A Review Paper on: Autonomous Underwater Vehicle

Sandeep Kumar Jain[1], Sultan Mohammad[2], Suyog Bora[3], Mahender Singh[4]
[1]Associate Professor
Electronics and Communication, Department
Vivekananda Institute of Technology (East)
Jaipur, India
[2,3,4]B.Tech Scholar
Electronics and Communication, Department
Vivekananda Institute of Technology (East)
Jaipur, India

[1]sandeep.jain85@gmail.com
[2]vit.sultanmohammad@gmail.com
[3]borasuyog@gmail.com
[4]mahendershekhawat4@gmail.com

***Abstract*— This paper describe general overview of design and use of the Autonomous Underwater Vehicle. The major part of earth is water (70 percent) and only few part is land (30 percent). In comparison to dry land only few part of underwater environment is known to us.To better understand the underwater environment and manage this environment and for searching we need detailed accurate and detailed information but it is clearly impractical to manually explore it. However an automatic machine can do this , and this reason for the development of Autonomous Underwater Vehicle.**

Keywords*— *autonomous underwater vehicle

I. INTRODUCTION

An autonomous underwater vehicle (AUV) is an underwater vehicle capable of self-propulsion, also known as unmanned underwater vehicle. It is a robotic device that is driven through the water by a propulsion system, controlled by an on board computer and maneuverable in three dimension. Such Vehicles are comes under the category of mobile robotics that have actuators, sensors, and on-board intelligence to successfully complete their task with little or no human efforts. The application of this vehicle is increased in recent years, such as cable or pipeline tracking and deep ocean exploration. So it is better to make these AUVs smaller and flexible as much as possible so that it can go to smaller region easily. And if we need high speed in water then a streamline body is required.

Different structures with different size of these AUVs are developed. Most of these AUVS are torpedo-like with streamline bodies, (like Sangekar et al., 2009).

And some are of small size like(Allen et al., 2002 and Madhan et al., 2009). There are some small other AUVs that have different body design, like (Antonelli and Chiaverini, 2002).

II. HISTORY

The first AUV was developed at the Applied Physics Laboratory at the University of Washington as early as 1957 by Stan Murphy, Bob Francois and later on Terry Ewart. The "Special Purpose Underwater Research Vehicle", or SPURV, was used to study diffusion, acoustic transmission, and submarine wakes. The first torpedo trial was in 1871 but this torpedo did not run.

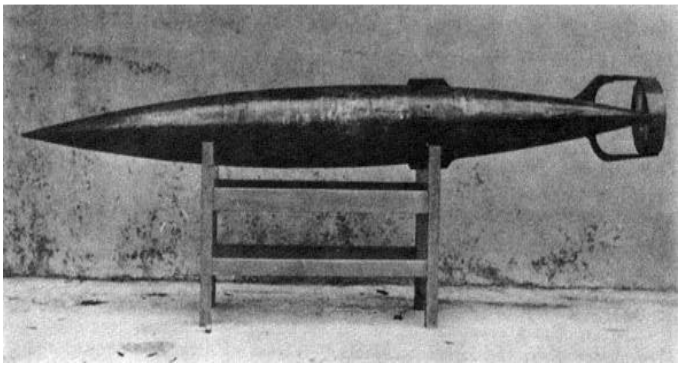

Fig. 1 Newport's Auto-Mobile "Fish" Torpedo(1871)

Robert Whitehead is credited with designing, building, and demonstrating the first torpedo in Austria in 1866. Torpedoes are named after the Torpedo fish, which is an electric ray capable of delivering a stunning shock to its prey. Whitehead's first torpedo achieved a speed of over 3.0 m/s and ran for 700m. The vehicle was driven by compressed air and carried an explosive charge. If we ignore the fact that it carried an explosive charge, it might be considered the first AUV.

III. APPLICATION

Autonomous robots not only present the next great milestone for science, but their practical uses span a wide range. In particular, AUVs are being used to explore underwater environment, mines clearing operation. Another area where these vehicles are in monitoring and maintenance tasks in environment where hazardous for humans or impractical for humans. For example, monitoring and cleaning the inside of a nuclear reactor vessel is a situation that is dangerous for human divers but not for AUVs.

IV. VEHICLE DESIGN

Hundreds of different AUVS have been designed over the past 50 or so years, but only a few companies sell these vehicles in any significant numbers. There are about 10 companies that sells AUV in the international market, including Kongsberg Maritime, hybrid (now owned by Kongsberg). Bluefin Robotics, International Submarine Engineering Ltd. and Hafmynd.

Vehicles range in size from man portable lightweight AUVs to large diameter vehicles of over 10 meters in length.

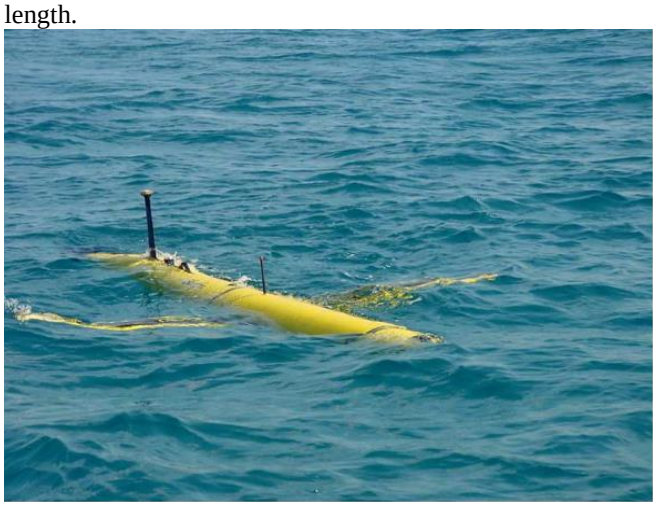

Fig.2 Bluefin-12 AUV

V. AUV Technology

Over the years, the focus of technology development has changed as new ideas surfaced to address technology problem. Some of the problem have been solved, other remain unrecognized problems.

