Design and Fabrication of Corpse Locating Submarine in Muddy Water

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Abstract **- The project is focused towards enhancement of a Compact Submarine for finding submerged bodies. The need of this submarine was that the traditional method of finding the corpse was too time consuming and required more man power for searching thoroughly by diving into the water body.The targeted segments are lakes, ponds, rivers, that are found in areas where the project is suitable for its use. There is a considerable increase in death by drowning and cases of not able to recover the bodies. The project basically aims towards such problem and eases the procedure for finding the corpse.The project aims on using different methods for locating dead bodies. Usage of camera, sonars, actuators, etc. is encouraged for improving the chances of locating the corpse. These components are placed to a constructed ROUV (Remote Operated Underwater Vehicle) for better movement under the water body.**

Key words **- submarine, corpse, ROV, bilge pump, sonar, camera**

I. INTRODUCTION

About 80 people drown every day, or more than 29,000 every year, India Spend calculated from data for five years to 2014, released by the National Crime Records Bureau (NCRB). It is reasonably well known that India has the world's deadliest roads, with traffic accidents accounting for 53% of unnatural deaths in 2014. What isn't as well known is the second major cause of unnatural deaths: drowning (9%). This confirms what is anecdotally evident in the media. Drowning was followed by accidental fire (6%), falls (5%) and electrocution (3%), according to the NCRB, which collates and analyses statistics from state police forces. 1,008 people die every day around the world due to drowning, according to World HealthOrganisation's Global Report on Drowning. Globally, drowning is the third-leading cause of unintentional injury death, accounting for 7% of all injury-related deaths.

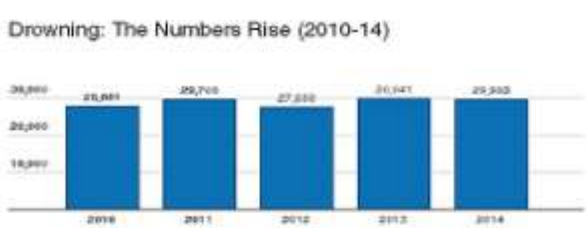


Fig. 1. Yearly statistics of drowning

55% rise in injuries to drowning survivors. Apart from deaths, many who survive drowning are injured, those numbers rising 55% over the last five years, from 738 in 2010 to 1,144 in 2014.Most deaths were reported in the age group of 18-45 years; it accounted for nearly 53% of all drowning-related deaths in 2014.As many as 7,882 in the 18-30 age group died and 7,835 in the 30-45 age group in 2014.

Drowning is also one of the top-five means to commit suicide. Hanging (42%) is the most prominent means of committing suicide, followed by poison (26%), self-immolation (7%) and drowning (6%). Over the last five years, 39,423 suicides by drowning were reported. Maharashtra topped the list, reporting 1,276 suicides by drowning in 2014.

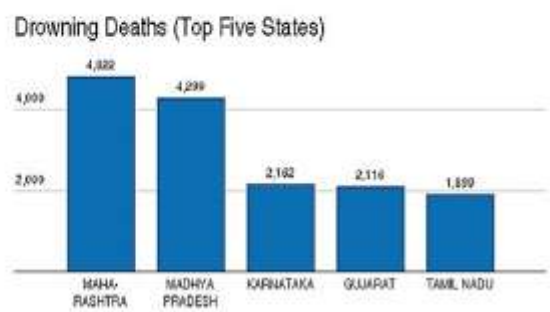


Fig. 2. Statistical data of drowning according to states

Maharashtra tops the list with 4,822 drowning deaths in 2014, followed by Madhya Pradesh (4,299), Karnataka (2,162), Gujarat (2,116) and Tamil Nadu (1,899). These five states account for 51% of drowning across India.

The most primitive method used in India for rescuing the body is by sending professional divers. The drowned human bodies are located and then pulled out by human divers. But it is really difficult for the divers to locate the bodies in deep water where humans cannot reach and the conditions of the water body may also add to the difficulties faced. In case if the help arrives in proper time the drowned person can be rescued. Hence to minimize the human effort and time, humans are replaced by submarines.

