

The Glove

Mock Design Review

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1. Block Diagram

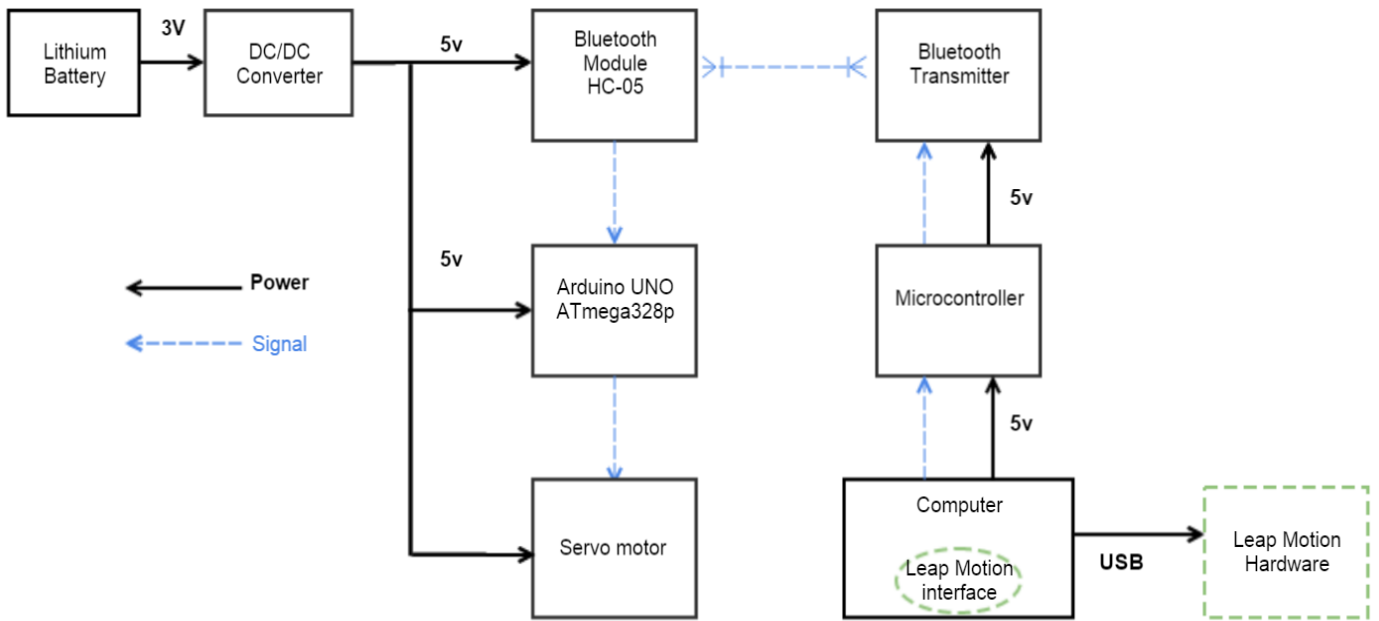


figure 1: block diagram

2. Circuit Schematic of Microcontroller and Servo

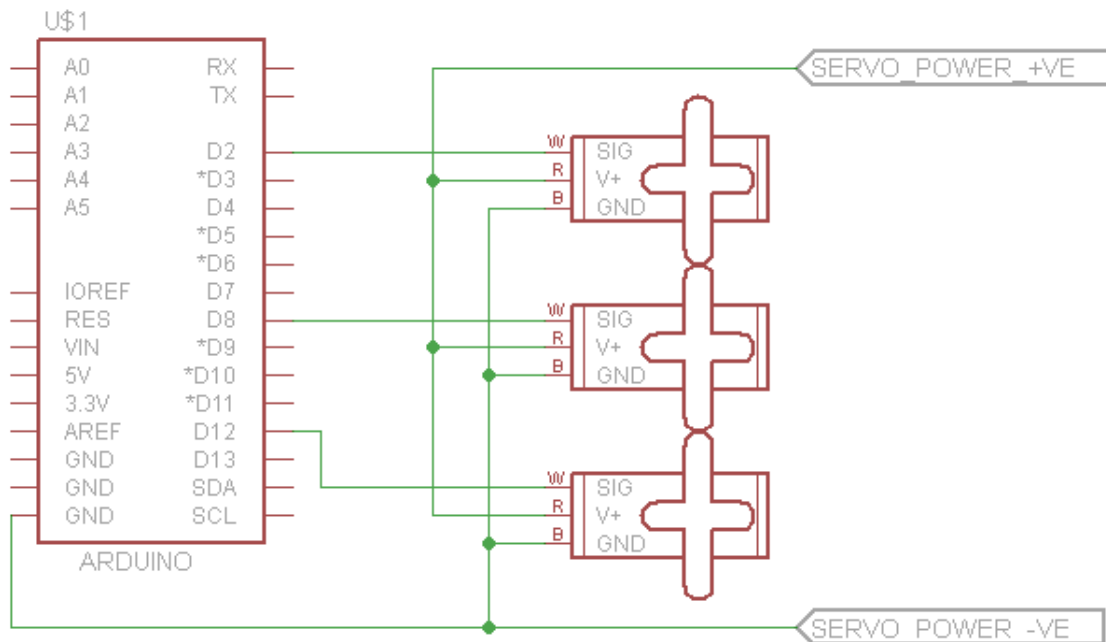


figure 2: circuit schematic of MCU & Servo

3. Block Description of Microcontroller

Arduino Uno ATmega328P:

INPUT: 5V Power input from the battery. Data input from the Bluetooth receiver.

PURPOSE: The microcontroller will receive the data from the Bluetooth receiver and use the data to control the server through the 6 PWM I/O pins. More specifically, it will convert the data into time signals in HIGH/LOW sequence.

OUTPUT: 6 PWM I/O pins to the servo.

4. Calculation of the duration of power source

We want to calculate how long the battery will last under a continuous work environment.

The total voltage delivery of the battery will be 3 volts, and the rated capacity is 75mAh.

We know from the data sheet that the mean current through the Bluetooth, no matter processing or not, is 8mA. And the current per pin of the Arduino Uno is 40mA. The Idle current of the servo is 4mA.

$$T = W / (I_1 + I_2 + I_3) = 75\text{mAh} / (8\text{mA} + 40\text{mA} + 4\text{mA} * 5) = 1.1\text{h}$$

So the time that our project will work at most 1.1 hours.

5. Simulation

Servos are controlled by sending them pulse of width by signal wire. Given the rotation constrains, the neutral has been defined to be the position that the clockwise potential position is exactly equal to counterclockwise potential position. For the servo we use for our project (HD-3001HB), the neutral pulse is 1.5ms, which we will make it as the neutral position of our fingers (allows straight fingers to curl inwards and outwards).

Shown below is a simple simulation of PWM (Pulse Width Modulation) of HD-3001HB servos. Precisely, PWM is 0.8 ms for minimum angles, 1.5 ms for neutral angles and 2.2 for maximum angles. The horizontal axis indicates the voltage. We have 4.8V or 6V voltage of choices. In our project, we will apply constant 4.8V voltage to make the speed slower and torque smaller for the sake of safety. For the 4.8V voltage, we have 0.14 s/60° for speed and 3.5 kg.cm for torque.

