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# Design and Fabrication of a Submarine and Comparative Study with 6000m Driving Submersible Submarine

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***Abstract:*** **Submarine is used to investigate under water. Now a day, with the advancement of technology it is used not only investigation but also to battle and mining operation. Sometimes there are some problems throughout the rivers in our country. Many peoples are lost their lives because of drowning of boat or water vehicle. Therefore, a submarine is designed to solve this problem by investigation underwater. Water and propeller driven by gear motor are used for driving the submarine. It is derived on the principle of jet propulsion. Water is sucked by a propeller which is derived by a pump motor. Then the water passes through the nozzle. Whole system is controlled by microcontroller. Moreover, the system is controlled with the help of remote control. The power which is used to drive motor can amalgamate a percentage from absorbing tidal waves. This design is done perfectly to reduce drag force. Therefore it is an effective design.**

***Keywords*****: Submarine, drag force, propeller, jet, propulsion, design, water, microcontroller, remote control.**

## I. INTRODUCTION

### 1.1 General

Once upon a time, it was unknown to us what was happened under the water .With technology advancements, one solution has been developed by scientists named after "submarine". The U.S navy decided in 1950 to turn the ocean itself against Soviet navy. For this purpose, submarine activities are used. The present historical analysis of this system highlights the importance of the environment in naval warfare, further illuminates the relation between naval & civilians ocean science reveals significant challenges to naval culture. Besides, the investigation activities are performed by submarine now days. Now a day's under water investigation and defense technology is one of the most prominent sections of research. Submarine is obviously an important subject of research. In this project a submarine is designed to investigate, search under deep water by using the law of Archimedes and jet propulsion. To dive under water compressed air chamber and load chamber is used. The submarine was controlled and monitored from remote place using user interface software developed by the team. The submarine is given a unique aerodynamic shape for less drag force.

The objective for this project is to design & fabricate an efficient submarine. The principle objective is to model a cost-benefit & effective submarine which can be used for investigation.

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### 1.1 Scopes & Limitations

#### *1.1.1 Scopes*

1. It can be used for underwater investigation what is done by navy.
2. It may be used to find out the resources & for mining.
3. It may be of great advantages against a Navy of enemies, who by this may be undermined in the water and blown up [1].
4. It may be of special use for the relief of any place besieged by water, to convey unto them invisible supplies; and so likewise for the surprise of any place that is accessible by water. It may be of unspeakable benefit for submarine experiments [1].
5. It can be used for enquiring drowned people from rivers and sea.

#### *1.1.2 Limitations*

a. small size, very compressed interior

b. controlling system is difficult.

c. there is problem of air & water leakage.

d. flow rate should be high.

e. system

### 1.2 Motivation

The motivation for this research is twofold. 1. The need to support a Submarine commands decision making while overseeing the operations of multiple unmanned underwater vehicle. 2. The development of a methodology that evaluates different devices objectively in the conceptual design stage. Concepts developed for these two themes will aid Bangladesh Navy in its vision of futuristic Submarine mission. It will play the framework for developing conceptual design for human-system decision support integration efforts that could apply across the department of defense.

### 1.3 Research Objective

The objective for this research is to lay out the functional and informational requirements of a decision support system for the previously described futuristic Submarine mission, and then to decide what physical form best supports the functional and information requirements. The next phase of the objective is to model a cost-benefit analysis method that could help decide the most suitable display interfaces for the MAT.

## II. MATERIAL AND METHODOLOGY

### 2.1 Vehicle components

A self-propelled submarine is designed & developed capable of producing both a steady & unsteady jet while maintaining the same $\eta_{mech.}$

### 2.2 Mechanical components

The design & detailed drawing of submarine are developed by CAD (solid works).The exterior structure of the submarine is composed of four main parts: water filled anterior cap, motor housing, fluid housing with attached hydrofoil and the fluid nozzle. The submarine is 30.0 inches in length and 6.0 inches in nominal diameter. The length of the motor housing is 11.0 inches and it is 6.0 inches in diameter. The fluid housing is attached to the backside of the motor housing. There are two housing one for water & another for air. The fluid housing is 6.0 inches in diameter and 10.6 inches in length.

**Fig. 1: Propeller**

### 2.3 Electrical Components

#### *2.3.1 Arrangement of pumps inside of structure*

There are two motors inside the structure which are used to suck and discharge. This is the backward part of submarine.

