Design Assignment - KICAD

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Directory: CPE301D/myShield

   The goal of the final project in CpE301D will be to design an Arduino Shield for your Xplained Mini Atmega328p/pb. The shield should have the following components listed below. Students are required to submit the schematic, PCB and Gerber files of this project. The entire project folder along with the libraries used and created should be uploaded to the github page under the folder CpE301D.

The Arduino Shield should have the following components:

1. Two LEDs with appropriate resistors connected to PORTD pins 5&6 in reverse logic.
2. Two push buttons working in internal pullup mode connected to PORTD pins 2&3.
3. A 10K Potentiometer with a filter connected to PORTC pin 0.
4. A Quad 7-SEG display with shift registers with connections as shown in the multi-functional shield that will operate in HW SPI mode.
5. Connectors to interface the ultrasonic sensor to the T1 capture pin.
6. DC motor driver (TB6612FNG dual motor driver) interface with external motor power terminals, chip and connectors.
7. Stepper Motor (ULN2003) interface (with chip and connectors).
8. Interface to the servo motor (connectors only)
9. Female header pin for I2C interface with VCC and GND to accommodate the MPU6050 sensor.

Connection Summary:

- PC4-PC5: I2C,
- PC0: POT,
- PD2, PD3: Switch
- PD6, PD5: Led
- Use any appropriate free GPIO/pins for 7SEG, i2c, and motor drivers. If needed, you can use certain uC pin connections to multiple components. If you have pin conflicts use a jumper mechanism.

1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

Insert only the modified sections here
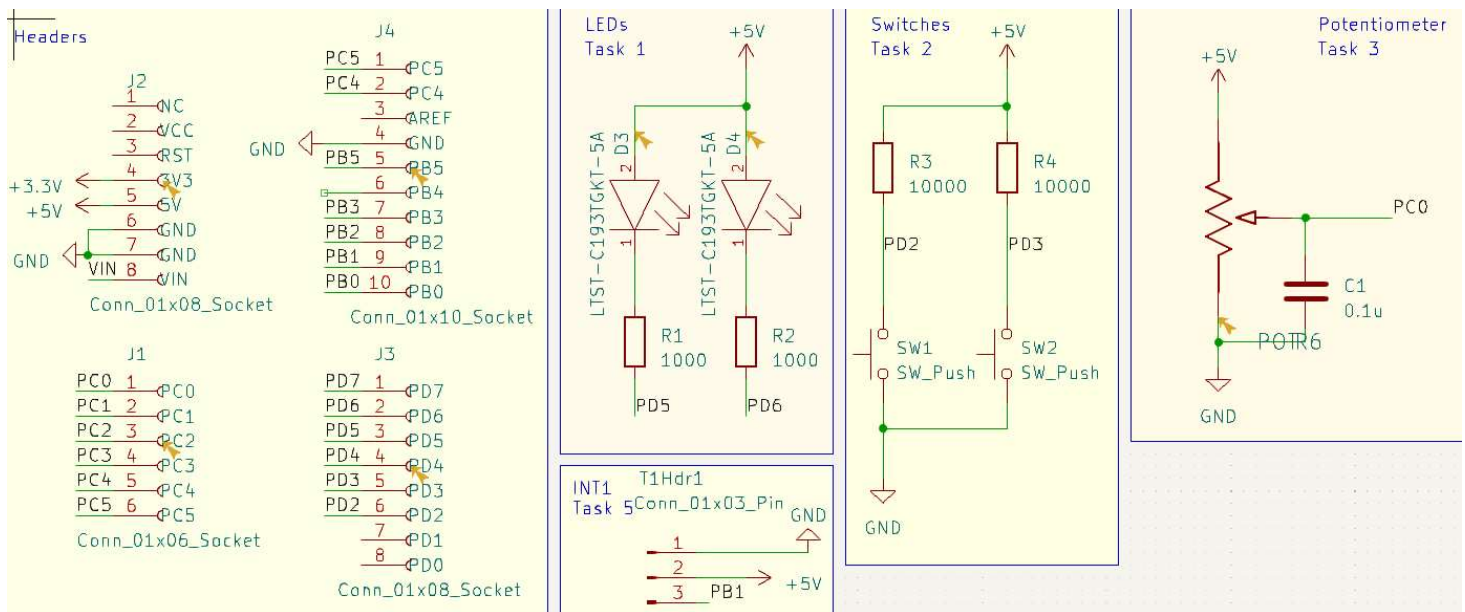
2. SCHEMATICS

First the main sets of headers that connect the shield to the Atmega328p/b were created (left). Not all of them are used but they were included for familiarity and stability when connecting the shield.

