Robotic Fish

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Abstract:- **In recent years, several techniques and methodologies have been developed for monitoring the surrounding area of water. Robotic fish potentially can be used as an efficient device for water monitoring. The design is aimed at high maneuverability, efficiency and ability to control the speed suitable for surveillance using wi-fi camera. Recently robotic fishes are widely used in various applications such as ocean exploration, military operations and marine environment protection. This project is focused on the fish forward movement mechanism, the robot moves with the help of flexible tail. The tail part of the robotic fish is connected to the active body segments which are connected in series and forces caused by waves will act on each segment. It can navigate efficiently over a given distance with a good balance of speed and maneuverability.**

Keywords—ESP 32, Ultrasonic sensor, Servo motors, Wi-Fi camera, DHT 11 sensor.

I INTRODUCTION

Water resources and aquatic ecosystems have been facing various chemical and natural threats. Like contaminated materials from industries, and waste disposal. The chemical leakages may also have dangerous impact on human health and sustainability of ecosystem. Submarines have been considered to be the most successful in under water exploration, but they lack several important features of natural swimmers like flexibility, ease of maneuverability and efficiency which led to fish swimming being better adapted ecologically in comparison to submarines. A new experiment in unmanned water exploration has been unleashed with the introduction of robotic fish. A robotic fish would serve as a perfect agent for such a exploration missions. Biomimetic fish like robots are gaining popularity as they can be used extensively for investigations in water. To achieve high movement of quickness in water, some robotic fish, with soft-body and multiple-joint tails, use multiple actuators to make the body-tail more flexible. Motivated by the need for system analysis and efficient control of robotic fish, averaging of robots' dynamics is of interest. Fish drive themselves by bending their bodies or using their tail and pelvic fins, and have gained surprising swimming and maneuvering abilities after thousands of years of evolution. For example, the tuna fish swims with high speed and more efficiency, the pike fish accelerates in a flash and the electric eel can swim skillfully into narrow holes. This has inspired many researchers to build new kinds of aquatic man-made robots, namely robotic fish. Instead of using conventional rotary propeller in ship or underwater vehicles, a robotic fish relies on oscillatory movements to generate the main propel energy. The observation on a real fish shows that this kind of movement is less noisy, more effective and maneuverable than the man-made underwater vehicles. The proposed system consists of sensor unit, wi-fi camera, servo motors. The sensor unit consists of DHT11 sensor for measuring temperature and humidity values, waterproof ultrasonic sensor for obstacle detection. Servo motors are attached to the fish for the smooth locomotion. For monitoring of the water the wi-fi camera is attached to the fish. This wireless camera will capture the videos in live and that will be captured in the mobile.

II LITERATURE SURVEY

In this paper yong Zhong [1], wire driven mechanism the compliant tail molded through multi pseudo link model it is simple in design, easy to control the locomotion, high speed swimming and the bodies are fabricated using soft elastic materials. The kinematics of the robotic fish presents the design and fabrication of the robotic fish the active and compliant propulsion mechanism is driven by one motor. Pichet Suebsaiprom [2], based on roll, pitch and yaw develops 6- degree of freedom mathematical model. It is based on barycenter mechanism and to provide the body stabilization to actuate an active control design. The kinematics and rigid body dynamics and fish tail mechanism are enabled in the fish robot to freely move in three-dimensional space. The results of the simulation are satisfactory performances and path tracking control. Global velocity, yaw angle and LQR controller arethe types of 3D swimming tracking control. A M Aminur R B, B Hema Kumar, M P R Prasad [3]: review on robotic fish locomotion and propulsion in marine environment, the fish locomotion is one of the prime inspirations of robots and most of the bioinspired fish robots are designed by mimicking the swimming profiles. Robotic fish propulsion mechanism is complexed to realize in models, it involves several aspects such as shape of the robot, hydrodynamics involved, pattern of moment, control system involved, mechanical properties, location of various mechanical components and the properties of the material used.

Zu guang zhang [4], fully designed and fabricated by illogically inspired robotic fish. It can be propelling by its own through flexible tail they referred to use electrostatic film motor it consists of two pieces stator and slider through flexible power transmission system. This fish robot has mainly based on two types of swimming locomotion body caudal fin and medium paired fin. The principle is based on the electrostatic motor with six phase synchronous motor. Shaurya Shriya [5], Robotic Fish Design and Control based on biomechanics. This paper presents a theoretical framework on the design, modelling and control of a robotic fish inspired by the carangid form mode of swimming. The physical design of the robotic fish is obtained by trying to mimic the external

anatomical features of a Tuna. To mimic the undulation of the fish posterior, a novel combination of manipulator link mechanism and a flexor-extensor mechanism has been used.

