Design of a Multi-Functional Mobile Robot

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Competition Overview [1]

- Five Events
  - The Tennis Ball Throw
  - The Golf Hit
  - The Lift
  - The Sprint
  - The Stair Climb
- Project Objective
  - Design a multi-functional robot capable of lifting, throwing, and hitting while maintaining a high degree of mobility

Figure 1: Host of Competition

Competition Constraints [1]

- 50 cm x 50 cm x 50 cm box
  - Must contain:
    - Robot
    - Weight to be lifted
    - Batteries
    - Controller
- All other energy must be returned to its original form
  - This includes:
    - Compressed Air
    - Springs

Project Overview

- Background Research
- Brainstorming
- Design Generation
- **Component Selection**
- **Preliminary Testing**
- Assembly
- Optimization
- Compete
- Win

Where we have been

Where we are

Where we are going

Design Selection

From House of Quality

Success of design is heavily dependent on:

1. Power Consumption
2. Mass of lifted object
3. Strength of Frame
4. Battery Capacity

From Morphological Chart and Pugh Matrix

Primary Power Sources: Electric and Compressed Air

Hit: Golf Club Head on Vane Actuator

Sprint: Pneumatic Projectile

Climb: Chaos Frame

Lift: Pneumatic Pistons

Throw: Air Cannon

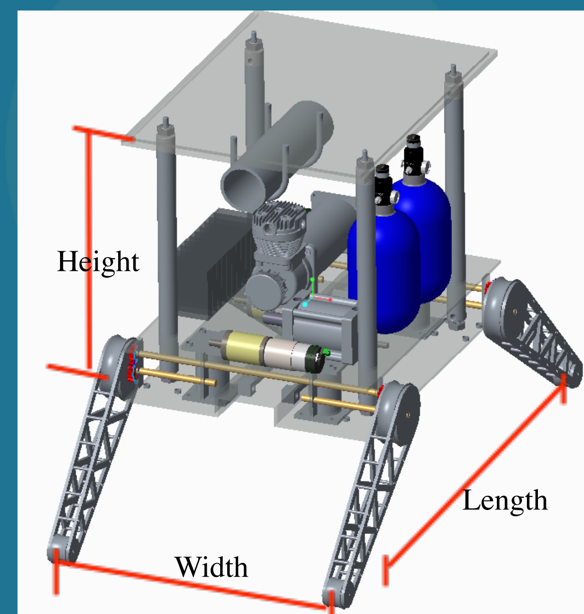
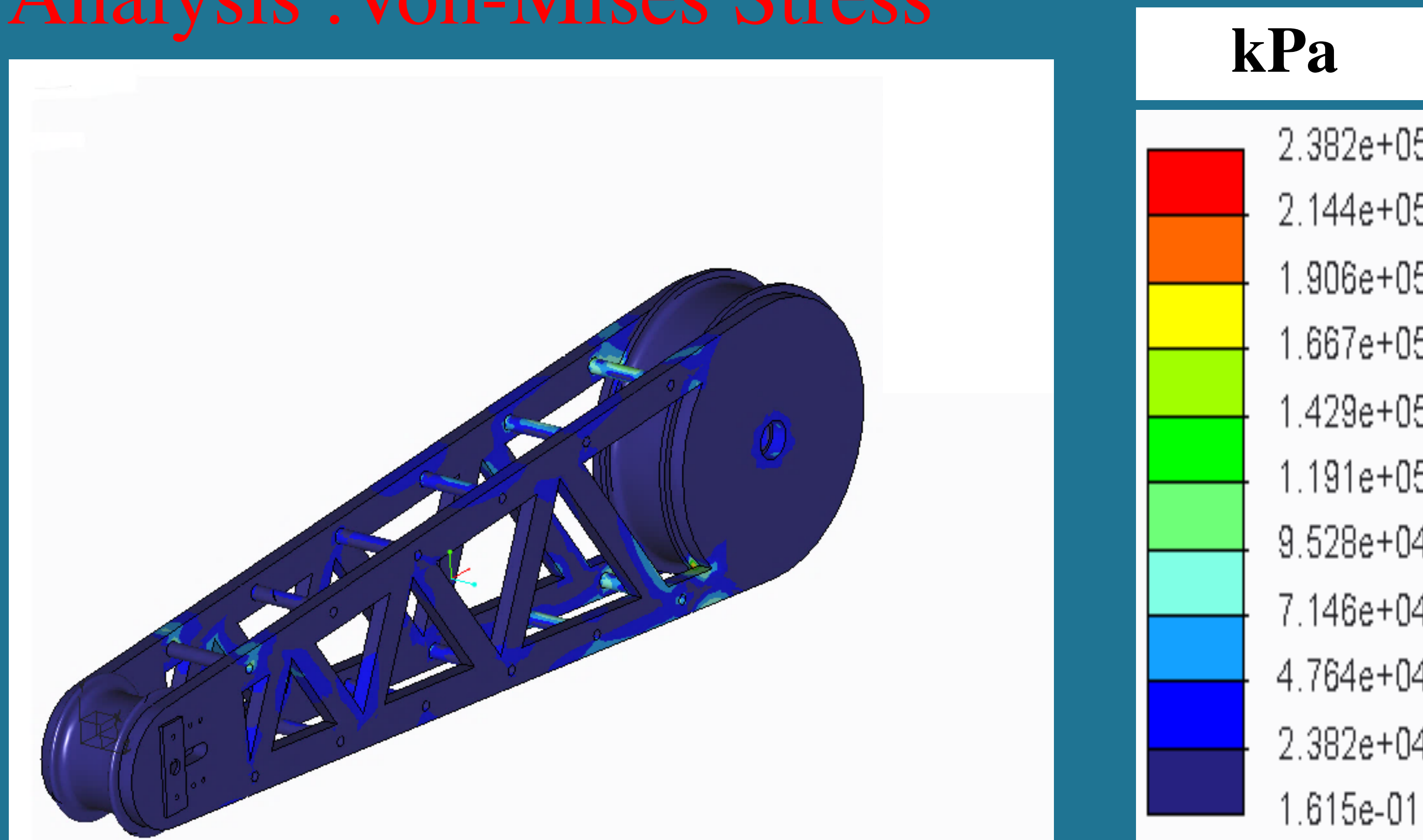


