Deliverable D: Conceptual Design

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Abstract

The Department of National Defense requires an automated, user friendly and cost efficient robotic arm that can provide potential to assist crew members on ships to complete certain tasks with minimal supervision. The design criteria was taken into account when producing sketches so that each design concept can be evaluated on the basis of meeting the requirements for this project. For this deliverable we have further analyzed and discussed certain specifics to reach the final functional solution.

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1. Introduction

The Department of National Defense which is affiliated with the Canadian Navy Forces has proposed a project of a robotic arm that would complete specific tasks on docked navy ships. In this Deliverable, several design concepts will be presented along with a final functional solution.

Each team member will be contributing to the 2D design drawings with their own vision, based on further discussion the best 3 will go on for further development eventually leading to a final solution. Additionally, the implementation of subsystems has been incorporated into each design concept. The subsystems consist of software, hardware and design, all of which must be in correlation with the design criteria.

2. Concept Description and Analysis

Subsystem 1: Software (Kathryne)

```
INITIALISE variables
ACCEPT user input for dimensions of the wall

SET sprayer state to LOW

FOR each 'column' of wall space
        IF column is within the specified parameters THEN
        SET sprayer state to HIGH

        INCREMENT column tracker variable, move applicable axes
        SET sprayer state to LOW
END FOR
```

Figure 1. The pseudocode

This image displays the pseudocode for the robotic arm movements. It will be incorporated with the DC motors and arduino uno. As the project is still in its early stages, it isn't suitable to further develop this code into a programming language such as python or C++. The code provides a basis on the functionality and purpose which serves as the foundation. As the project progresses the code will be much more complex and able to work with its counterparts.

Subsystem 2: Hardware (Jaber)

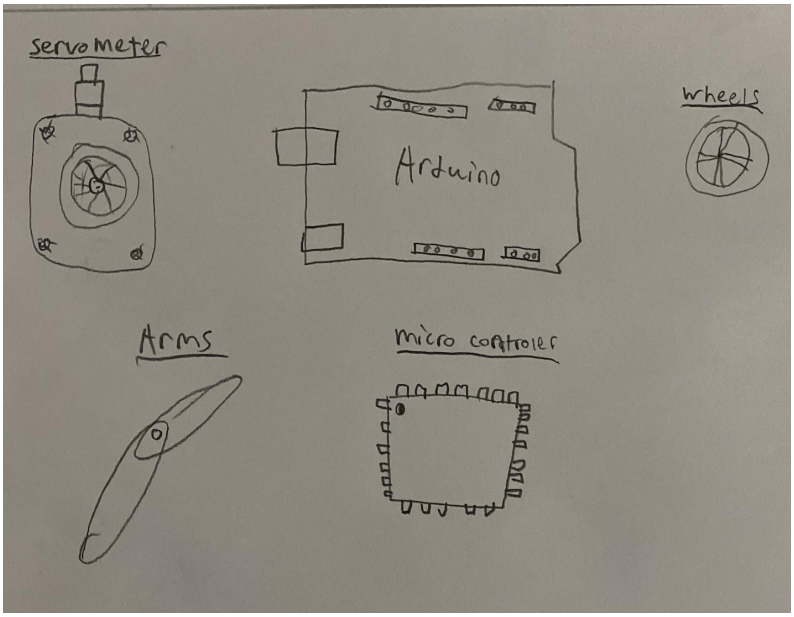

Figure 2. The required hardware

This image displays the different hardware needed in order to operate the robotic arm and develop a conceptual design. The microcontroller in order to control the movement of the arms, the servometer will make the movements possibly and the arduino will act as the brains.

Subsystem 3: Design (Kathryne)