The method currently used to find body is not efficient. The chances of finding body are too low and will depend on the diver efficiency and experience. The diver experience physical strain and it requires him to put maximum effort to go beneath and come at surface again. Also he will experience difficulty in vision under the water at depths. The vision problem will also depend on the ecosystem and condition of water.

II. MOTIVATION

- Encourage the introduction of robot in search and rescue operation in India
- To search and find the body of drowned victim as soon as possible before it reaches beyond identification because of decomposition.

III. AIM and OBJECTIVES

The aim of this work is to design and fabricate a corpse locating submarine to find submerged corpse in muddy water. This aim is achieved through following objectives:

- To perform conventional designing task of the submarine keeping in mind the positioning and structure so that the components can be installed easily.
- To calculate and finalize the size, structure and dimension the actual submarine as per the parameters considered in conventional design.
- To fabricate the submarine according to the calculated measurements
- To test the developed submarine so as to check whether it works or not and to detect flaws in it.
- The reconstruct the flaw making parameter and develop the perfect submarine.
- To check the feasibility of developed submarine to locate corpse in muddy water with respect to other submarines.

Keeping this in mind, the focus of this paper will be on a Remote operated underwater vehicle which can help mankind with search and rescue mission. The proposed ROUV will help in locating the corpse with help of accessories such as sonar, cameras and water sampling technique.Camera installed in the ROV will help the operator to guide and find the body by transferring real time data input from the camera to a display. The operator Sonar will help the operator to map the reservoir bed and locate body by using ultrasonic sound waves. The ROV will be moved over the lake surface cover all area and while doing so the output received will be studied to identify the location of body. Water sampling method will help to identify the location by comparing the concentration of gases. Water samples are collected throughout the lake and the concentration of gases is compared. The portion of reservoir having comparatively higher concentration will be the area where the body is present.

IV. ROV

Remotely Operated Vehicles, or ROVs, are underwater robots that allow the controller to be located above the water. ROVs are connected to the topside via an umbilical link that houses communications cables, an energy source and information transfer. All ROVs contain some sort of visual device, such as a camera, to see under the water, and additional tools vary according to what type of ROV is being used. ROV technologies and capabilities are improving at very fast rate allowing various worldwide industries to rely on it, like oil and gas, various deep water exploration and development projects, etc.

In recent applications, they are used for search and rescue operations. There are major developments of ROV in this field. The ROV used may range from 1kg to tonnes depending upon the field of application. Searching under sea or ocean will have bot weighing tonnes that are equipped with high quality accessories for finding and mapping of seabed. Low field application will have less weight comparatively and the equipment will also be economical compared to heavy usage ROV.

The limitation in the available techniques or submarines are that, they are very huge in size and even there costs are really high. And even they are not suitable for India’s environment.

So therefore these shortcomings results to our aim of the project i.e. to design and fabricate a human corpse locator in muddy water. We are trying to put together these short comings and present a solution with respect to India’s local conditions so that every individual would be accessible to it when required. The Submarine will make use of equipment like camera, sonar, water sampler for detecting the body.

