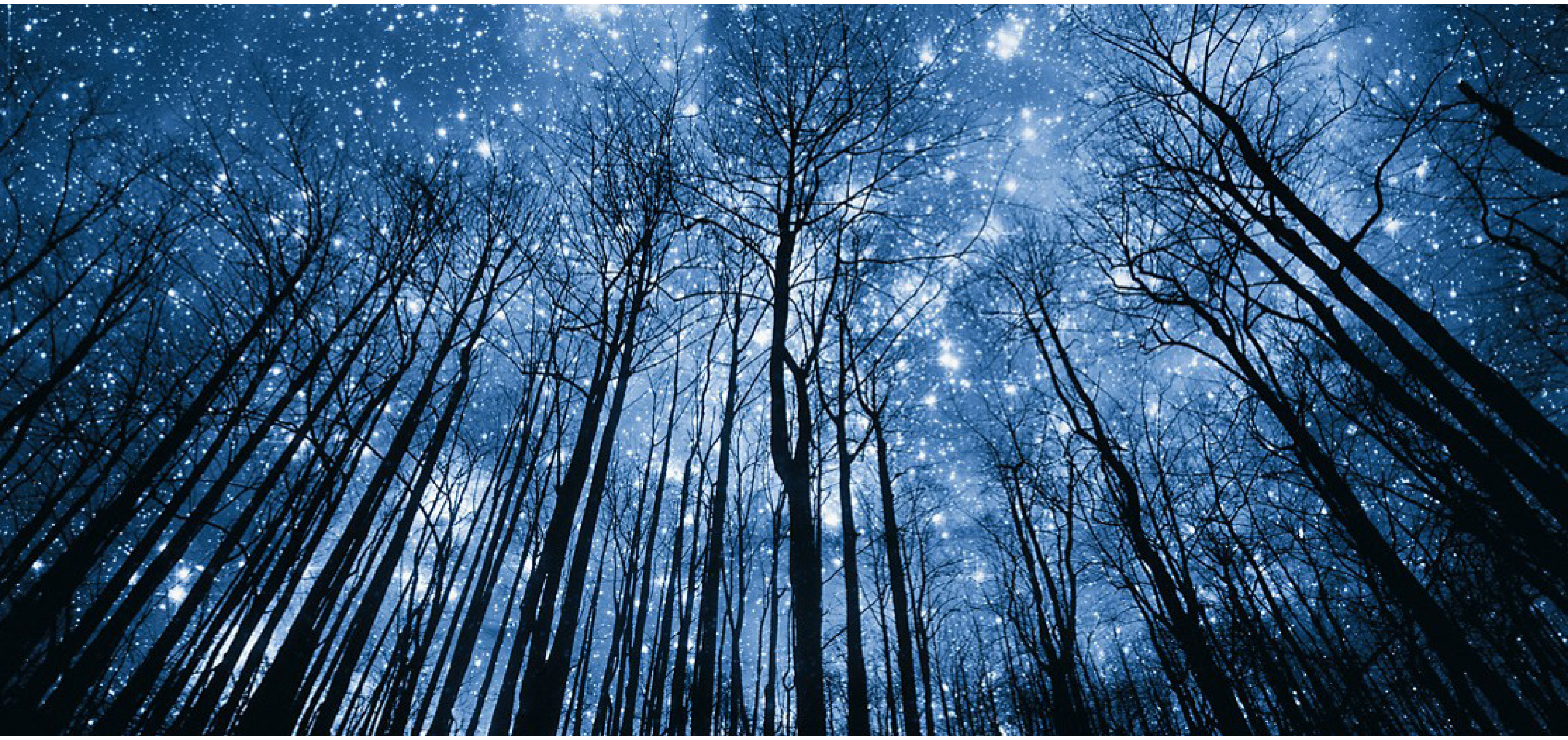
ROBOTIC FISH - AI SECURITY/ SURVEILLANCE



