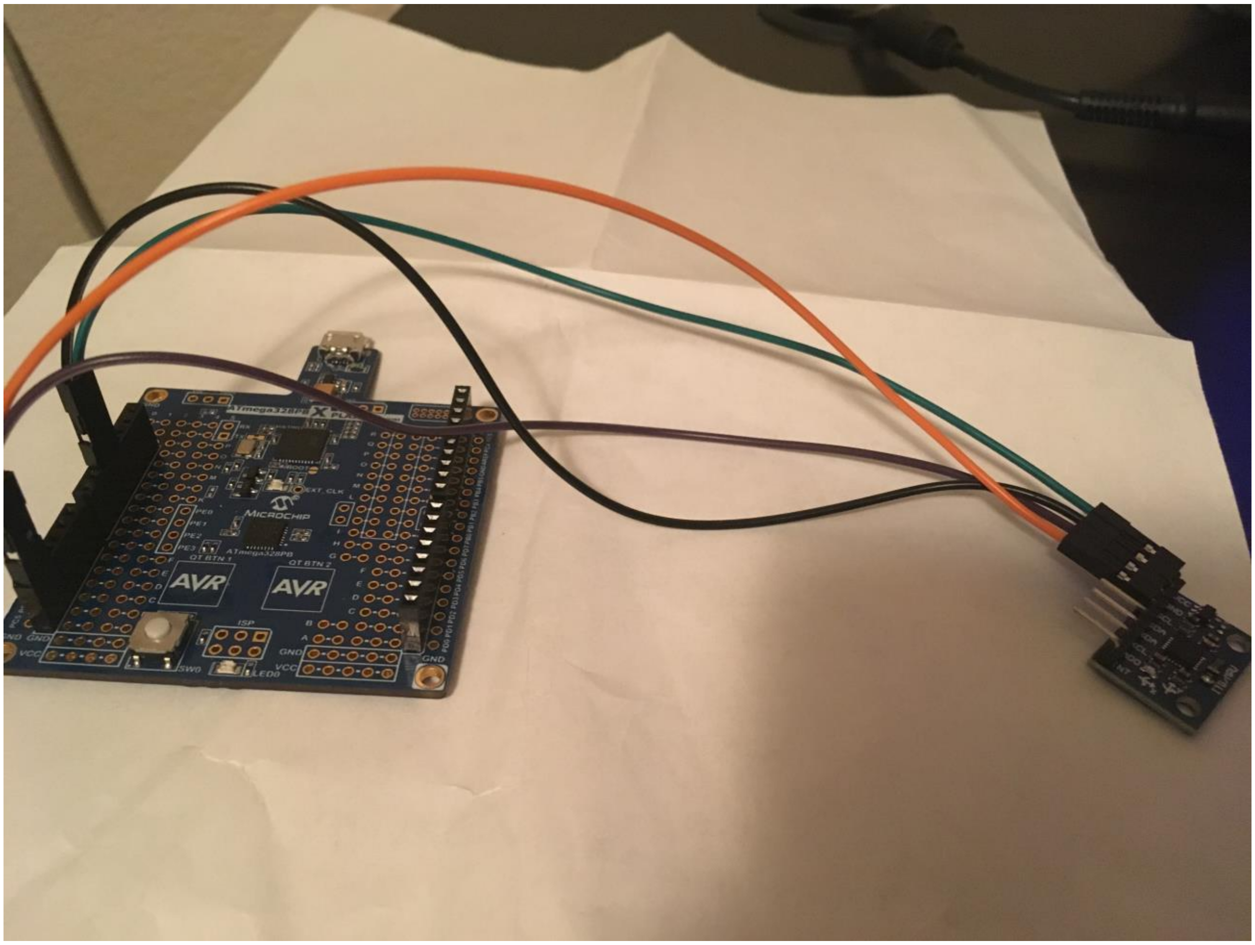
Baud rate: 9600 Parity: None Stop bits: 1 bit

```
----------------------
Ax = 0.27 g, Ay = -0.15 g, Az = 0.70 g

Gx = 9.45 degrees/s, Gy = -41.89 degrees/s, Gz = 2.87 degrees/s
----------------------

----------------------
Ax = 0.34 g, Ay = -0.31 g, Az = 1.18 g

Gx = 13.96 degrees/s, Gy = -24.57 degrees/s, Gz = -26.22 degrees/s
----------------------

----------------------
Ax = 0.39 g, Ay = -0.17 g, Az = 1.38 g

Gx = 12.50 degrees/s, Gy = 70.85 degrees/s, Gz = 21.16 degrees/s
----------------------
```

☐ Add \r\n ☐ Hexadecimal Values ☐ Show Timestamp
☑ Automatically Scroll to End

Task 1 serial output for acceleration and gyro values

5. SCREENSHOT OF EACH DEMO (BOARD SETUP)



Task 1 Board setup

6. GITHUB LINK OF THIS DA

https://github.com/portig1/submissions_E/tree/master/DA/LAB6

Student Academic Misconduct Policy

http://studentconduct.unlv.edu/misconduct/policy.html

“This assignment submission is my own, original work”.

Geovanni Portillo