Following is the list of Technology:

- Energy System/Energy management
- Navigation
- Sensor System and Processing
- 3D imaging
- Communication

Energy System/Energy management: Endurance of Auvs has increased from a few hours to 10s of hours. Some System now contemplate missions of days and a very few, of years. This extended endurance, however, is at expense of sensing capability, as well as very workhorse for energy systems. Batteries used in AUVs can be Lead Acid batteries , Silver Zinc batteries, Lithium primary batteries. A number of chemistries were tried for different application.

Solar Energy is now being used to power the vehicle

Fig. 3 The solar powered AUV(SAUV), AUSI & IMTP, RAS, FEB

Navigation: Early AUV system relied on dead reckoning for their navigation. Acoustic transponder navigation system provided greater accuracy but a significant logistics cost. With the advance in technology in past few years many AUVs have taken advantage of Global Positioning System (GPS).

AUVs are equipped with SONAR. SONAR (originally an acronym for SOund Navigation And Ranging) is a technique that uses sound propogation(usually underwater, as in submarine navigation) to navigate, communicate with or detect other vessels.

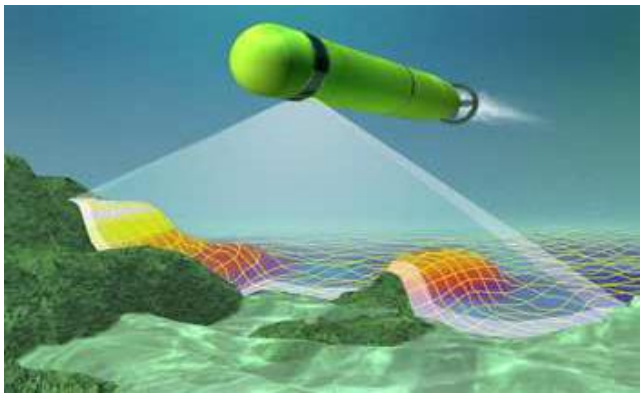

Fig. 4 AUV Model with SONAR scanning

For many years, there has been extensive use of vision systems as a navigational aid for surface vehicles. Nevertheless their use in navigational of underwater vehicles is relatively new.

Sensor System: An AUV is simply a platform on which to mount sensor and sensing systems. This carries sensors to navigate autonomously and map feature of the ocean. Typical sensor includes compasses, depth sensor, sidescan and other sonars, magnetometers, thermistors and conductivity probes.

A demonstration at Monterey Bay in California in September 2006 showed that a21-inch(530mm) diameter AUV can tow a300 feet(91m) long hydrophone array while maintaining a 3-knot(5.6 km/h) cruising speed. Sensor aquire data from the ocean environment. The sensor should be smarter lower power, highly reliable, smaller in size, etc.

VI. MILITARY USE

On the military side of the Equation, AUVs have been under development for decades, and they are now reaching an operational status. Their initial fleet application will be for mine hunting, which was also the case for fleet introduction of ROVs. However, in the case of AUVs, they will operate from a submarine and not a surface ship.

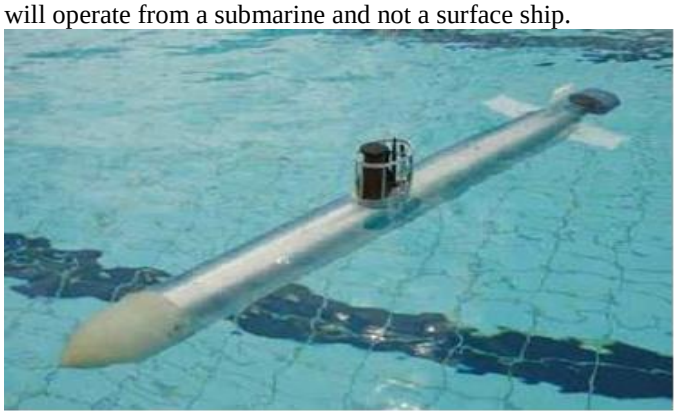

Fig. 5 Starfish 2 USA navy

A typical military mission for an AUV is to map an area to determine if there are any mines, or to monitor a protected area (such a harbour) for new unidentified objects, AUVs are also employed in anti-submarine warfare, to aid in the detection of manned submarines.

VII. HOBBY

Many roboticists construct AUVs as a hobby. Several competitions exit which allow the homemade AUVs to compete against each other while accomplishing objective. Like commercial brethren, these AUVs can be fitted with cameras, lights, or sonar. There are several task in this competition. That is:

- Wall Following
- Pipeline Following
- Target Finder
- Object Mapping

VIII. FUTURE POSSIBILITIES:

"The trouble with our times is that the future is not what it used to be". –Paul Valery

AUVs are now at an early stage of acceptance. As they work their way into the phase of operational acceptance on commercial level, there numbers will grow.

C&C Technology, Inc.'s AUV Hugin has proven that the cost of deep water survey operations can be reduced by 40% to 60% by using AUV's rather than conventional methods, while improving the quality of data that is collected.

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