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Abstract

About 71 percent of the Earth's surface is covered by water. This natural resource is being used by humans for various activities including trade, transportation, underwater resource extraction and defense. Humankind has experienced various emergency situations related to the activities performed over these water bodies, and for emergency circumstances, divers are required but may not be available. Also, the exploration and surveillance of the underwater environment by human labor is not efficient. To overcome these challenges, we propose a UUV (Unmanned Underwater Vehicle) named "Robotic Fish." The proposed system includes the design and construction of robotic fish which resembles a natural fish. The design procedure adapts a bio-inspired approach which makes the model resemble a natural fish in both its appearance and movements. Robotic fish are more competent than current UUVs propelled by motion because the fish is a paradigm of bioinspired UUV. Robotic fish can operate in complex environments. They can perform underwater exploration and be used for surveillance of submerged zones. While operating, the proposed model can deliver heightened performance when compared to other UUVs available. An attempt has been made to develop a robotic fish with improved maneuverability (movements) and performance features.

Introduction

Underwater worlds like the seas and oceans are huge water bodies that have not been fully explored. The exploration of these water bodies by manual approach is exceedingly difficult and dangerous. An Unmanned Underwater Vehicle (UUV) is the most suitable approach for achieving this goal of exploring the underwater world. UUVs are much more efficient, accurate and safe compared to humans for performing exploration tasks. A bio-mimicked (bio inspired) UUV is better than the other UUVs. One such bio mimicked UUV is this Robotic Fish. Fish are the best natural swimmers - They are fast, and their narrowness helps them swim well in any circumstances. Hence this bio inspired UUV named Robotic Fish is chosen to be a Fish model. The Fish resembles a natural fish in appearances and maneuverability (movement). This is one of the major advantages of bio-inspired models since their appearance and movements leave the other underwater creatures undisturbed. Another advantage of a bio inspired model is that it can be used to spy on enemy countries under military application. The Robotic Fish is implemented using a fin propulsion system enabling the model to swim as a natural fish.

The Robotic Fish was developed with the mechanism of thrusters and fans that create sediment distortion. As a result, the monitoring of the area was a challenging task. Hence the videos and images that were recorded were not reliable and efficient. The fish that we have designed is based on a complete fin propulsion system and is wireless. A robotic fish based on fin propulsion provides higher maneuverability, agility and is a versatile solution for diverse marine applications. For example, examination of submerged animals and assets, assurance of contaminations in water and checking on the nature of water, perception of living structures, study of submerged territories, deficiency identification in oil pipelines, security, and guard applications. The fish is remote controlled from outside of the water. It also gives instructions for directing the UUV. The UUV is always ready to take the commands from the controller and it constantly monitors the area under surveillance and provides real time videos and the data related to the area.

Figure 1: Plane Crash

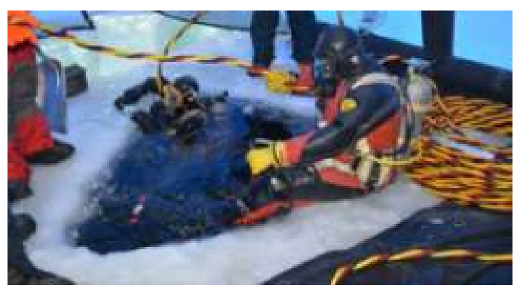

Figure 2: Rescue Operation

Literature Survey

Malec et al. [1] designed three-link Cyber Fish by focusing on BCF (Bodies Caudal Fins)-like locomotion. The prototype was produced by using acrylic, rubber, aluminum, and stainless steel. In the referred work, the angle of the pectoral fins associated with the servomotor is changed to provide the same up-down motions as sharks. Masoomi et al. [2] used 3D-printing technology to construct the tuna-like robotic fish with a main body and flexible tail mechanism. The robot surface was covered with epoxy to provide waterproofness. Kodati et al. [3] developed Ostaciiform-type box fish which has pectoral and caudal fins. Phamduy et al. [4] designed a miniature robotic fish prototype to investigate animal-robot interaction studies. They used 3D-printing technology to manufacture the robot prototype. Shibata, M. [5] proposed a fish-like underwater robot with a body in a thin plastic film manufactured by using a vacuum packaging machine. The prominent features of this work are that although it is not a biomimetic design, it has a high-pressure resistance and is lightweight.

