**Engineering Design** 

**Deliverable D** 

**Conceptual Design** 

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Lab C01 Group 5

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# Problem Statement

Design a 3D printed mechanical arm with three degrees of movement that can perform manual tasks to a navy ship's hull, while only being operated by one person.

## 1. Sub-Systems

Arm joints	Pertains to the movement of the arm
End effector (hand/claw)	End of the arm Tools' contact points (e.g grips)
Base	Responsible for housing electronics and initial yaw movement of the arm
Electronics	Source of power and controlling the arm

## 1.1 Brief Explanation of each subsystem

### <mark>Arm joints -</mark>

A Mechanical joint that can move in two directions with as little friction as possible. The joint must be strong enough to support the weight of the rest of the arm as well as whatever tool needs to be attached to the end-effector.

### End effector -

The endpoint of the arm that the tools will be attached to. For example, it needs to be able to hold the weight of the nozzle of a pressure washer or sandblaster. The end-effector's grip on the tool must be strong enough to withstand the movement of the arm and rough conditions aboard a ship.

### <mark>Base-</mark>

The base of the arm provides stability, housing electronics, and providing power to all subsystems. Also houses the first motor for the first degree of motion being the yaw of the arm.

### Electronics -

The circuitry of the arm will consist of the power source of the arm. The Power source needs to be enough for 24hrs. Another form of electrical circuitry that will be used to operate the robot will be Arduino.

## 2. Refined Sub-System

Arm-Joints	EEZYbotArm mk2 with modified servo type and hollowed out inside for tubing
End Effector	Non moving grip with sockets for devices
Base	Geared servo in based housing electronics, water pump and power allowing for low center of gravity
Electronics	Arduino or ESP-32 ideally depending on coding time

## 2.1. Brief Explanation of Refined Sub-Systems

## Arm-Joints

Arm joints are based on lever pulled sections actuated by motors in the base or early joints to remove weight near the end of the arm allowing for more effective carrying capacity.

## End Effector

Block with sockets for attachments without moving part such as "finger" grips allowing for less weight and more effective execution of tasks

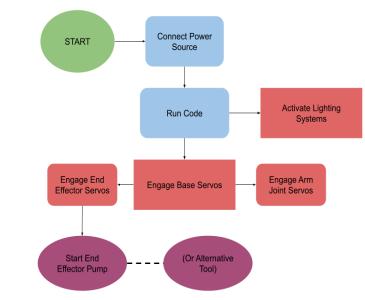
## Base

Low CofG base housing all power electronics etc excluding exterior tank to demonstrate pressure washing/pressure painting ability as proof of concept.

## Electronics

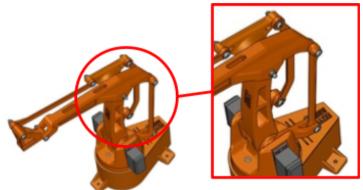
Water Pump, Microcontroller either arduino or ESP-32, low power LED "bulbs" potential ultrasonic sensor for distance measuring to stay more within budget compared to camera and allows to code within time constraint, Servos.

## 3. Solutions



**Functional Decomposition** 

3.1 Solution 1 - Arm Joints



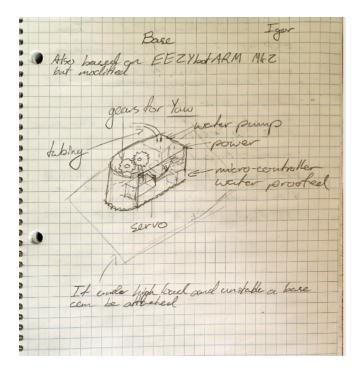
The arm joints are rotated by an exoskeleton-like arm lifted and raised near the base, which in turn will control the up and down rotation of the upper part of the arm. This lessens the weight on the arm, and in turn creates a more heavy base which aids the stability.

## 3.2 Solution 2 - End Effector



The movement of the end effector is controlled in a similar way to the main arm joint. The end effector itself can have a claw-like grip, but it is not necessary depending on the current tool being used. There will also be a socket on the end to connect tools modularly.

## 3.3 Solution 3 - Base



The base will be the foundations of the arm where all the electrical and other components are located in order to support the arm. The base itself will be a good support system for the machine and make the arm have good stamina in order to get the most optimal result.

Electronics recommended Lyer ESP-32 it compare the programming will be cheaper, more processing penter They and who Also has blue tooth veceiver, average 205g/cm servos & concept: 12V mini water BCOLIL - microservo for enclotector blue to the and checyp attached way toy wireless card live curallor vicles fransmission. "bulb" 4 for \$8 Hashlight

3.4 Solution4-electronic

The electronics are a very important part of this system. It takes on the responsibility of making the system move. In addition, it must have a longer duration, preferably more than 24 hours. This includes wires and wire splices and a reliable power supply.



# Appendix I- Task Plan Update

Wrike Updated.