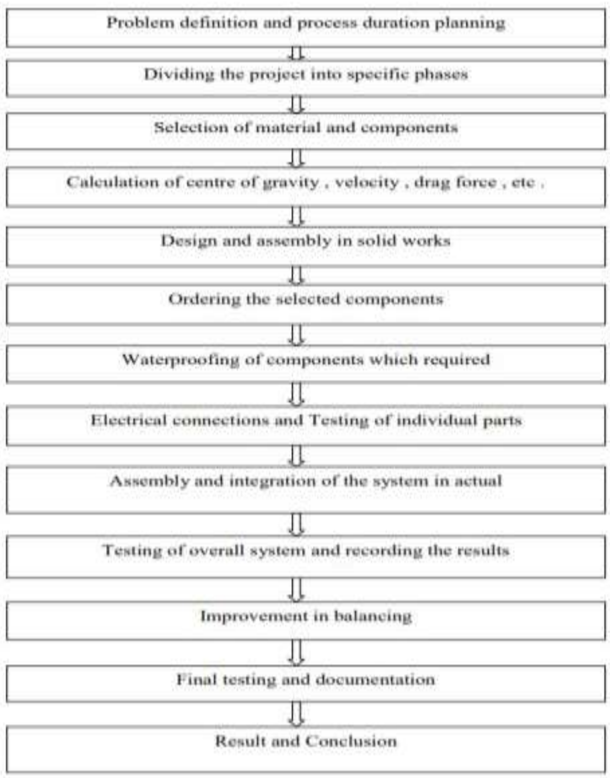
V. PROBLEM DEFINITION

A ROV with systems embedded in it will be precise for finding corpse at any instance. But the systems required such as sonar, cameras, analyzers, water samplers etc.. are high in cost. The sonar giving a perfectly visible imaging of seabed costs around 2lakhs. The analyzers for detecting gases costs more than 1.5lakhs. This shortcoming was taken into consideration and a prototype was developed involving the cheapest equipment available as pet the constrained budget. The prototype was installed with T-POD sonar, a camera and water sampler.

The main field of application was in ponds and lake. i.e. still water reservoirs where the drowning cases occurs. The limitation would be that it cannot function properly in moving water.

VI. METHODOLOGY

Flow diagram of Methodology followed throughout the project is presented below:



- The project was divided into specific phase such as Selection phase, Design phase, Manufacturing phase and Assembly phase.
- Literature review was done before starting selection phase in which previous underwater ROV's get studied.
- The selection phase consisted of selection of driving and detecting parts with the material selection for structure and by considering balancing need. Waterproofing was also an important factor while selecting components.
- A critical selection is crucial in designing a perfect system based on criteria availability, cost, weight and scope.
- The design phase consisted mainly included conventional as well as computer aided design of the structure. In designing centre of gravity was important for making the system stable in water also an other factors calculated like velocity, drag force, power.
- Manufacturing phase consist of various operation like drilling, tapping, cutting, grinding, soldering, etc.
- The final phase is assembly and testing where the components were tested separately by doing electrical connections.
- Faults are identified within the manufacture submarine. After that components were assembled and again tested with whole assembly. Improvements are done for the perfect balancing and to give the strength to system.
- After testing the submarine, results were plotted and recorded. The recordings gave the conclusion and future scope and developments required in the submarine.

VII. DESIGN AND CALCULATIONS

The conventional design was done under the following design consideration:

- Compact size
- Low cost
- Less weight
- Easy to control
- Availability of material in market
- Cost of components to be installed

The design of frame should be such that it should accommodate the components and should provide a rigid support. The basic conceptual design was done with respect to the placements of components.

The placements are done according to consideration of the above mentioned forces like buoyancy, gravitation, pressure, stabilities, etc. and also by considering the size and shape of various attachments and accessories.

A. Selection of Material for Main frame

There are varieties of materials to be found that are suitable for the required application. The material should have the following consideration:

- Material should have low mass.
- Should not corrode in presence of moisture.
- Should not react with acids and gases when exposed.
- Should be low in cost.
- Should be strong enough to withstand underwater pressure.

Taking these considerations, the material for frame was selected.

Material used: Polyvinyl chloride pipes of ½ inch diameter. The material was suitable for the purpose and was least in cost compared to other metals like steel, aluminum, etc. Also this material was easily available in market.

B. Selection of Components

The main area of selection with respect to components are the thrusters, pump, floats, camera and clamping.

1) Selection of Thrusters:

Thrusters are made by joining 2 components together, the submersible pump and propeller. The main requirement for selection of thruster is that it should push the submarine in any case. Hence, it should have high torque for operation.

Pump used for thruster: 1100GPH Bilge pump 12V/24V

Propeller used for thruster: 52mm rotating diameter.