Task 1 schematic shows two surface mounted LEDs connected through PD5 and PD6 in reverse logic with 1k Ohm surface mounted resistors.

Task 2 schematic indicates two surface mounted pushbutton switches connected to internal pullup resistors with values of 10k Ohms.

Task 3 schematic shows the specified potentiometer connected to PC0 with a 0.1uF capacitor acting as a filter.

Task 5 (bottom middle) contains the headers for connecting to INT0/VCC/GND for the sonic sensor.
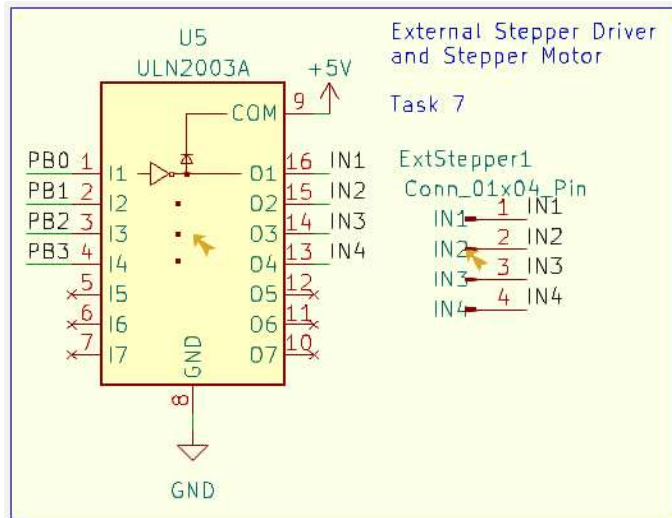

Schematic for base headers to Atmega328 board (left). Task 1 and Task 5 (middle). Task 2 and Task 3 (right).

Task 4 schematic on the left shows our 4-digit 7-segment display of choice (CC56-12SRWA) connected with two 8-bit static shift registers (74HC595) to PB0/PB1/PD4/PD7 by SER/QH`/SRCLK/RCLK respectively. These synchronize the shifters and connect our 7-segment display through SPI.