**Fig. 2: pump arrangement**

#### *2.3.2 Suction and Discharge Motor*

There are two motors which are used to suck and discharge. One is used to suck water from outside to the water chamber when submarine is going to drown. On the other hand, another motor is used to discharge water from water chamber to outside during lifting. The rating of the motor is 12 volt DC, 2A current.

**Fig. 3: Pump motor**

### *2.3.3 Gear Motor with Propeller*

There are two gear motors which are mounted on the wings of the submarine. Gear motors drive the propellers which result the forward, backward and turning motion of the submarine. The gear is used to reduce the speed of the motor and to increase the torque as the high speed is not effective under water. The rating of the motor is 12 volt DC, 2A current.

**Fig. 4: Gear motor**

### *2.3.4 Electrical Circuit and Remote Control*

A simple circuit is designed for this project which can perform effectively without disturbance. The circuit is consisted of microcontroller, wires, capacitor, resistance, crystal oscillator, IRM 569n etc. There is a remote control which is used to control the submarine from away. The remote control is integrated to the main circuit. Moreover, this system is programming based.

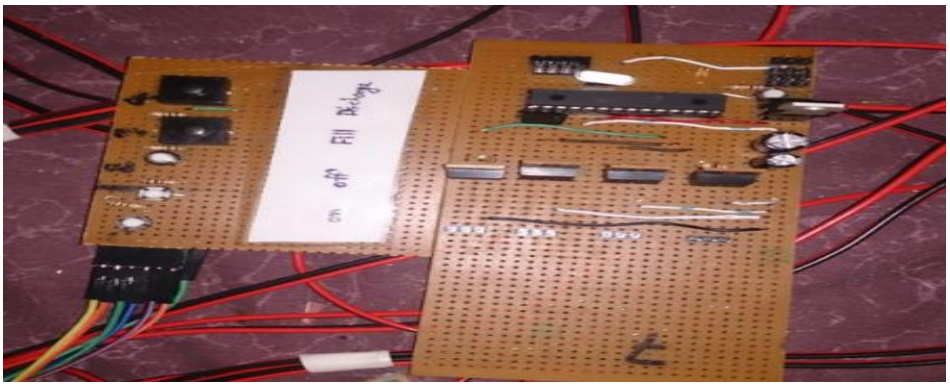

**Fig. 5: Electrical circuit and remote control**

### 2.4 Power Supply

Power supply flowchart describes the operations of power supply from battery to the motors and remote control. Battery provides 12 volt dc power supply. Microcontroller acts as a supply controller.

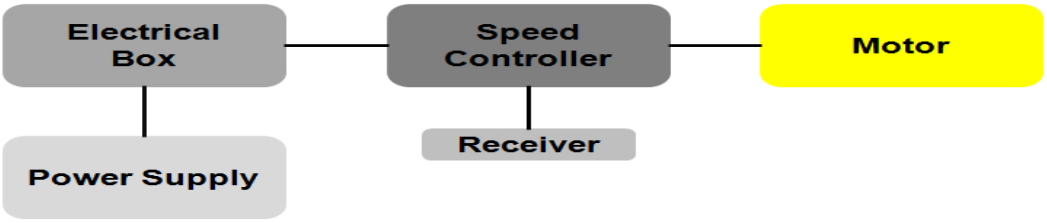


**Fig. 6: Power supply**

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### 2.5 Design Overview

#### *2.5.1 CAD design of a Submarine*

This is the previous design which is designed for my project. The design is done by solid works. It is the basement of my project. This is the preliminary step to perform a job. Firstly, material selection for whole bodies was mild steel sheet metals which thickness was 1.5 mm. There was a propeller inside the body which main function was propulsion. This propeller is not used for the final model for limitations.