Marchese et al. [6] designed and fabricated a soft robotic fish with rapid motion ability. In this work, they focused on the rapid escape responses of the prototype. Chowdhury and Panda [7] proposed to produce a robotic fish with undulatory swimming behaviors. In this work, biological vertebrate fish swimming was integrated into the mobile underwater vehicle. Huang et al. [8] suggested a solution to minimize a swimming robot by using polymer film works as motor. The robotic fish mimics BCF-type Carangiform swimming modes with a propulsive tail mechanism driven by servo motors. An anterior rigid torpedo-shaped body is designed for housing the electronics, sensors, and Centre of Gravity (CoG) control mechanism. CoG control mechanism successfully provides up-down motion abilities. The locomotion control is adapted based on a Central Pattern Generator (CPG) to generate robust, smooth, and rhythmic oscillatory swimming patterns.

Proposed System

The UUV seems like a torpedo in numerous viewpoints. It is comprised of an impetus framework having a couple of blades, control surfaces that control the development of the vehicle, a streamlined fairing for diminishing hydrodynamic drag and a weight structure to contain control gadgets. The vehicle conveys its own vitality source and is modified with directions fit for doing submerged mission with help from an administrator. The directions incorporate the data required for route between pre-decided geographic positions with contingency measures should be an occurrence of gear breakdown, systems for payload gadget activity and techniques to maintain a strategic distance from hindrances. Careful check of the UUV is directed before beginning the submerged mission. The vehicle is submerged into the water and discharged to begin the mission. In certain missions, the gathered sensor information must be sent to the administrator to guarantee that the information is of high caliber. In such cases, broadcast communications arrange is accommodated accomplishing this reason. The vehicle goes to its pre decided endpoint toward the finish of its mission and the information is recovered from the vehicle.

3.1 Propulsion System: There are several drive procedures for UUVs. Some of them utilize a brushed or brushless electric engine, gearbox, lip seal, and a propeller which might be encompassed by a spout or not. These parts installed in the UUV development are engaged with impetus. Different vehicles utilize a thruster unit to keep up the measured quality. Contingent upon the need, the thruster might be furnished with a spout for propeller crash insurance or to decrease commotion accommodation, or it might be outfitted with an immediate drive thruster to keep the proficiency at the largest amount and the clamors at the most minimal dimension. Progressed UUV thrusters have a repetitive shaft fixing framework to ensure an appropriate seal of the robot regardless of whether one of the seals comes up short amid the mission.

3.2 Fin Propulsion: Fish motion is the assortment of kinds of creature headway utilized by fish, chiefly by swimming. This is accomplished in various fish gatherings by an assortment of systems of impetus in water, frequently by wavelike developments of the fish's body and tail, and in different fish by developments of the blades. The real types of motion in fish are anguilliform, in which a wave passes equally along a long thin body; sub-carangiform, in which the wave increments rapidly in sufficiency towards the tail; carangiform, in which the wave is focused close to the tail, which sways quickly; thunniform, fast swimming with a huge incredible sickle formed tail; and ostaciiform, with no wavering aside from of the tail blade. Progressively particular fish incorporate development by pectoral blades with a mostly solid body, as in the sunfish; and development by engendering a wave along the long balances with an unmoving body in fish with electric organs, for example, the blade fish.