2) Selection of pump for water sampler:

The main idea of water sampler is to collect water from the specific area and collect it in a bottle. For this the best component that we came up with was the air filter pump used in aquarium. The main idea is to use the pump only, removing the filter, and to submerge it into the water. The two input openings will collect draw in the water and make it to flow through the output valve. The output valve will be sealed to bottle, where the collection of sample water will take place.

Component used: 50Hz, 12W air filter pump

3) Selection of Camera:

Function of camera in the submarine is most important because it will help the operator to guide the submarine when inside water. The camera should be waterproof so as it won't fail while operation. Beside the guiding, it will also help the operator to confirm the location of body underwater. Waterproof camera were costly. The technique of potting was effective for the same application. so, a normal webcam was used. It was concealed waterproof and used in submarine.

Component used: INTEX IP SP-500 webcam

4) Selection of Sonar:

Sonar is another important equipment for locating corpse, The sonar required should provide atleast the basic imaging in 2d rendering. Sonar will help to locate by showing waterbed imaging at real time transfer. The imaging output will help the operator to differentiate the body with other irregularities. There are many high end sonar that provide top notch imaging but costs about 1.5 lakhs. Considering this as a limitation, a low cost sonar was embedded in this submarine.

Component used: Vexilar T-POD

5) Selection of clamping technique:

Clamping the components into main frame was a serious issue because the clamping technique should not add further weight to the submarine such that it will start to imbalance. Hence at first attempt zip ties were used to restrict the components to main frame. The problem that was faced was, the components were loosely fitted and came out of clamping more often. Then Aluminum clamp were use for fitting which solved all the issue of misbalancing and weight addition.

Component used: Aluminum U clamps

C. Placement of Main Accessories

1) Camera:

The placement of the camera used has been done at the front side of the ROV. It is so placed as it facilitates the movement of the robot and also gives a clear and unobstructed image. The placement of the camera at the very front also helps with the navigation part of the robot and also acts as a very crucial for the detection of the specimen even in the dark environment.

2) Thrusters:

To facilitate smooth and accurate navigation four motors have been provided two at the vertical side for enabling upward and downward motion and the rest two motors at the horizontal side for forward and backward motion. The two motor at the horizontal sides also enable left and rightwards movement of the robot. This can be achieved by shutting down one of the two motors provided depending on which direction the motion has to be made. The propellers coupled with the motors also helps in providing the smooth motion.

3) Sonar system:

As mentioned above, the type of sonar used is a fish finding sonar, known as the Vexilar sonar phone SP100 TPOD. The sonar floats on the surface of the water body and directly sends the output sonar imaging to the mobile device along with the sensed depth and temperature of the water body.

Considering these aspects the conceptual design is made in as a 3D model so as to identify its shortcomings.

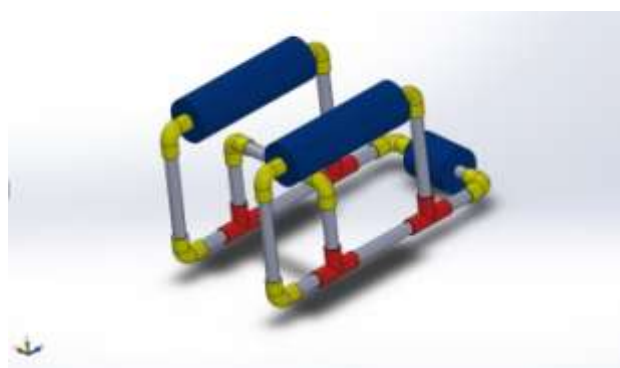


Fig. 3. Conventional Design of submarine made in Solidworks

D. Electrical Connection

The required motion for the ROV was provided by the three waterproof motors. Among these 3 motors, 2 have a specification of 12V 3A while one has a specification of 24V and 1.5 A . The power required to control the motors are supplied through two 12 V & 7.5 amp batteries. The connection between the motors and batteries are as shown in the figure. The 12V motors draws current from one single battery while for the 24 v motor we arranged the batteries in series and then completed the circuit with the 24v motor.