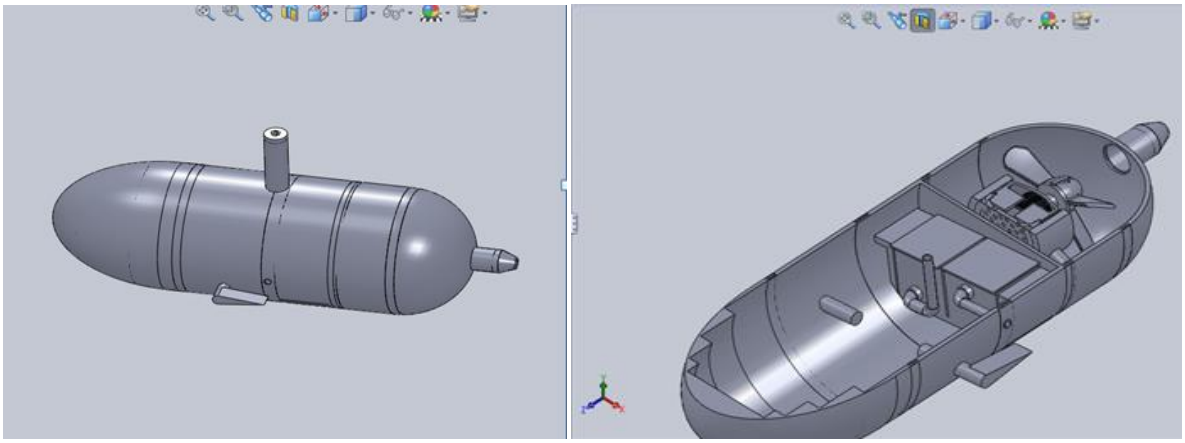

**Fig. 7: Pre-design of submarine**

#### *2.5.2 Projected Design of a Submarine*

Pre-design have been modified through some modifications which have made the project practical. Therefore, submarine has been established after some steps to make it effective. The model has been tried to construct as like the design. Here I have used 1.5 mm thick mild steel sheet plate for the middle body and wings. There are two semicircle shapes which are made of aluminum attached front and backward. There is a round acrylic sheet attached with front and middle.

**Fig. 8: Projected design of a submarine**

### 2.6 Working Principle

Fig. 8 shows a complete model of my project submarine. The working principal can be explained from my design. There are two chambers for air & water. Air is used for lifting when submarine is drowned. Water is used for drowning under water. There are two pump motors named suction pump and discharge pump. They are placed inside the back chamber. They are used for fluid controlling. When both switches of motor are on, two gear drive motors start to drive the submarine. If one switch of gear motor is on, it takes a turn either right or left. After few times, when the switch of the

suction pump is on, the submarine will be drowned due to the weight of water. During this time both gear motors are on. When the discharge pump is on, submarine will be lifted due to the loss of weight as well as the upward force of air inside the chamber. Whole system is controlled by remote control.

## III. RESULT AND DISCUSSION

### 3.1 Compression between 6,000 m Driving Submersible Submarine with the Projected Model

In France, IFREMER continues to support the concept of placing a man in a submersible for work, science and exploration purposes [2]. The Nautile serves the French well in this regard. A sketch of Nautile systems and sensor is shown in fig 4.1. Technical specification is displayed in table 4.1. Of the 25 projects visited in Russia and Ukraine, 11 are involved in the design, fabrication and operation of manned submersibles. The eight organizations with projects most closely related to manned submersibles at this time are discussed in this chapter.