Methodology

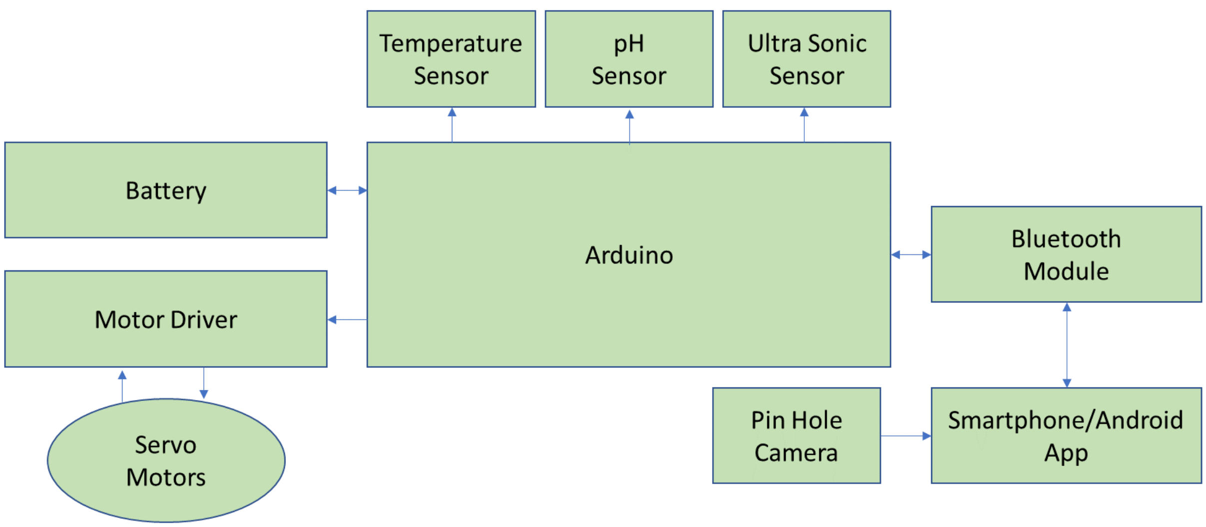

Figure 3: Block Diagram of Proposed System

Flowchart of proposed system

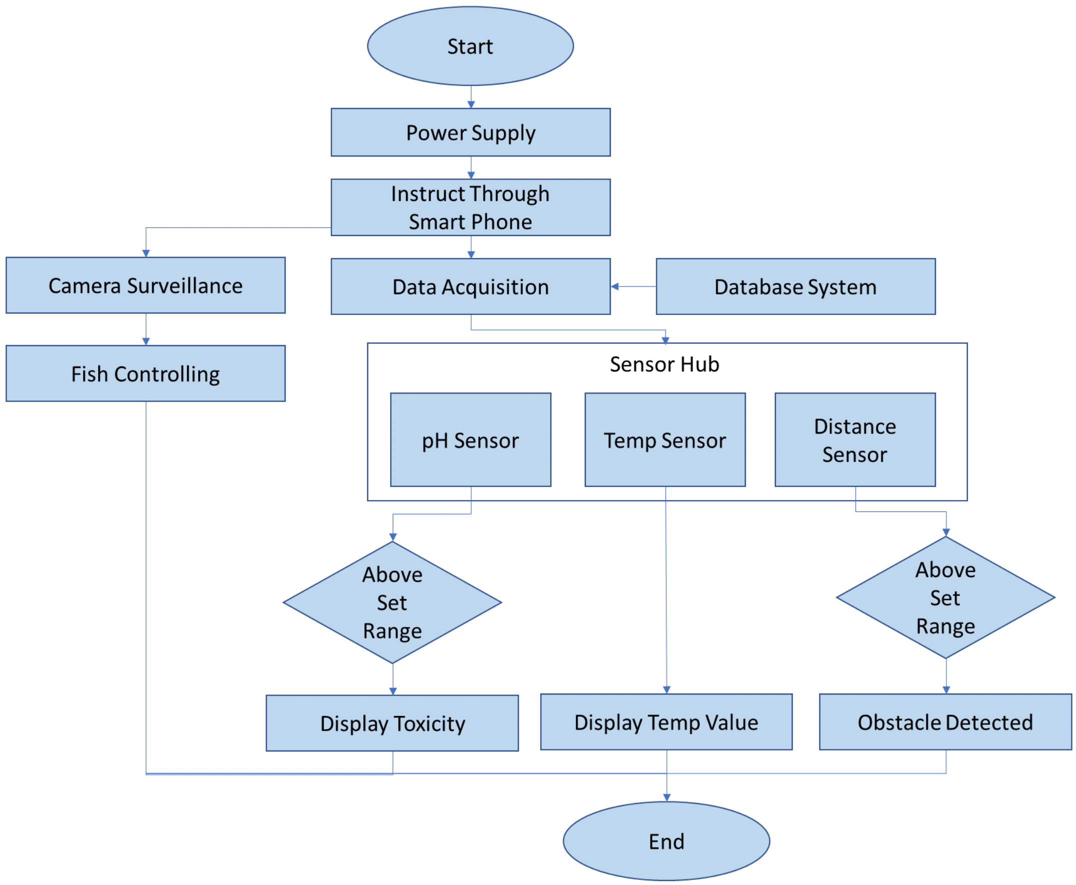

Figure 4: Flow Chart of Proposed System

The Robotic Fish is designed using Fin Propulsion system (FPS) for precise maneuverability which makes the fish more agile. Various types of sensors are embedded within the model to determine the required data with respect to desired objective. The system is equipped with a camera which will provide live videos of an underwater environment. It also can be used for survey of submerged areas, and it can provide the latest data regarding the area under surveillance. The data can be retrieved and analyzed. Also, it is equipped with two types of sensors which are temperature sensor and pH sensor. The temperature sensor will sense the difference in temperature at the various places under the water. The pH sensor will determine whether the water is toxic, and it will provide the data regarding the toxicity of the water.

Result and Analysis

ELECTROMATED FISH	OTHER UUV
It uses a Fin Propulsion System which reduces noise and gives smooth locomotion.	They use Thrusters and Fans which are noisy.

Controlling is through smart phone connected through Bluetooth.	Controlling is through Remote.
Single device performs multiple applications like water quality determination using pH Sensor and obstacle detection using Ultra Sonic Sensor.	Does not combine all these objectives in one UUV model.