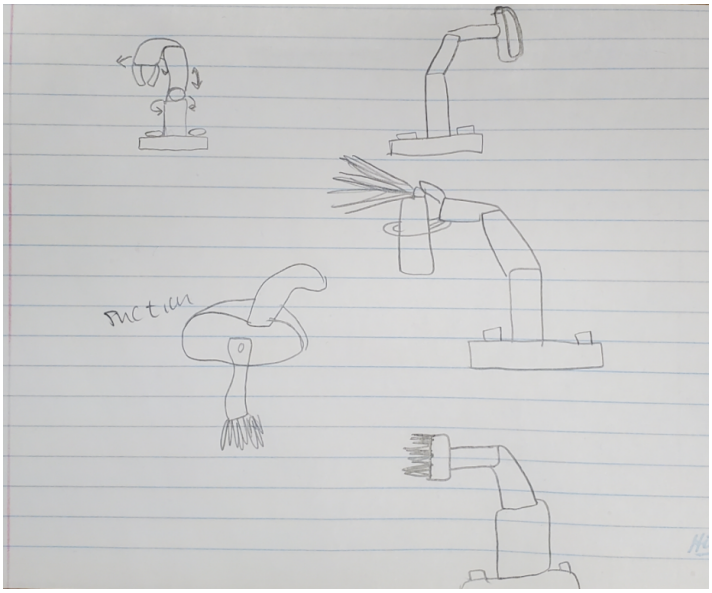

Figure 3. Kathryn's Design

This hand drawn design concept proposes different visual appeals to the robotic arm along with the different end effectors.

Subsystem 3: Design (Jaber)

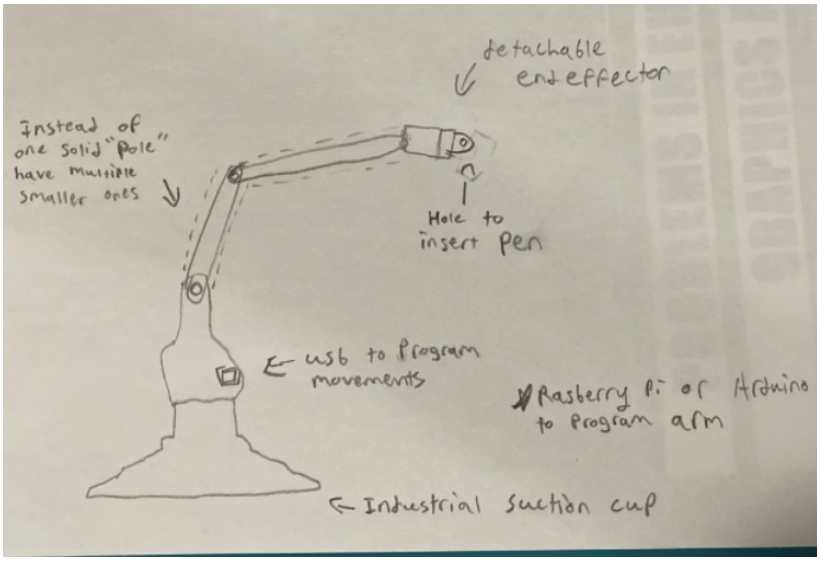

Figure 4. Jabers Design

This hand drawn design incorporates a focus on the end effector holding a paintbrush, pen or marker along with how the robotic arm will stay on the surface

Subsystem 3: Design (Nikita)

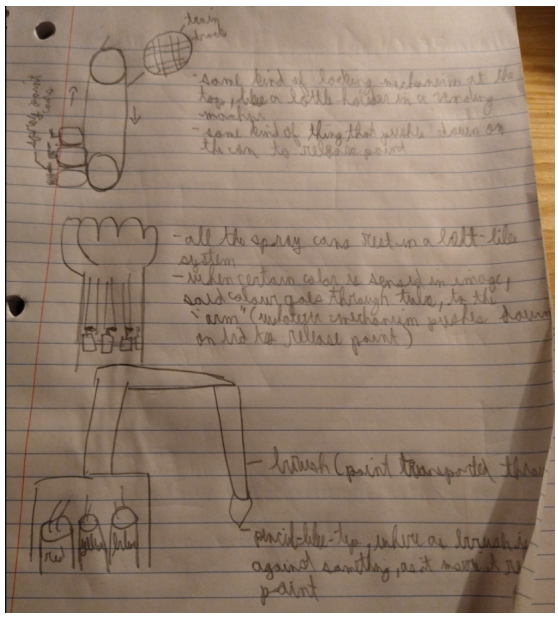

Figure 5. Nikitas Design

This hand drawn design has multiple visions with a main focus on painting with an emphasis of paint can storage.