Junzhi Yu [6], mainly focused on the controlling of a fish robot on multiple control surfaces to get the stable motions in aquatic environments. The fins are helpful in balancing for propulsion, steering, and paddling. Muhammad Rusydi Muhammad Razif [7], a review on development of robotic fish. The material of the fin and actuator must be flexible for efficient high thrust and high maneuvering. Development of robotic fish propulsion involves several aspects such as shape of the robot, pattern of movement, hydro-dynamics, control system, location on the machine, mechanical properties and material properties. Various structures and materials used in existing fish robots and significance of selection are reviewed.

Aim: To design a small and inexpensive fish-like robots consists of multiple sensors for monitoring the quality of water.

Objectives:

- The conditions of water vary with time and with location, continuous sampling that is not feasible with fixed sensors hence to measure the temperature of the water at different locations robotic fish is designed.
- To design and development of a prototype robotic fish: The test setup has been built for getting sine wave using two servomotors.
- Water conditions vary with time and with location, continuous sampling that is not feasible with fixed sensors hence to measure the temperature and humidity above the water level at different locations robotic fish is designed.

III PROPOSED WORK

Robotic fish consists of ESP32 microcontroller, servo motors, Wi-fi camera, rechargeable battery along with various sensors like ultrasonic sensor, DHT11 sensor.

- The robotic fish can be turned on by using switch.
- Whenever the robotic fish faces any obstacle it will change its path automatically. The fish can move in left, right and forward directions.
- Wi-fi camera present in the robotic fish gives the continuous live video of the water surface.

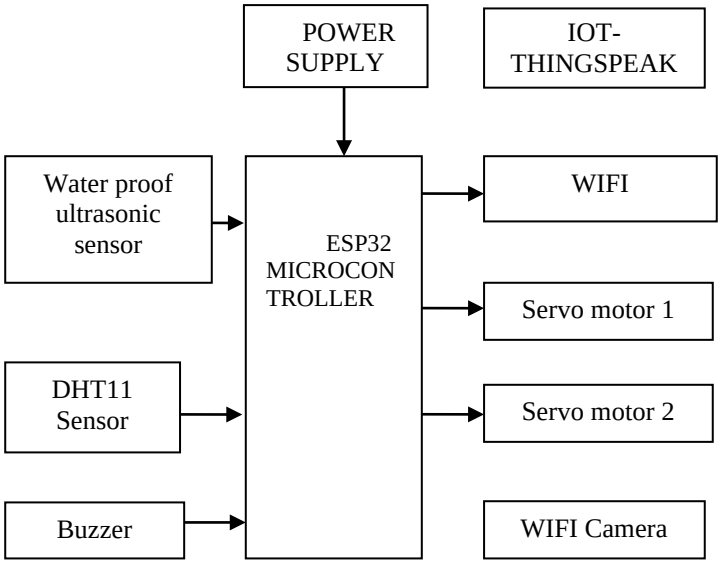

Fig: 1 Block diagram

This system consists of four major units: Sensing unit, Processing unit, Image capturing unit, rotating unit. Fig 1 illustrates the block diagram of the proposed system.

A. Sensing unit

Sensing unit consists of waterproof ultrasonic sensor and DHT11 sensor. Ultrasonic sensor detects the obstacle in the range of 25cm to 450 cm. It detects the object and sends data to the controller.

Fig: 2 Ultrasonic sensor

DHT11 sensor is used to measure the temperature and humidity of the surrounding area of the water and sends the data to controller.

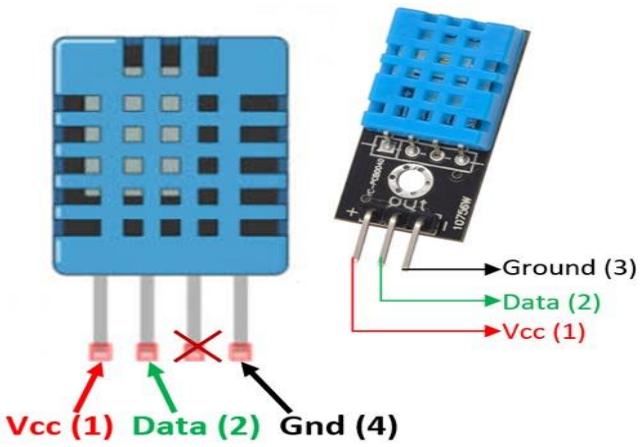

Fig 3: DHT11 sensor

B. Processing unit

The whole system functionality is controlled by the ESP32 controller. ESP32 is capable of functioning in industrial environment. Its operating temperature ranges from –40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external imperfections and adapt to changes in external conditions. Upon receiving the signal from sensing unit it instructs the robotic fish to change the direction of path and temperature and humidity data is send to thingspeak for visualization.