Performance and Efficiency is more compared to other UUV.	Performance and Efficiency is comparatively less.
Bio-inspired approach hence resembles natural fish which leaves other aquatic creatures undisturbed	May not resemble a natural creature.

Conclusion

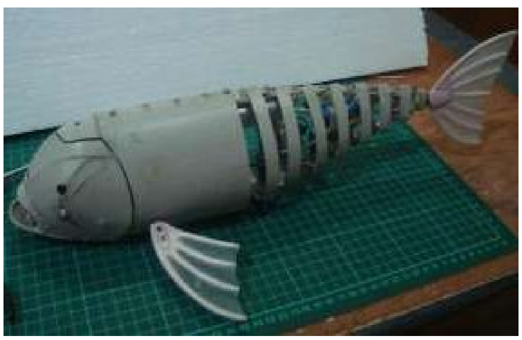

Figure 5: Working Fish model

This examination shows the bio emulation plan and development of the Robotic Fish model dependent on bio Inspired swimming to perform certifiable investigation and review missions. The created mechanical fish mirrors the regular fish swimming modes with tail component. This fish can fill in as a standout amongst the best UUV. It tends to be utilized for different submerged applications. The Robotic Fish accomplishes the targets like examination of submerged assets, assurance of contaminations and checking the nature of water, perception of living structures, Survey of submerged territories, territory observing to check if the specific zone is all right for plunging and angling, it can likewise be utilized for impediment location. It gives precautionary measures and spares lives and assets from being lost. This model can be stretched out for progressively future applications, for example, shortcoming identification in gas or oil pipelines, coastline security and military missions, giving live recordings of the submerged condition.

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