Task 6 (shown right) connects up to two external DC motors to the motor driver chip hosted on the board. The headers ExtMotor1/2 connect the external motor to pins AO1/2 and BO1/2. Power is provided by the shield in the form of 5V for both logic and motor input.
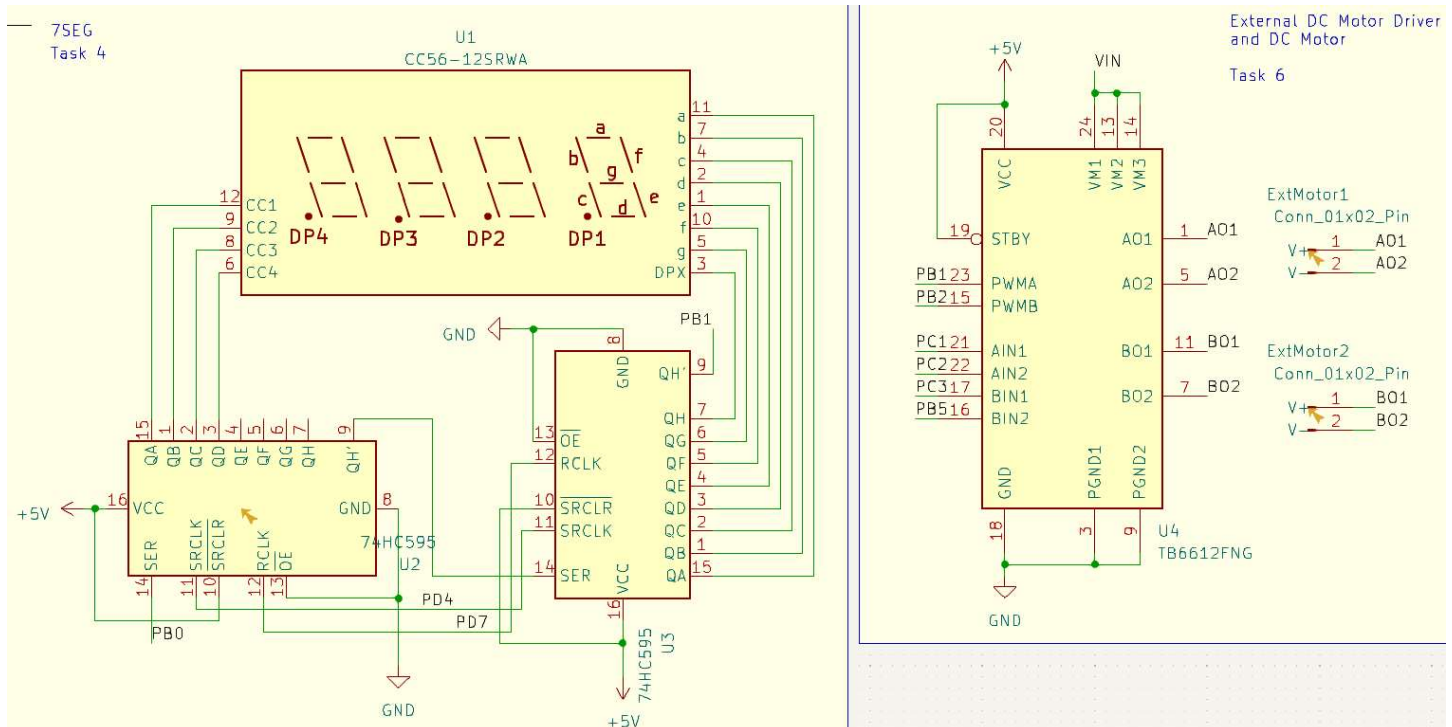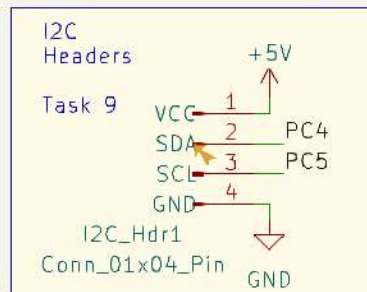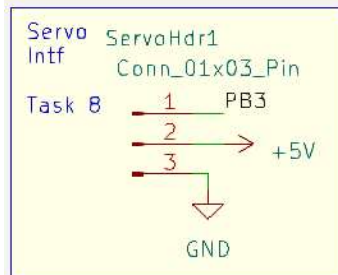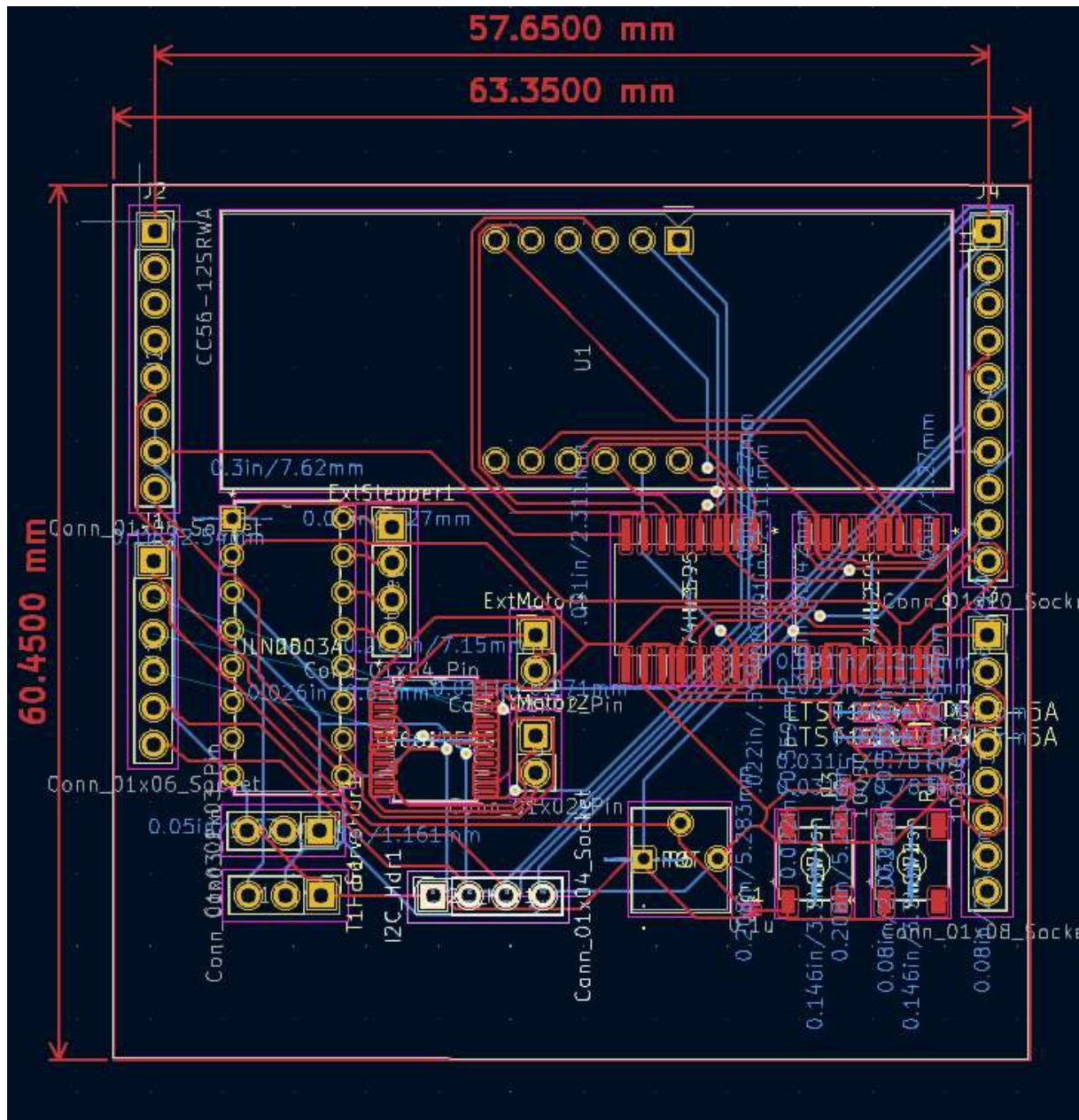

