INTRODUCTION:

An excavator is a piece of equipment which can dig, transport and dump a certain amount of underwater laying soil in certain time. This process is called Excavating. The purpose of Excavating is generally to gather bottom sediment and either disposes it at a different location or uses these sediments in various products, eg., sand and gravel is used in concrete mixture.

Excavators are usually designed depending on purpose. Robotic excavators are generally designed for small scale operation of around 0.5-50kg capacity for excavating. Robotic excavators are partly automatic and partly manual.

OBJECTIVES:

The conventional excavation use for cleaning purpose of lake and ponds tends to be very costly and also are prone to accident due to soft soil near the banks of these ponds and rivers. More over these cannot be used for cleaning of the lakes and ponds at the centre as their movement is restricted only till its arms.

The main aim of our project is to design and make a machine which can easily reach the centre and conduct the cleaning process. This call for robotic excavator with floating concept which uses two barrels with plywood attached to it. A special grabbing mechanism is used which can go under water and grab the sludge and dump it in the container kept on plywood. This can later be brought and dumped on the shores or can be used as fertilizers for plants.

METHODOLOGY:

Design of grab

- Total area of grab= Area of rectangle + Area of triangle + Area of semicircle
  \[ \text{Total area } A_1 = 2(l \times b) + 4 \left( \frac{1}{2}b \times h + \frac{\pi}{4} r^2 \right) \]
  \[ = 2(19 \times 25) + 4\left( \frac{1}{2} \times 28 \times 17 + \frac{\pi}{4} \times 17^2 \right) \]
  \[ A_1 = 0.280992 \text{ m}^2 \]
- Area of upper link \[ A_2 = (b \times h)^2 + (b \times h)^2 \]
  \[ = (37.5 \times 5)^2 + (5 \times 3)^2 \]
  \[ A_2 = 0.0405 \text{ m}^2 \]
- Total area \[ A_T = A_1 + A_2 \]
  \[ = 0.280992 + 0.0405 \]
\[
\text{Total volume } V = \text{Total area} \times \text{thickness} \\
= 0.321492 \times 0.2 \\
= 6.42984 \times 10^{-4} \text{ m}^3
\]

- Total mass = volume \times density
  \[= 642.98 \times \frac{7.85}{1000} \]
  \[= 5.0474 \text{ kg} \]
- Mass with pulley (M) = 5.0474 + 0.235 + 2(0.113) 
  \[= 5.0584 \text{ kg} \]
- Cone volume \[= \frac{1}{3} \times l \times b \times h \]
  \[= [\frac{1}{3} \times (34 \times 19 \times 20)] / 1000 \]
  \[= 4.306 \text{ lits} \]

**Design of motor**
- The material used for the shaft is mild steel.
- Yield Stress \( \sigma = 380 \text{ MPa} \)
- Shear stress \( \sigma_s = \frac{\sigma}{2 \times \text{FOS}} \)
  \[\text{FOS}=12 \]
  \[\sigma_s= \frac{380}{2 \times 12} \]
  \[\sigma_s=15.833 \text{N/mm}^2 \]
- Load acting on the motor shaft = 10Kg = 100N
- Torque acting on the motor \( T = \frac{\pi}{16} \times \sigma_s \times d^3 \)
  \[= \frac{\pi}{16} \times 15.833 \times 8^3 \]
  \[= 1546.97 \text{ N-mm} \]
  \[= 1.546 \text{ N-m} \]

**Shear force and bending moment for the simply supported beam**

- Load acting at centre of the beam (\( w \)) = 100N
- Length of the beam (\( L \)) = 1828.8 mm

Shear force calculations
- \( R_A = R_B = \frac{W}{2} = \frac{100}{2} = 50\text{N} \)
- \( F_X = R_A = \frac{W}{2} = \frac{100}{2} = 50\text{N} \)
- \( F_{AB} = \frac{W}{2} = 50\text{N} \)
- \( F_{BC} = \frac{W}{2} - W = 50 - 100 = -50 \text{N} \)

Bending moment calculations

- \( M_X = R_A \times X = \frac{WX}{2} \)
- \( M_A = 0 \)
- \( M_B = \frac{W}{2} \times \frac{L}{2} = \frac{100 \times 1.828}{4} = 45.7 \text{ N-m} \)
- \( M_C = 0 \)
RESULT:

It can easily remove the sludge from the centre of the lake, which the conventional excavator cannot. Cost of cleaning the lake can be minimized. Water pollution can be reduced. Highly portable.

Initial cost is high. The depth of the pond is to be known first. Trained personal is required.

The robotic excavator can be easily employed for cleaning of small ponds. It can also remove the mud from the bottom which is used for various purposes. Digging action can be carried out.

CONCLUSION:

This simplicity of the mechanism is giving flexibility of its effective use. This mechanism is working properly. Its construction is supportive to the stability of the boat and provides large carrying space. So it is easier to use this mechanism for excavating in future. Since it is our very first attempt to a robotic excavator, there are few are concerns that need to be corrected. A few important of this machine would greatly impact the rate of collecting the sludge. An addition feature is purposed for hyacinth removal, which will be added in the next improvement.

SCOPE FOR FUTURE WORK:

It can be made more stable by using 4 oil barrels, which gives more stable floating to the excavator.

It can be made fully automated by,

1. Using proximity sensors, to sense the depth of lake, type of waste present inside the lake or ponds.
2. One motor can be used for movement of barrel and plywood assembly or we can use properly designed boats.
3. One motor for movement of trolley on upper frame ie transverse motion of trolley.
4. One motor for opening and closing of grab where as now we are using manual mechanism for it.

Big scale robotic excavator can also be used for taking away dead bodies from lake.