Electrically Operated Tank Cleaning Robot

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Abstract - *The concept of "Electrically Operated Tank Cleaning Robot"presents an innovative solution for effectively cleaning debris from the surface of underwater tanks. The system utilizes a PMDC motor as its driving force, A diaphragm water pump and filteration bag is used to efficiently remove contaminants. A suction pipe is employed to facilitate the intake of debris into the system. Additionally, to ensure operational safety and longevity, a thermistor is integrated to monitor and regulate motor temperature underwater. To enhance user interaction and control, the system is equipped with a Cam Development Board (ESP32). This allows users to monitor and manage the cleaning process via a wired connection, providing real-time feedback and control capabilities. Additionally, SMPS and motor controlling switching are employed to efficiently distribute power among the left motor, right motor, and water pump. Algae removal is facilitated by brushes, while a buck converter is linked with the cam board for optimized functionality. This holistic design guarantees effective, user-friendly, and dependable underwater tank cleaning.*

***Key Words*: PMDC Motor, Flow Meter, Filteration Bag, SMPS (Switch Mode Power Supply).**

1. INTRODUCTION

Clean water supply is important in ensuring good health of people. Water supply is distributed from water storage tanks. Sediment that accumulates over time in water storage tanks will deteriorate the water quality used by consumers. Therefore, water storage tanks are required to be cleaned once in every three years by water utility operators or tank cleaning service providers. Manual cleaning method is done by draining off and resupply water into the tank after workers have cleaned the tank using water jet and brushes. [1]. Rather than relying on continuous chemical treatment, the removal of sediment from the tank floor offers a more effective solution. Traditional cleaning methods are often laborious and time-intensive, demanding manual effort and significant resources. In response, the "Electrically operated tank cleaning robot " offers a pioneering approach by harnessing modern technology and engineering concepts. ROVs designed for cleaning domestic and industrial tanks have been developed both internationally and in India, although not as extensively as ROVs for tank inspection. Various reservoir structures and water management techniques are employed by corporations and water utilities, leading to the need for specialized ROVs tailored to specific types, sizes, and conditions of reservoirs. In India, for instance, Grid bots has developed a robot called SaUsR for this purpose. [2].In This paper introduces a comprehensive system meticulously designed to clean debris from underwater tank surfaces efficiently. At its core, the system utilizes a PMDC motor as the primary driving force for cleaning operations. Complementing the motor are a diaphragm water pump and a specialized porous bag engineered to effectively eliminate contaminants. Incorporating a suction pipe facilitates seamless debris intake, ensuring thorough cleaning while minimizing disruption. Prioritizing operational safety and equipment longer life , the system integrates a thermistor to monitor and regulate motor temperature underwater. This proactive measure mitigates overheating risks and potential damage, thereby enhancing the system's reliability and lifespan. Additionally, the system is equipped with a Cam Development Board (ESP32). This functionality enables users to oversee and manage the cleaning process via a wired connection, offering valuable feedback and control options.

2. METHADOLOGY

1. It would use suction pipe to suck various types of debris that are found in underwater tank including algae, mold, rust, sediment, sand, organic matter, and sometimes even rocks. These materials may need to periodically removed to maintain the tank's efficiency and prevent clogging or contamination issues.

2. It would use PMDC motor serves the purpose of driving the cleaning mechanism, suction devices, to remove dirt from tank's surface. The PMDC motor provides the necessary power and torque to operate the cleaning equipment efficiently underwater (compact size, high efficiency, precise speed control).

3. The key components would include a dc motor, an intake hose or nozzle, and filteration bag to capture particles. The motor creates a pressure difference that causes air to be drawn in, carrying debris with it into the collection tank.

4. The filteration bag is used to capture the debris that are found in tank's surface. It will also capture large debris such as stones, leaves, twigs, that may have fallen into tank, or other sizable particles from entering the potentially clogging the cleaning equipment or the plumbing system.

3. TECHNICAL SPECIFICATION

The water suction and filtration process is shown in fig.1, for which it uses water suction element from which it will take in the water and the debris of tank's surface that will go through primary porous element. An 800 LPH high flow suction pump will create pressure difference causes air to be drawn in carrying debris with it into the secondary filter element and the water flow sensor will sense water flow after that clear water will be come out.