Subsystem 3: Design (Sara)

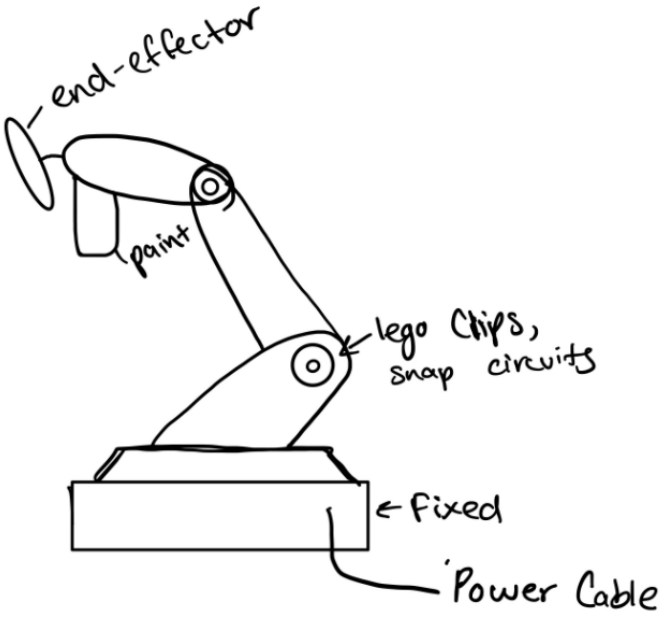

Figure 6. Saras Design

This design has a focus on painting end effector and is a cleaner example of the potential looks for the robotic arm. It also incorporates technical benchmarking aspects.

Subsystem 3: Design (Josh)

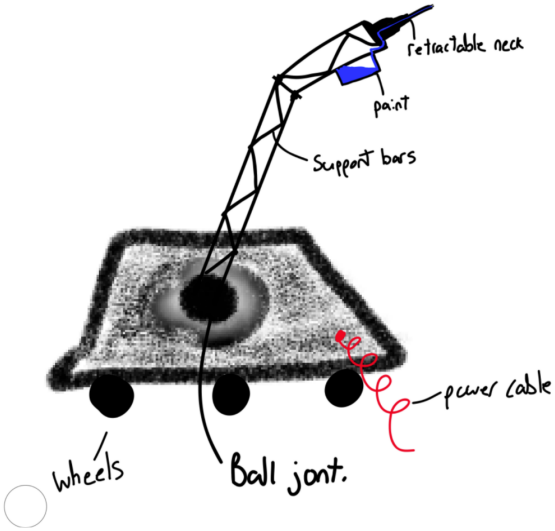

Figure 7. Josh's Design

This design was a rough sketch that is meant to focus on portability.

3. Fully Functional Concepts

Concept 1: (Nikita)