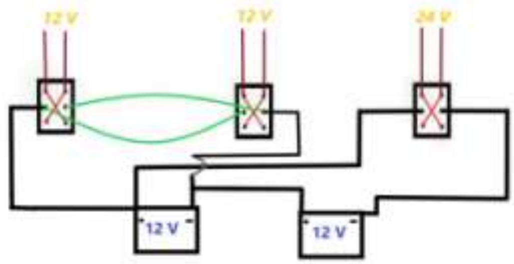


Fig. 4. Electrical Connection

We have used Double Pole Double Throw (DPDT) switches to control the motion of the ROV. the manoeuvrability of the ROV is an important factor as the ROV has to travel in different directions. Also it was important for all motors to not activate at the same time since the ROV had to turn about its axis, move forward or backwards without deviating sideways and surface or descend with minimum complications. Hence we decided to use Double Pole Double Throw (DPDT) switches to manoeuvre the ROV. The three thrusters are individually connected to a DPDT switch. The batteries are connected to the switch box by connecting wires. The switch box consists of three DPDT switches. These switches are connected to the thrusters thus giving supply for the motion of the ROV underwater.

DPDT switches makes it easy to control the motion of ROV. The rotation of motor shaft is dependent upon the direction in which the switch is pressed. for eg: The switch which is connected to the 24V is responsible for the upward and downward motion of the ROV. When the upper part of the switch is pressed, the motor shaft rotates in anticlockwise direction giving the ROV an upward movement in the water similarly when pressed in the downward direction, the motor shaft rotates in clockwise direction giving the ROV downward movement in water.

E. Calculations

1) Particulars of Submarine:

- Length: 32cm
- Breadth: 16cm
- Height: 18cm
- Weight: 17.74 N
- Mass: 1.808 kg

2) Calczulation for Centre of Gravity:

- Mass of Bilge pump (Horizontal) m1= 320 grams
- Mass of Bilge pump (Vertical) m2= 315 grams
- Mass of camera m3= 260 grams
- Mass of float m4 = 10 grams
- Mass of Aqua pump m5= 200 grams

The center of gravity of an object is calculated by taking the sum of its moments divided by the overall weight of the object. The moment is the product of the weight and its location as measured from a set point called the origin.

$$C.G_{\text{axis}} = \frac{mil\,1 + m\,2l2 + m\,3l3 + \cdots\ldots + mxlx}{mi + m\,2 + m\,3 + \cdots\ldots + mx}$$

- C.G about X axis

X1 = 24cm X2 = 13cm X3 = 0cm

X4 = 0 cm X5 = 19cm

$$C.G_{X\text{-axis}} = \frac{24*320 + 13*315 + 0*260 + 19*200}{315 + 200 + 640 + 0}$$

$C.G_{X\text{-axis}}$ = 20.134 cm

- C.G about Y axis

Y1 = 18cm Y2 = 8cm Y3 = 8cm

Y4 = 0cm Y5 = 16cm

$$C.G_{Y\text{-axis}} = \frac{18*320 + 8*315 + 8*260 + 16*200}{320 + 315 + 260 + 200}$$

$C.G_{Z\text{-axis}}$ = 12.383 cm

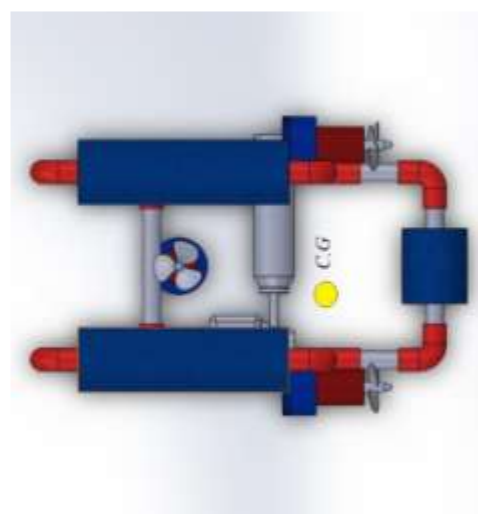


Fig. 5. Setup for location of Centre of Gravity of Submarine

- C.G about Z axis

Z1 = 10cm Z2 = 7cm Z3 = 10cm

Z4 = 0cm Z5 = 5cm

$$C.G_{Z\text{-axis}} = \frac{10*320 + 7*315 + 10*260 + 5*200}{320 + 315 + 260 + 200}$$