Fig 4: ESP32 module

C. Video Capturing unit

WI-FI camera is used as a video capturing unit and provides the live video and can be viewed in mobile.

Fig: 5 WI-FI camera

D. Rotating unit

Servo motors are used in the tail part for forward undulating movement of the fish . They have a limited rotation of 180^0 i.e. angle of rotation and requires a power supply of 5v.

Fig 6: Servo motor

IV FLOW CHART

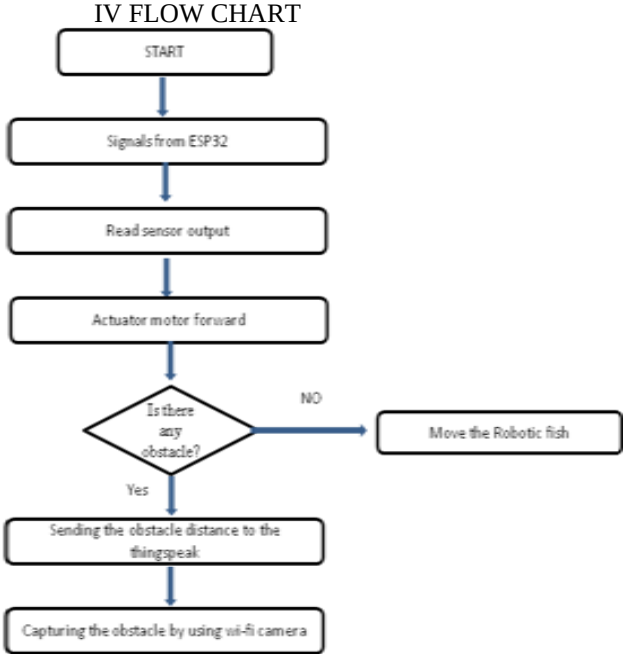

Fig 7: flow chart

This section includes the sequential representation of the processes involved in this project. The major steps involved in this approach includes receiving the signals from the ESP32 module and upon receiving the signals the servo motor moves forward. If there is any obstacle in the path the distance between the obstacle and fish is send to thingspeak otherwise the fish moves forward. WI-FI camera captures the obstacle video and surrounding area of the water.

V RESULT

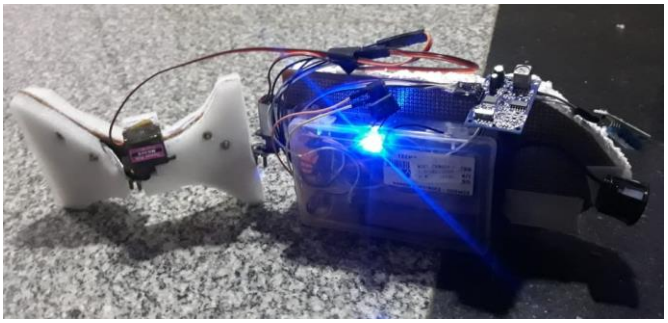

Fig 8: Implementation of robotic fish

The proposed system has been tested for its features like object detection, temperature and humidity sensing successfully. The device continuously monitors the temperature and humidity above the water level. The device detects the obstacles on the way and changes its direction automatically. The robotic fish provides live video of the water environment.

VI FUTURE SCOPE

As this robotic fish looks like natural fish and with the help of this, we can explore the underwater environment. GPS technique can be used for navigation purpose. Different chemical sensors can be used to detect chemicals in the water. Oil spills from the ship and other pollutants can also be

detected using relevant sensors. The 3D printed technologies can be used to increase the efficiency and movement of the robotic fish exactly look like natural fish.

VII CONCLUSION

Autonomous robotic fish has been developed to perform operations such as object detection and monitoring. The movement of the robotic fish includes a caudal fin which is controlled and actuated by a sensory circuit, servomotor, and microcontroller. The robotic fish measures temperature in different areas of water. Video capturing facility will be helpful for monitoring the water bodies.

Acknowledgement

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