Figure 13: Isometric view of preferred design

Stress Analysis :Von-Mises Stress

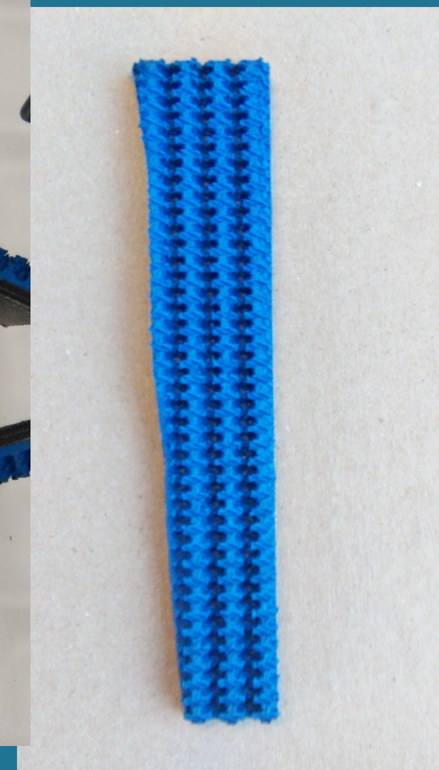


Further Design Considerations

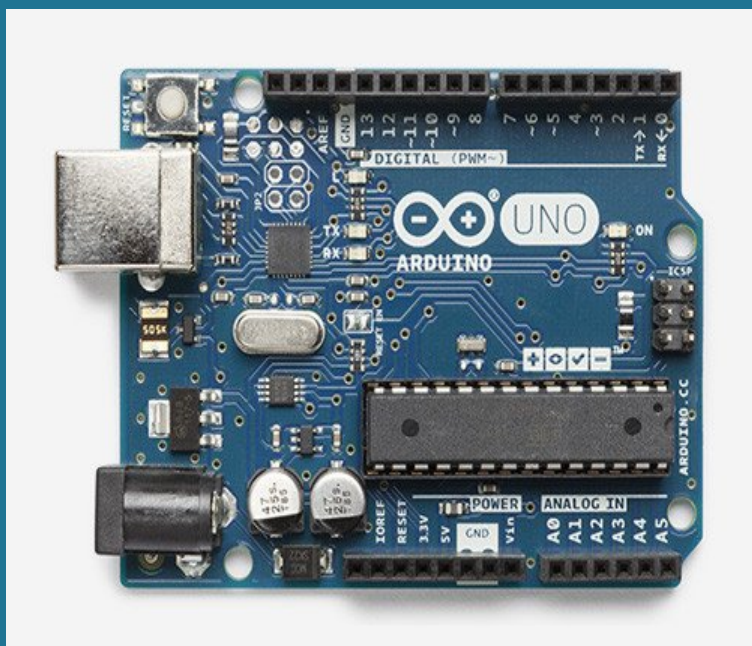
- The Lift
  - Air Jacks
    - Less expensive
    - Lower level of complexity
  - Object to be lifted
    - Grouped pieces
- The Sprint
  - Motorized Measuring Tape Concept