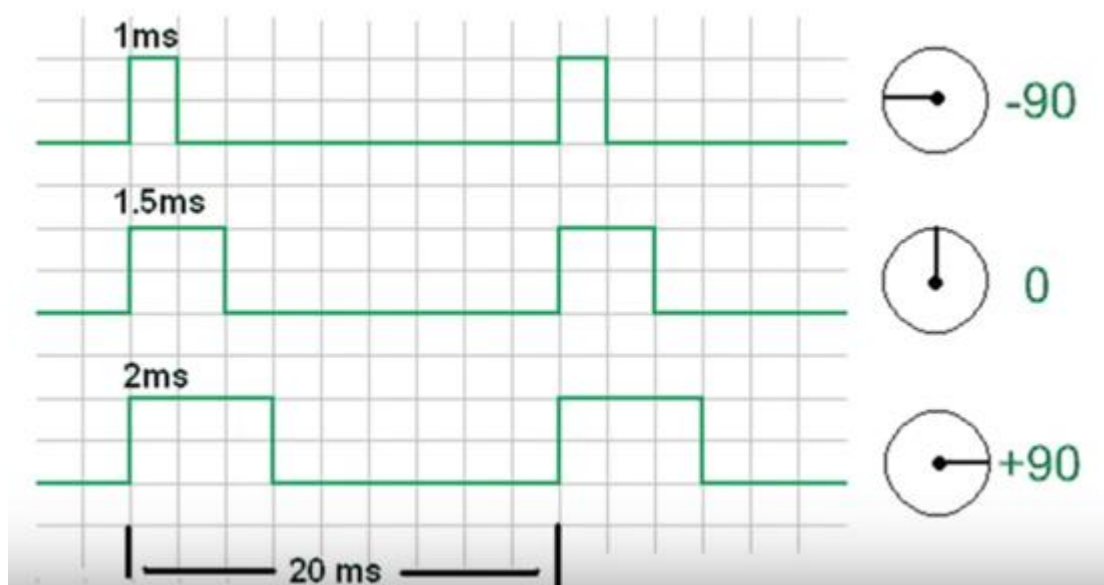


Figure 5.1

6. Requirement and Verification

| Requirement | Verification |
|--|--|
| HD-3001HB Servo Motor: 1) rotate 90 degrees in both clockwise and counterclockwise direction 2) Rotate precisely 3) Rotate simultaneously | 1) Signal sent from integrated circuit makes the fingers curl inwards and outwards 2) Fingers move to the exact positions we want they to move to rather than somewhere else 3) Multiple motors work simultaneously in order to move our fingers to the position we want rather than somewhere else. |

7. Safety

Lab safety is the biggest concern of our project. We must take extra care to ensure that all lab policies are followed. When we build our project, we will take care to prevent any possible injuries.

We will use servo to implement the skeleton. Because servo motors allow precise angular positioning of their output shaft, it is possible that the servo motors position our fingers to the positions that might hurt ourselves. We will be very careful when using these devices by testing the precise positions, at which we want the servo motors, before wearing it personally.

To prevent damages to the circuits and sensors, we will check all wirings to ensure there is nothing has been grounded/shorted.

Finally, we will follow the standard procedures and requirements working with the equipments and tools in lab.

8. Reference

1. Figure 1: YouTube channel "<https://www.youtube.com/watch?v=XICTT-mTtco>"
2. Arduino UNO data: <https://www.arduino.cc/en/Main/ArduinoBoardUno>
3. ATmega328P: http://www.atmel.com/images/Atmel-8271-8-bit-AVR-Microcontroller-ATmega48A-48PA-88A-88PA-168A-168PA-328-328P_datasheet_Complete.pdf
4. Servo: <https://www.pololu.com/product/2820>
<https://www.arduino.cc/en/Tutorial/Sweep>
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Bluetooth module : http://www.tec.reutlingen-university.de/uploads/media/DatenblattHC-05_BT-Modul.pdf
5. Battery info: <http://www.large-battery.com/cr2016-3v-lithium-battery.html>
data sheet of 3001HB servo: https://www.pololu.com/file/download/HD-3001HB.pdf?file_id=0J728

| Specification | HD-3001HB |
|------------------------------|-----------|
| Speed @ 4.8V (s/60°) | 0.14 |
| Speed @ 6.0V (s/60°) | 0.12 |
| Torque @ 4.8V (Kg.cm) | 3.5 |
| Torque @ 6.0V (Kg.cm) | 4.4 |
| Signal To Control Angle | TTL PWM |
| PWM At Min Angle (ms) | 0.8 |
| PWM At Max Angle (ms) | 2.2 |
| PWM At Neutral Position (ms) | 1.5 |

| | |
|-----------------------------------|---------------------|
| Operating Voltage (VDC) | 4.8-6.0 |
| Operating Frequency (Hz) | 50.0 |
| Moving Range(degree) | 0-180 |
| Wiring (Black/Brown Wire) | Ground |
| Wiring (Red Wire) (+VDC) | 4.8 to 6.0 |
| Wiring (Orange/Other Wire) | Signal |
| Dimension (mm) | ~ 40.7x20.5x39.5 |
| Weight (g) | 43.0 |
| Gear material | Plastic Gear |
| Servo type | Standard |