Schematic for Task 4 the 7-segment display (left) and interface for an external DC motor using a driver chip on the board (right).

U5
ULN2003A

External Stepper Driver
and Stepper Motor

Task 7

+5V

COM — 9

PB0 1 — I1 — O1 — 16 IN1
PB1 2 — I2 — O2 — 15 IN2
PB2 3 — I3 — O3 — 14 IN3
PB3 4 — I4 — O4 — 13 IN4
5 — I5 — O5 — 12
6 — I6 — O6 — 11
7 — I7 — O7 — 10

GND 8

GND

ExtStepper1
Conn_01x04_Pin
IN1 — 1 IN1
IN2 — 2 IN2
IN3 — 3 IN3
IN4 — 4 IN4

Servo Intf   ServoHdr1
Conn_01x03_Pin

Task 8   1 — PB3
           2 — +5V
           3
GND

I2C Headers   +5V

Task 9   VCC — 1
           SDA — 2 — PC4
           SCL — 3 — PC5
           GND — 4

I2C_Hdr1
Conn_01x04_Pin   GND

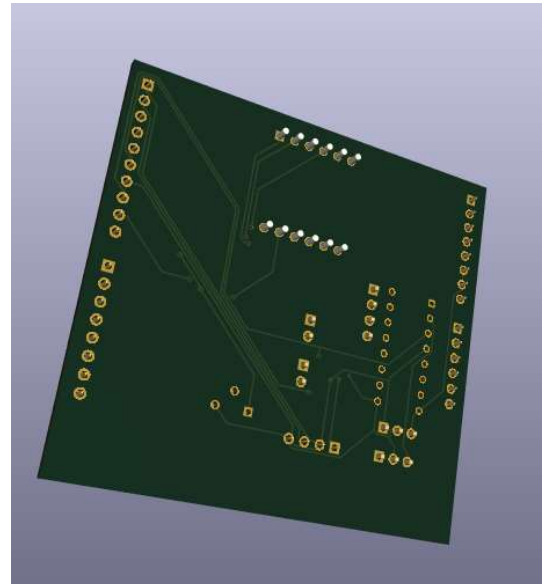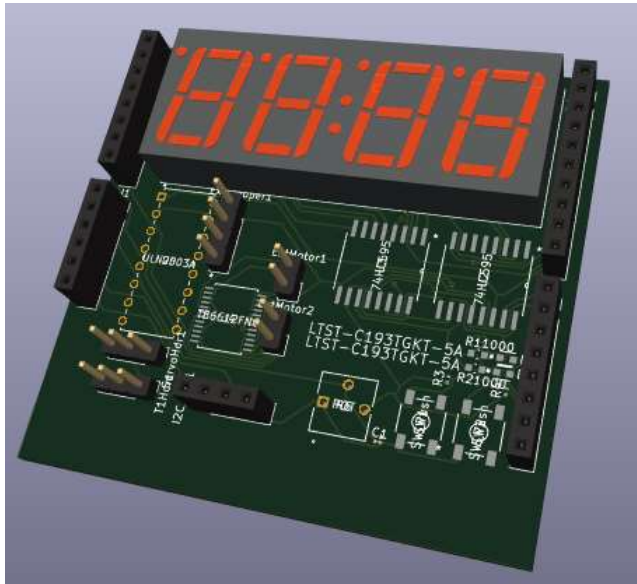Schematic for Task 7, similar to above, includes headers for an external stepper motor to connect to the chip through an onboard driver. Not designed to be used simultaneously with a DC motor. Pinouts are simply as shown. PB0-3 for logic and the board supplies 5V.

Task 8 and Task 9 shown below Task 7 show pin headers for connections to an external servo motor and sockets for female pins to interface to I2C.

3. LAYOUT

PCB Layout for combined schematic. The edge cut is 60.45 mm x 63.35mm. The socket bores for connecting the Atmega328p/b board are spaced 57.65 mm apart to align with the corresponding pins on the board below so that it may stack.

Most of the real estate is taken up by the 7-segment display and corresponding shift registers (top middle). LEDs and Switches are nestled in the bottom left. Motor drivers are on the middle left. Interface headers for servo, I2C, and INT1 (sonic sensor) are in the bottom left.

4. 3D VIEW (Front & Back)

3DViewer for PCB shield front (left) and back (right).

5. BILL OF MATERIALs

Bill of Materials

Part #	Part Name	Description	Procurement Type	Quantity	Unit of Measure	Add. Notes
LTST-C193 TGKT-5A	LiteOn LED	LED GREEN CLEAR CHIP SMD	Off-the-shelf	2	each	
RC0603JR-071KL	Yageo Resistor	RES 1K OHM 5% 1/10W 0603	Off-the-shelf	2	each	
8-1437565-1	Alcoswitch Pushbutton	SWITCH TACTILE SPST-NO 0.02A 15V	Off-the-shelf	2	each	
RMCF0201 FT10K0	Stackpole Resistor	RES 10K OHM 1% 1/20W 0201	Off-the-shelf	2	each	any generic smd resistor will work
3362P-1-103LF	Bourns Potentiometer	TRIMMER 10K OHM 0.5W PC PIN TOP	Off-the-shelf	2	each	
CL03A104K Q3NNNC	Samsung Capacitor	CAP CER 0.1UF 6.3V X5R 0201	Off-the-shelf	1	each	any generic smd capacitor will work
CC56-12SR	Kingbright	LED Character and	Off-the-	1	each	

WA	7-segment	Numeric RED Common Cathode	shelf			
SN74HC595DWR	TexasInst. 8-bit shift	IC 8BIT SHIFT REG 3ST-OUT 16SOIC	Off-the-shelf	2	each	any 16-pin 74HC595 chip will work
TB6612FNG,C,8,EL	Toshiba DC motor driver	IC MOTOR DRIVER 2.7V-5.5V 24SSOP	Off-the-shelf	1	each	
ULN2003A	STMicro Stepper driver	IC PWR RELAY 7NPN 1:1 16DIP	Off-the-shelf	1	each	

6. GITHUB LINK OF THIS DA

https://github.com/brokenboredom/tech-muffin/CpE301D

Student Academic Misconduct Policy

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

"This assignment submission is my own, original work".

Samuel McCormick

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