$C.G_{Z\text{-axis}}$ = 8.625 cm

- C.G of Submarine

(X, Y, Z) = (20.134, 12.383, 8.625)

3) Calculation for Velocity:

Mass of submarine = 1.808 kg

Distance (D) = 1.14m

Time taken by the submarine to travel the given distance (t) = 2sec

$$\text{Velocity (V)} = \frac{distance}{time} = \frac{1.14}{2}$$

Velocity (V) = 0.57 m/sec

The velocity of Submarine is 0.57 m/sec

4) Area of Submarine:

C/S Area about X-Z axis = height * width

C/S Area about X-Z axis = 16*18

C/S Area about X-Z axis = 288cm^2

C/S Area about X-Z axis = 0.0288 m^2

5) Drag Force Calculation:

Coefficient of Drag (C_D) = 1.2 (assumed)

Density of water (ρ) = 1000 kg/m^3

Area of Submarine (A_{rov}) = 0.0288 m^2

Velocity (V) = 0.57 m/sec

$$\text{Drag Force} = \frac{1}{2} * C_D * \rho * A_{ROV} * V^2$$

$$\text{Drag Force} = \frac{1}{2} * 1.2 * 1000 * 0.0288 * 0.57^2$$

Drag Force = 5.614 N

6) Input Power Calculation:

Voltage Rating = 12v Bilge Pump

Current Rating = 3.5 amp

Power Input = 12*3.5

Power Input = 42 W

Voltage Rating = 24V Bilge pump

Current Rating = 1.8 amp

Power input = 24*1.8

Power input = 42 W

7) Power Absorbed due to Drag Force:

$$\text{Power Absorbed} = \frac{D*V}{550} = \frac{5.614*0.57}{550}$$

Power Absorbed = 5.81 * 10^{-3} W

VIII. PROCESS SHEET

A. PVC frame

Process: Cutting of PVC according to the required lengths.

TABLE I
Process Sheet 1

Sr. No	Process	Machine/instrument used
1	Dividing 6 feet pipe into 1 foot each	Ruler and Marker
2	Cutting the PVC pipe at marked measurement	Hack Saw
3	Marking two of those 1 foot pipe with measurements of 6 ½ inches and 5 inches	Ruler and Marker
4	Marking another two of those 1 foot pipe with measurements of 5 inches, 4 inches, 1 ½ inches	Ruler and Marker
5	Marking 5th cut out of the 1 foot PVC with measurements of 4 ½ inches, 4 ½ inches, 1 ½ inches	Ruler and Marker
6	Marking the last cut out of 1 foot PVC with measurements of 2 ½ inches, 2 ½ inches, 1 ½ inches	Ruler and Marker
7	Cutting all the marked measurements of each pipes done so far	Hack Saw Blade

B. Propeller Extension

Process: Making of an extension for Propeller to assemble it to the shaft of bilge pump for getting the thrust required for movement of submarine ROV.

Same operations were carried out on each of the 3 copper rods used.

TABLE II
Process Sheet 2

Sr No	Process	Machine/instrument used
1	Checking the length and diameter of copper rod	Vernier calliper
2	Reducing the diameter to 5mm	Turning operation in Lathe m/c
3	Reducing the length of copper rod to 2.5cm	Facing operation in Lathe m/c
4	Checking length (2.5cm) and diameter (5mm) of copper rod	Vernier calliper
5	Making a hollow depression at one end of the rod at it's face having length equal to the length of shaft of bilge pump	Drilling operation in Lathe machine using Tailstock Drill
6	Marking a point about 5mm from the hollow end	Vernier calliper and Marker
7	Creating depression at the marked spot	Spot engraving using a sharp object
8	Creating a hole of 3mm diameter	Drilling operation in Milling m/c
9	Finishing the rough edges created during machining	Grinding operation in Grinding m/c

