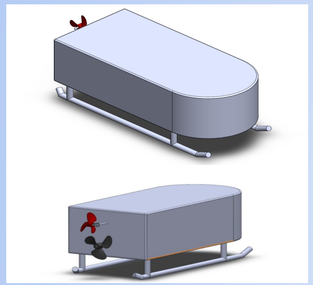
# Underwater Swarm of Robots

## Introduction

Traditional drug delivery relies on blood circulation through the whole human body to reach the required location, however, due to the untargeted nature of those methods many side effects emerge and harm the healthy organs of human bodies in the process. Recent technological advancements have managed to reduce the size of microrobots and make targeted delivery of medicine in the human body more accessible. With this in mind, the underwater explorers want to simulate targeted medicine delivery by creating a swarm of underwater vehicles that can autonomously navigate in a swimming pool, approaching a target location using magnetic and sound sensing, and attaching to it using electromagnets, simulating the drug delivery.



## Purpose

To develop a second generation of an underwater swarm of robots that can be used in the near future as research to develop nano-sized robots that can detect and retrieve/destroy cancer cells inside the human body

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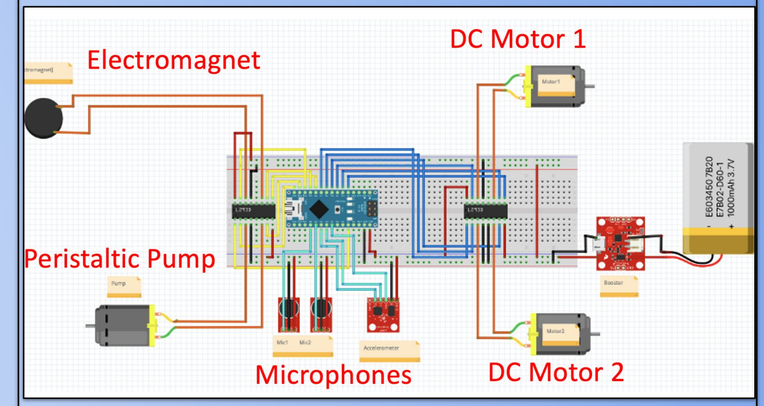
## Propulsion

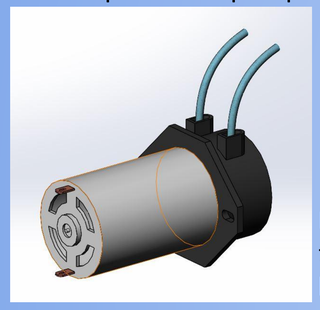
The autonomous underwater vehicle will operate using two 130A DC Motors powered by a 3.7V Lithium Polymer battery.




## Buoyancy Control

A peristaltic pump will be used to pump water in and out of the robot, controlling the robot's depth

An NPN transistor will be used as a switch to turn the peristaltic pump on and off



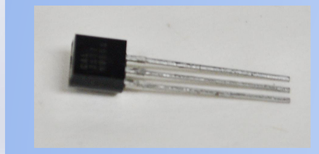


Figure: Solidworks design of the peristaltic pump that will be used

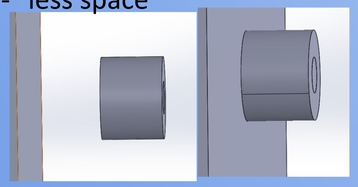
## Connectivity

The use of electromagnets will aid in the connection, holding, and disconnection of the robot in close proximity. This will also allow the connectivity to be autonomously controlled by a microcontroller.

**Future developments**:

Current commercial electromagnets require high current to keep them on. In an effort to downsize, the implementation of electro-permanent magnets will be used.

- less current
- less space



Left hand figures depicts electro-magnet without constant current applied and with constant current applied

Right hand figure depicts electromagnet used in robot

## Magnetic sensing

Robot will use magnetic sensor to steer the robot towards targeted position

Magnetic sensor will use the magnetic field of the magnet to determine its position

In conjunction with the propulsion system it will be able to steer the robot towards the magnet to ultimately connect to it

**Future developments:** Test magnetic sensor with electromagnets to calculate the residual magnetism of magnets to complete formula for finding position

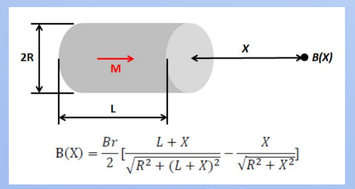



Figure _: Magnetic field strength formula for cylindrical magnets

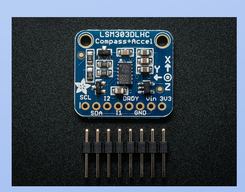



Figure _: LMS303DLHC Magnetic sensor

## Distress Signal Sensing

The use of two microphones separated at 5cm that will be collect the voltage amplitude reading as they detect a continuous 10 khz sinusoidal sound signal. Based off the data collection of both microphones into arrays. Angle of arrival can be calculated using cross correlation on the data.

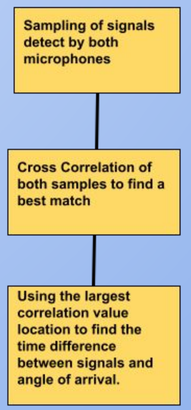



Figure: Basic rundown of Signal Sensing Program

**Future developments:** Increase the accuracy of angle detection. Calibrate program and circuit for underwater use.

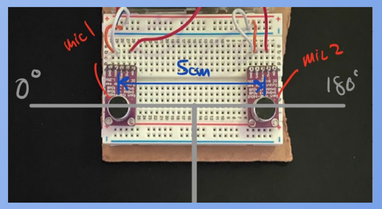



Figure: Circuit set up for Distress Signal Sensing