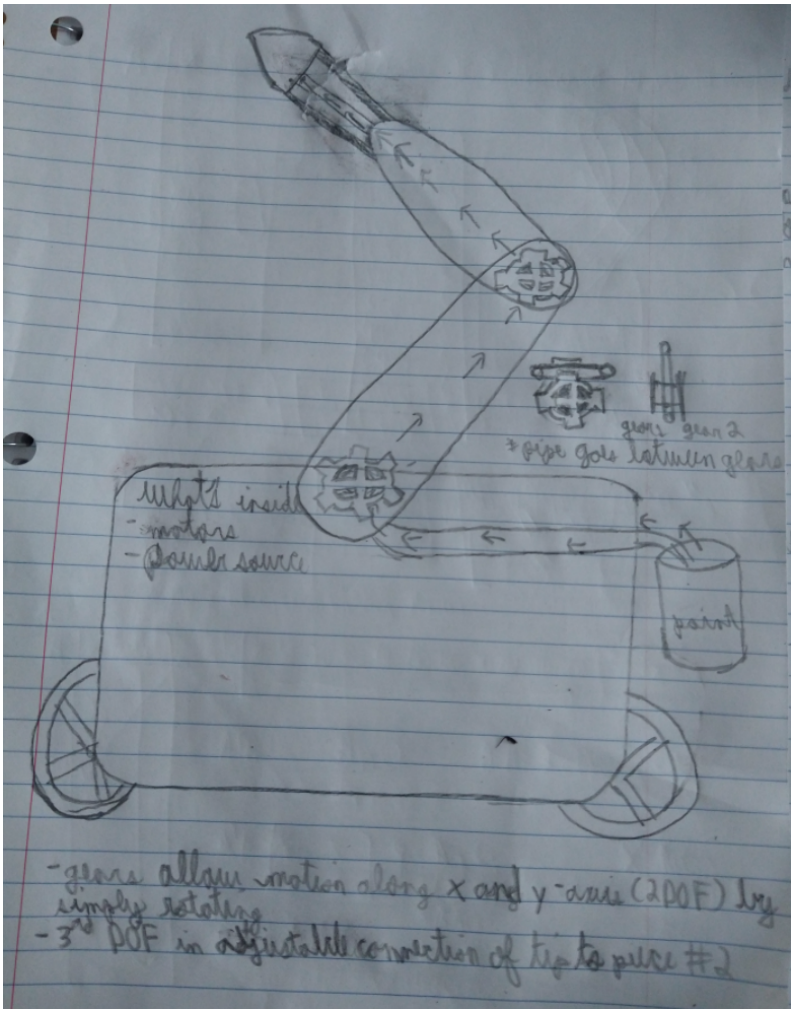

Figure 8. Nikita's Concept

Concept 2: (Sara)

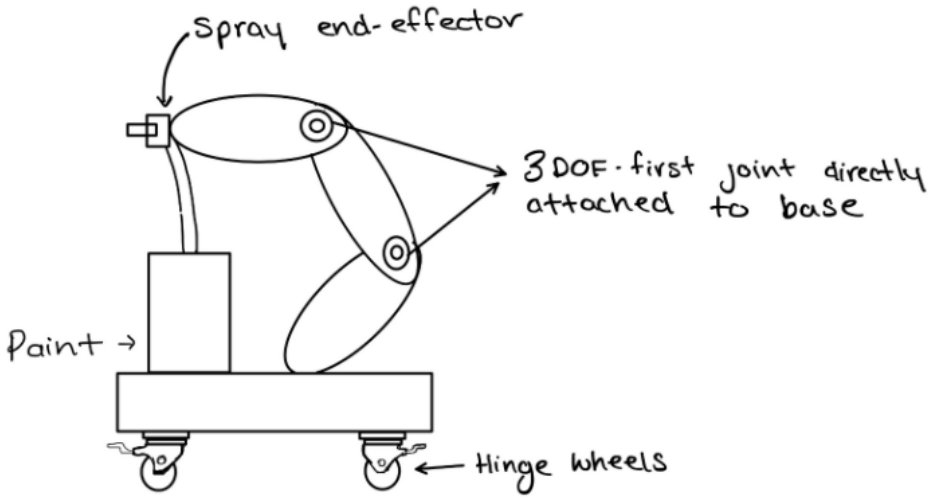

Figure 9. Sara's Concept

Concept 3: (Josh)