C. Wires

Process: Sealing of wires are done to prevent the wire from damaging due to water. Total concealing of wire will prevent water from damaging the exposed areas and functioning of ROV

TABLE III

Process Sheet 3

Sr. No	Process	Machine/Instrument used
1	Marking the wire with a length of 70m into equal span of 10m	Measuring tape and white marker
2	Cutting the wires on marked spots	Wire cutter
3	Exposing the wires for connecting it to the components	Exposing the conductive element using a plier
4	Connecting the wires to components	Soldering iron, Flux, Soldering wire
5	Sealing the connected wires after soldering it	Heat shrink tubes, heat source

D. Water proofing Camera

Process:Sealing camera into closed container to prevent its damage from water.

TABLE IV

Process Sheet 4

Sr No.	Process	Machine/instrument used
1	Measuring the dimension of camera	Ruler, Standard Dimension provided
2	Cutting container into required length	Hacksaw blade, ruler
3	Providing cushioning for camera	Styrofoam
4	Sealing the container	M-seal

E. Bill of Materials

TABLE V

Bill Of Materials

Sr. No	Particulars	Quantity	Specifications
1	PVC pipe	1	Diameter: ½ inch Length: 10 feet
2	PVC joints	12	Elbow joint: 8 T joint: 4
3	Bilge Pump	3	2x (12v - 3amp) 1x (24v - 1.8amp)
4	Battery	2	12v- 7.5amp
5	Zip Ties	2	1x (30cm x 0.5cm) 1x (15cm x 0.25cm)
6	Sonar	1	T-pod Vexilar SP-100
7	DPDT switches	3	3cm x 2.4cm
8	Switch Box	1	10cm x 6cm x 3.5cm
9	Propeller	3	I.D: 4.16mm Rotating diameter: 52mm
10	Screw	3	
11	Copper Rod	3	Diameter: 0.5cm Length: 2.5cm
12	Wire	6	Length: 10m each
13	USB extension (M-F)	1	Length: 10m
14	Heat Shrink Tube	2	1x (dia-1cm, length-100cm) 1x (dia-1.8cm, length- 100cm)
15	Floats	1	Diameter: 6.4cm Length: 118cm
16	Camera	1	Intex IP SP305
17	Pump	1	220-240v, 50Hz, 15W
18	Light	2	
19	Adhesive	1	PVC adhesive
20	U Clamps	3	2x (5.6cm diameter) 1x (3.6cm diameter)

F. Material cost

TABLE VI

Material Cost Estimation

Sr No	Particular	Quantity	Cost (Rs.)
1	PVC pipes	1	220
2	PVC Elbow joint	8	
3	PVC T joint	4	
4	Bilge Pump	3	2,856
5	Battery	2	1,500
6	Zip Ties	2	380
7	Sonar	1	11,204
8	Switch Box	1	150
9	DPDT Switch	3	
10	Propeller	3	562
11	Screw	3	5
12	Copper Rod	3	20
13	Wire	1	490
14	USB extension (M-F)	1	350
15	Heat Shrink Tube	1	30
16	Float	1	299
17	Camera	1	1000
18	Pump	1	250
19	Adhesive	1	20
20	Light	1	30
21	U-clamp	3	35
	TOTAL (A)		Rs. 19,376/-