Further Design Considerations

- The Throw
  - Cannon testing
- The Climb
  - Tread selection



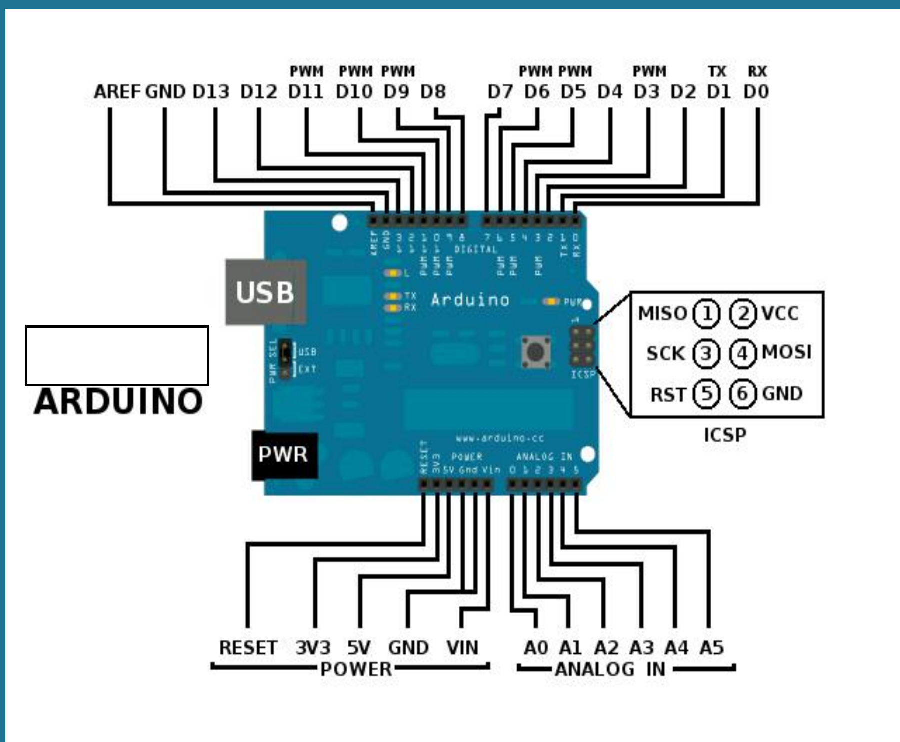
USB Shield Arduino Microcontroller



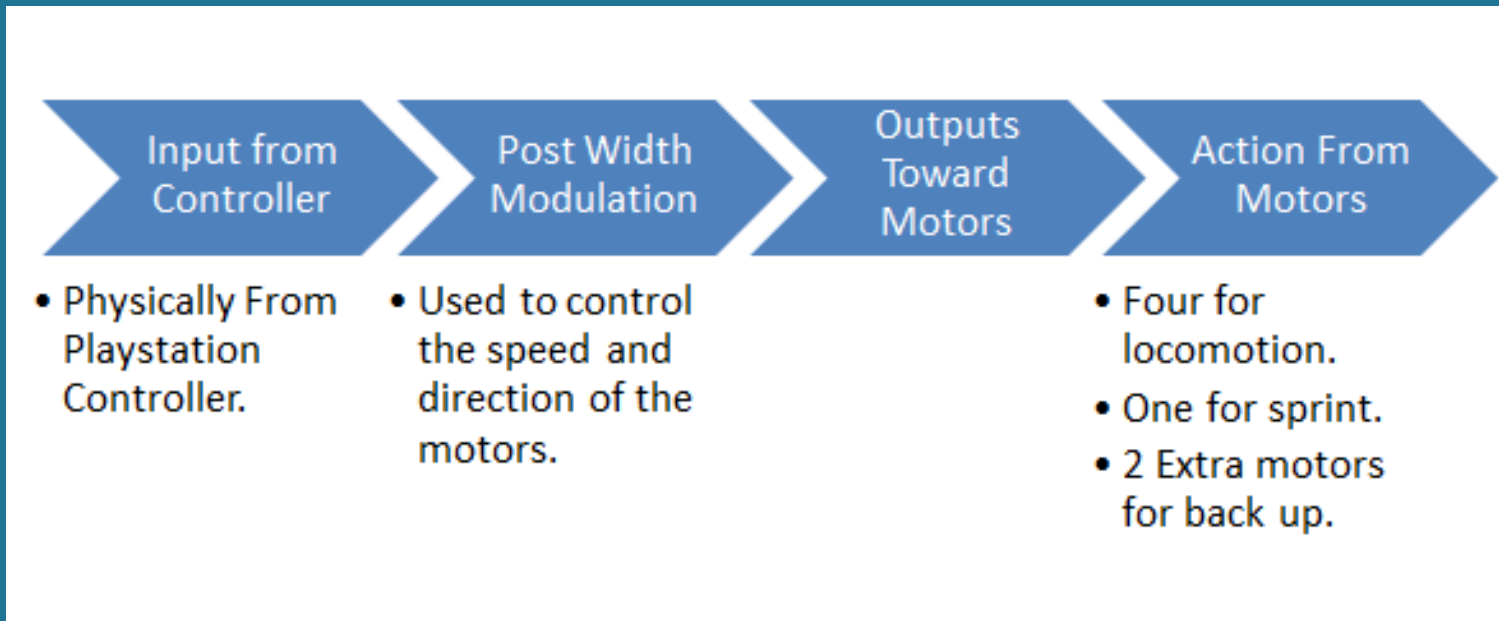
- Can communicate and support USB Hub Functions.
- 500mA max current when powered by power supply.
- Lightweight with a 5V operating voltage.
- Will be needed to connect controller via bluetooth using a bluetooth dongle.
- For relay-based DC motor control applications.
- Six pins for PWM.