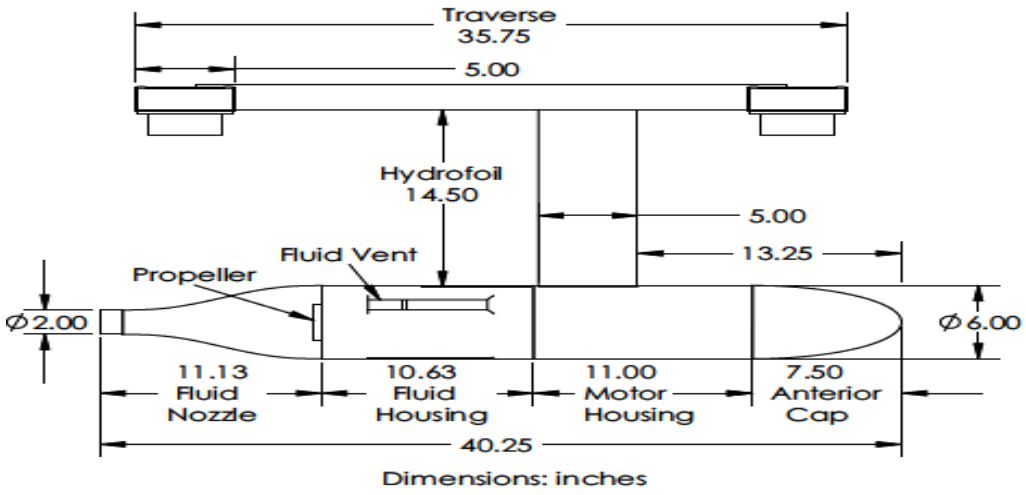


**Fig. 9: 6000m Driving submersibles [8]**

**Table 1: Technical specifications of 6000 m driving Nautile [8]**

| Main Characteristics | |
|---|---|
| Depth rating | 6000 m |
| Dimension | |
| Length | 800 m |
| Width | 270 m |
| Height | 345 m |
| Power system | |
| Voltage | 1200 volt |
| Current | 40 A |
| Power | 50 kw |
| Control | Remote control |
| Propulsion system | |
| Main propulsion | Axial motor (1) |
| Weight | 10 ton |

### 3.2 Data Analysis

Data collection method: The amount of water displaced by the body is the weight equal to it.

**Table 2: Technical specifications of the prototype submarine model**

| Main characteristics | | |
|---|---|---|
| Depth rating | .75 m | |
| Dimension | | |
| Length | 20 inch | |
| Width | 6 inch | |
| Height | 6 inch | |
| Weight of submarine | Unit | |
| With load | 10 kg | |
| Without load | 7 kg | |
| Volume of air | .5 liter | |
| Volume of water (load) | 2 liters | |
| Power system | Units | |
| Current | 2 A | |
| Voltage | 12 volt | |
| Power | 24 w | |
| Control system | Remote Control | |
| | | |
| Propulsion System | Motor type | No. motor |
| Main propulsion | Axial motor(gear motor) | 2 |
| Auxiliary propulsion | Axial pump motor | 2 |

There are comparisons between 6000 m driving Nautile and prototype submarine model. There is no axial pump motors in the Nautile but the prototype model has. The speed of the model is higher than Nautile. The prototype model is wire remote control whereas Nautile is wireless.

### 3.3 Discussion of the Result

Finally I made the model which was submersed up to .75 m with a load of 2 liters of water. Moreover, the model was fully remote control system. From this system I have learnt how a prototype submarine works. I have also observed the variation of output related to the load. Also the efficiency of the submarine largely depends on the perfect transmission system, load, hydrodynamic and the design of propeller. Results obtained from this experiment are depth rating, velocity, propeller efficiency, power rating, controlling system and load. The summary of the results are given below:

- Depth rating: .75 m
- Velocity: 15 m/s
- Propeller efficiency: 60 %
- Power rating: volt 12 v, current 2 A, power 24 watt
- Controlling system: completely remote control
- Load:

- without load: 7 kg
- with load: 10 kg

Archimedes has made the perfect passage to the hydraulic application. His principal made to build the water vessels like ship and submarine. I tried to follow Archimedes principle and how a submarine works smartly. I have got a clear idea which will provide me a passage to build a submarine that can be submerged in any depth under water which will be distantly controlled. It could be the inspiration to the batch next like to work on under water vehicles. The controlling system is not wireless so there was a problem during turning due to wires. Water tank should be large for drowning as the surface areas at the contact of water are large. Moreover, the vessel is full of air contained. On the other hand, the air is needed for lifting when the water is removed from the tank. Finally I am able to complete my project effectively and efficiently. There is a problem due to the leakage for which sometimes the system is dynamically unbalanced. The body of prototype submarine is made by casting and molding which confirm the reduction of leakages. Besides, mass balancing is done to balance it dynamically and statically. It can turn and run easily and smoothly. The functions of drown and lift are so sophisticated. As all the parts I collected from the local scrap market and the parts I made was not precious enough, the efficiency of the propeller is not sufficiently enough.

## IV. CONCLUSION

The design of submarine is derived without fuel. Here only renewable energy such as water, air is used. Here the main mechanism is to create change of momentum. In big sense, only propeller needs to drive. So a little amount of energy is need to drive the submarine .The percentage of this energy can be solved from tidal waves (power production), nuclear power plant etc. Therefore, it is an effective design for next generation. I have just shared my thinking to all. So, this project would be a new path of the forth coming engineers who want to make a distant control submarine. The technology of submarine is increased day by day. A distant control prototype submarine can be used to search the drowning people without spending time with faster. Bangladesh navy can use the submarine to investigate and searching new occurrences.

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