IX. DEVELOPMENT

Fig. 6. Front view of Developed Submarine

Fig. 7. Sideview of Developed Submarine

X. RESULTS AND DISSCUSSIONS

A. *Results of Testing of submarine*

- The movement of submarine was proper and the output received by the thrusters was satisfactory. The left most switch of switch box provided the upward and downward movement without any fail. 2 thrusters placed in horizontal direction provided the required forward, backward, left and right movements.
- The electrical connection perfectly executed the working of thrusters. The circuit operated two 12V and a 24V input Bilge pump without any fail. Also the sealing of exposed wires were done perfectly and did not have any kind of damage after testing.
- The Floats provided gave Positive Buoyancy to the submarine. Slight calibration of sizes were required for proper balanced buoyancy of submarine.
- With a cable length of 10m, the submarine was able to go to a depth of 7ft without fail. On stopping the supply of thruster the submarine automatically came to surface of water due to its positive buoyant factor.
- Sonar attached gave satisfactory result to some extent. The output was not always efficient and did fluctuate. The minimum depth required for working of sonar was 2m. For a depth of 10m the sonar readings were absolutely accurate and the results shown were properly interpreted. After a depth of 15m there were slight inefficiency in the sonar and the readings were difficult to interpret.
- The concept of water sampler executed was working fine. The pump was able to collect sample whenever required with the help of input source. These collected samples can be tested in authorised lab and the concentration of the dissolved gases in the collected sample canbe perfectly found out, which would give a much clearer picture.

B. *Calculation Results*

TABLE VII

Result Table

Dimension of submarine	32 x 18 x 16 cm
Mass of Frame	378.36 grams
Mass of Bilge pump	320 grams
Mass of camera	260 grams
Mass of aqua pump	200 grams
Mass of Floats	10 grams
Mass of Submarine	1.808 kg
Weight of Submarine	17.74 N
Area	0.0288 m^2
RPM of bilge pump	7800 rpm
Velocity of Submarine	0.57 m/s
C.G of submarine	X axis - 20.134 cm
	Y axis - 8.625 cm
	Z axis – 12.383 cm
Drag Force	5.614 N
Power Input	36 W
Power absorbed by drag force	5.81 x 10^{-3} W

C. *Discussion*

It is found that the manufactured submarine is not absolutely perfect. It has many limitations.

- The sonar provided is efficient within a certain level and only gives base reading which may be difficult to read sometimes.
- There is no proper covering of submarine to protect it from being tangled within lake weeds.
- The camera used needs to be calibrated manually when shaken with some external force
- The water sampling technique can collect water once at a time when submerged.
- The balancing of submarine changes with slight changes in placement of components while operation.

XI. CONCLUSION AND FUTURESCOPE

A. Conclusion

The aim of this project was to design and construct a small scale ROV from the start. In order for the project to be successful, all the right parts and components had to be found and put together properly. This was one of the parts during the whole process and took most the time and effort. During this project, some problems appeared. Most of them were solved, but not all of them. Therefore the project has a lot of space for further improvements. Even though the ROV does not have all intended features implemented, the system is functional at this point. Therefore, the main goal, constructing and controlling a small scale ROV, can be considered as accomplished.

The first thing that was carried out for completion of the project was to study in detail about the human anatomy and about the ROV submarine used worldwide. A detailed study led to the conclusion that the corpse can be located using a ROV of small size and low weight having various mechanism for locating.

The first order of installing those mechanism was to install the camera. The camera provide the operator wide area of guidance during operation of submarine. It will help the operator to move the submarine underwater with ease. But the installed camera was of low quality and most of the time blurred out the images. This can be further improved by adding high quality and resolution camera within the bot. there is also space for waterproof camera to be installed in the bot. the submarine can also be equipped with external light source for proper imaging under the water.

The sonar used in the submarine was the lowest priced sonar available within the market. The scope of the submarine to find the corpse can be improved by installing high end sonars available that gives real time imaging of reservoir bed, the only drawback would be the price of such sonars. It has a base price of 1.5lakh for having such sonar installed into the submarine.

During the study of human anatomy it was found that major gases like carbon monoxide, hydrogen sulphide and methane were released to the environment. This let to the idea about water sampling technique. However the water sampling method that was implemented can be improvised a lot by adding analyzers and other gas detecting sensors. Similarly the sonar used can be replaced with advanced sonar for better imaging at depth for identifying corpse. The efficiency of the submarine can be increased by adding high end technology.

B. Future Scope of the Project

- Can be improvised more in each and every aspect
- Installation of analyser module will ease the water sampling technique
- Introduction of new sonars of high working efficiency will enhance the locating efficiency of submarine
- Can be used as a surveillance BOT
- Many more alternative method for finding corpse can be incorporated within the submarine.

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