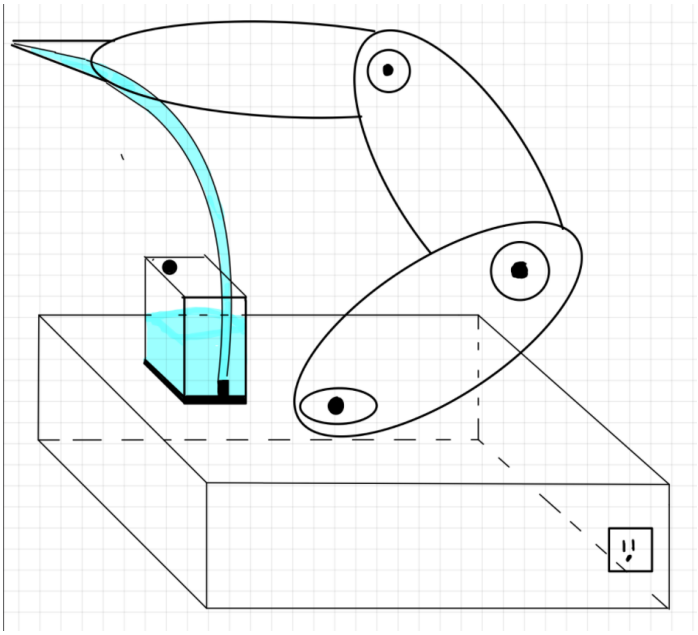

Figure 10. Josh's Concept

4. Final Solution

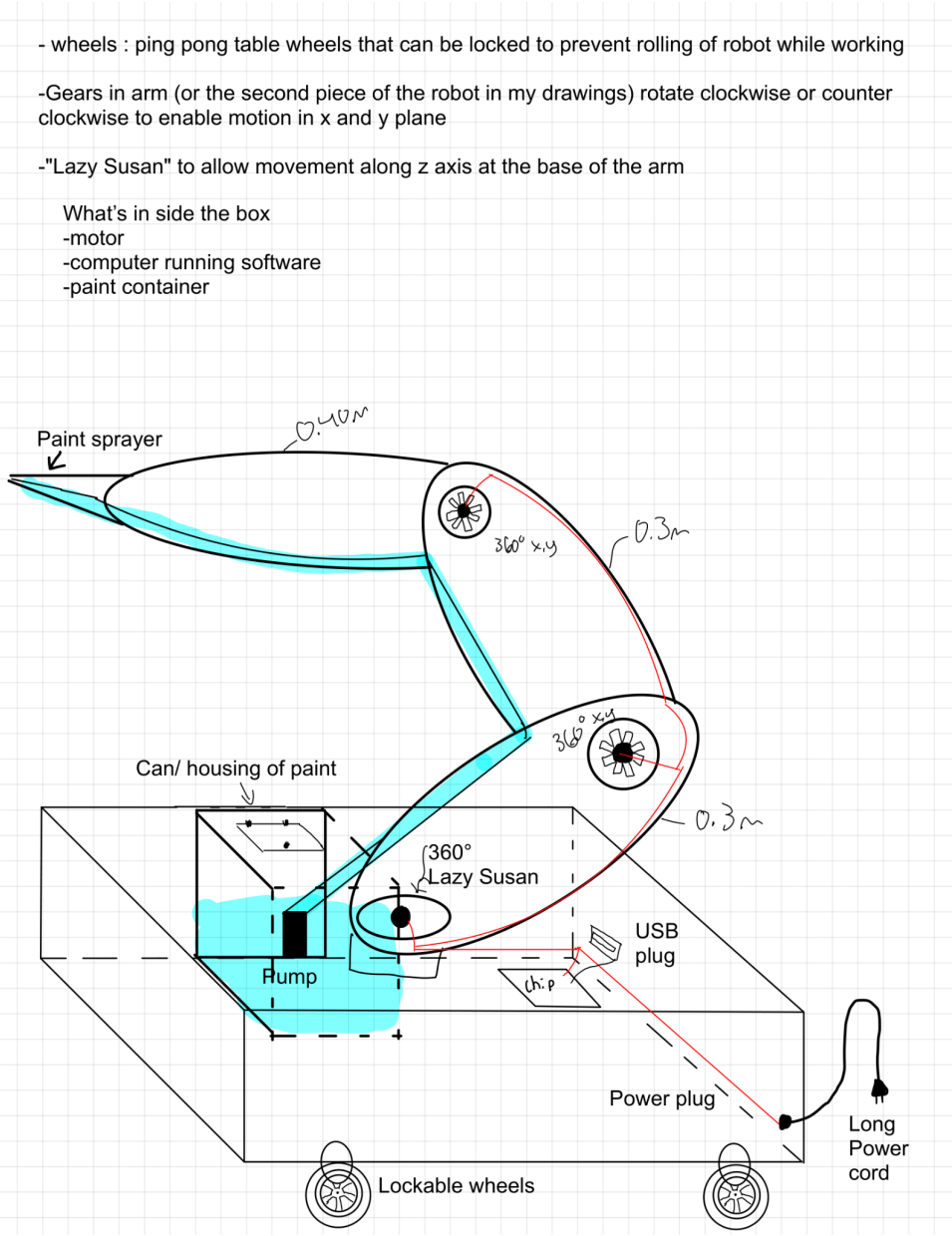

Figure 11. Josh's Final Concept

This fully functional solution has been further analyzed and evaluated, our team has further developed it from the initial sketch. This decision is based on the design criteria such as the dimensions, cost, portability, weight and so on. There are a variety of different systems put in place such as the USB port which allows for access to the arduino uno/raspberry pi for controls. Servo Motors to serve the purpose of arm mobility for the robotic arm. A can of paint housing implemented inside the platform of the robotic arm for stability and safety precautions. Wheels which are an easy form of transport.

The goal was for an easy user experience, this design concept has many benefits which work towards it. Although certain aspects may be a drawback such as the controls being through a USB port or the wheels causing stability issues whilst stationary in harsh conditions. Our team has taken notes on these issues and are working on refining and upgrading each aspect with prototypes being in development within the near future.