USB Bluetooth Dongle

Arduino Microcontroller Explained



- Hosts an external power supply along with a USB hub and Vin pin for power.
- Supplies 14 digital pins/6 power pins/6 analog pins
- Digital pins can be used as I/O pins



Pulse Width Modulation (PWM) for DC Motor

Flow chart explaining the process of input to output for the DC motors controlled by a Playstation 3 sixaxis controller.

Motor Selection

Primary

- 9015 Motor with a 27:1 Planetary Gearbox
- Used to control the tracts on the arms.
- Speed is determined based on sensitivity of the analog stick on controller.
- Will be needed for sprint and stairclimb event.

Secondary

- RS775 Motor with a 188:1 Planetary Gearbox
- Used to control the position on the arms
- Can rotate the arm 360° clockwise or counter-clockwise.
- Will be needed for the stair climb and hit event.

In the Future

PS3 Controller

Mapping out what each button does for every event.

Coding MCU

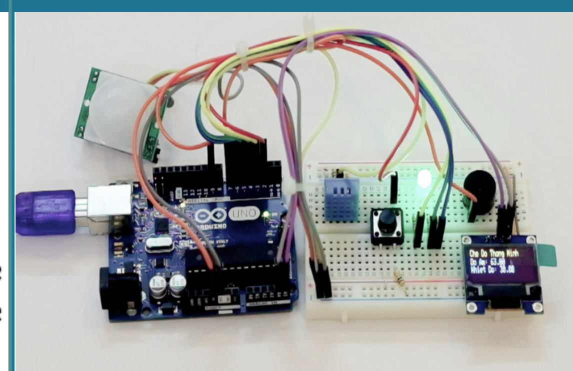
Coding/Debugging the microcontroller to control our robot.

```
void CommandMotors(int LY, int RY)
{

  if(LY < 120) {
   digitalWrite (ENABLE1, HIGH);
   digitalWrite (ENABLE4, HIGH);
   analogWrite(PWM1, (LY-120)*-2.125);
   analogWrite(PWM4, (LY-120)*-2.125);
  }
```

Testing

Checking on the efficiency of every event based on the given code and electrical components used.



Batteries

- Lithium Polymer batteries
  - Small dimensions
  - Quickly recharge
  - High energy density
- Alternative choice is Nickel metal hydride
  - Discharge rate
  - User friendliness

Design specifications

- MULTIPLE BATTERIES IN PARALLEL
  - INCREASE THE CURRENT OUTPUT
  - BALANCE BETWEEN EFFICIENCY AND POWER CONSUMPTION
  - DISADVANTAGES
    - MORE TO RECHAARGE
    - SELF DISCHARGE
    - SPECIFIC CHARGING REQUIREMENTS
    - SEVERAL PARTS WILL STOP WORKING AT DIFFERENT TIMES

Relay Circuit

- EACH MOTOR CONNECTED TO THE RELAY CIRCUIT
- EFFECTIVE SWITCHING MECHANISM
- LOW POWER SIGNAL
- EFFECTIVE FOR SETTING UP CONTROLLER
- USEFUL IN ISOLATING AND CATCHING FAULTS DURING COMMANDS

Where We Are Going(change)

- Short-Term Goals
  - Prototyping
    - Event Prototyping
  - Finalizing Component Selection
    - Order necessary parts
  - Stress/Failure Analysis
    - Machining/Manufacturing

- Long-Term Goals
  - Assembly
  - Preliminary platform testing
  - Functioning platform by mid-December

References

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Questions?