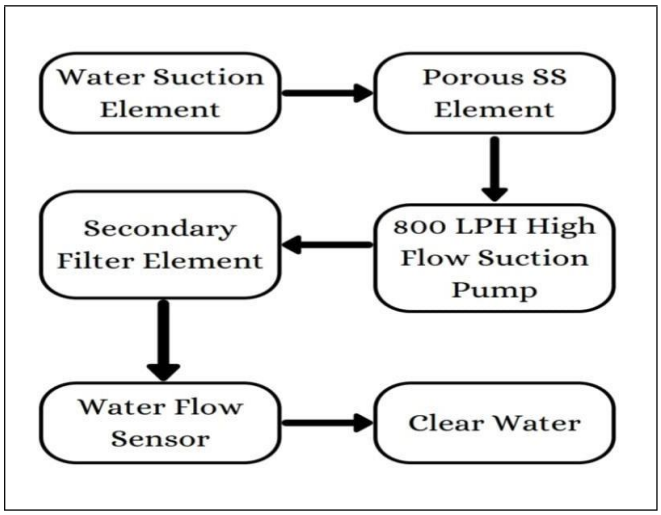

Fig.1.Water Suction And Filteration Process

The controlling mechanism is shown in fig.2, it uses arduino microcontroller displayed by 16*2 LCD display, and it takes input from robot control switches, filter switches, and water flow sensor and gives output to relay, relay driver and buzzer. As arduino and camera module works on 5 V DC, it uses SMPS that convert 230 V AC to 12 V DC, and gives input to buck converter that convert 12 V DC to 5 V DC. The relay and relay driver gives output to 230 V AC water pump, left motor and right motor to drive the wheels of the system

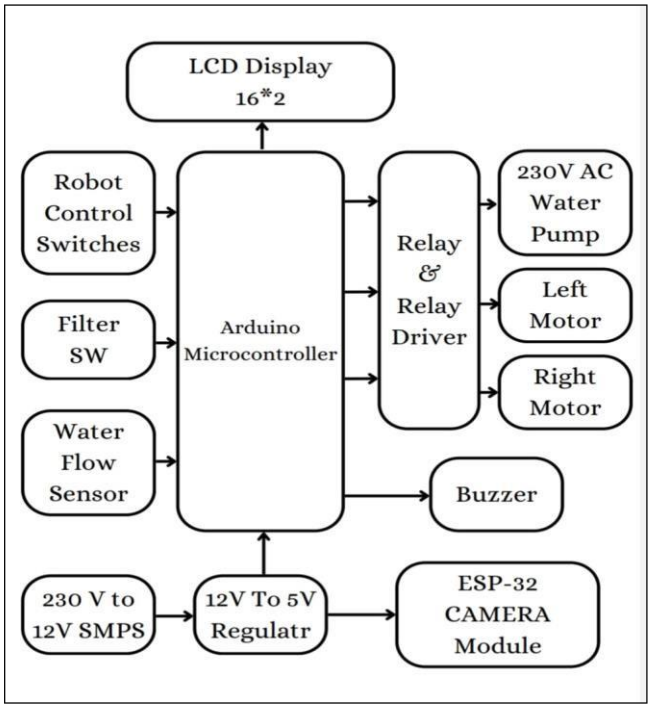

Fig.2.Controlling Mechanism

Fig.3 shows the image of motor used to suck water from tank

Fig.3.Motor

Fig.4 shows the image of water flow sensor that the system uses to sense the water flow

Fig.4.Flow Meter

Fig.5 shows the image of porous bag that works as garbage bag in the system

Fig.5.Filteration Bag

Table .1.Components Used

Sr.No	Components Used
1.	Brushes
2.	Suction Pipe
3.	SMPS
4.	Motor Controlling Switch
5.	Diaphargam Water Pump
6.	Porous Bag
7.	Wheels
8.	PMDC Motor
9.	Thermistor (To protect motor from heat underwater)
10.	Buck Converter
11.	Cam Development Board

3. ADVANTAGES

Electrically operated tank cleaning robot offer several advantages:

1. **Efficiency:** They can clean tanks quickly and thoroughly, reducing downtime for the tank and increasing operational efficiency.

2. **Safety:** By operating underwater, these machines eliminate the need for human divers to enter the tank, reducing the risk of accidents and injuries.

3. **Improved Water Quality:** Cleaning should lead to improved water quality within the tank, ensuring that it meets required standards for its intended use, whether it's for drinking water, industrial processes, or other purposes.

4. **Precision**: These machines are designed to clean every corner and surface of the tank, ensuring a thorough cleaning and preventing the buildup of sediment and contaminants.

5. **Environmental friendliness:** They often use eco-friendly cleaning agents and reduce the need for excessive water usage, contributing to environmental sustainability.

6. **Cost-effectiveness**: While the initial investment may be significant, the long-term savings in terms of reduced labor costs, decreased downtime, and extended tank life can make Electrically operated tank cleaning robots a cost-effective solution.

7. **Automation and Control:** Ideally, the system should offer automation and control features to streamline the cleaning process, allowing operators to monitor and adjust cleaning parameters as needed.

8. **Adaptability**: Many Electrically operated tank cleaning robots are versatile and can be customized to fit various tank sizes and configurations, making them suitable for a wide range of industrial applications.

4. CONCLUSIONS

In conclusion, the "Electrically operated tank cleaning robot" represents an innovation in the field of underwater maintenance, offering a comprehensive solution for efficientlycleaningdebrisfromtank'ssurface. By leveraging a PMDC motor, diaphragm water pump, and porous bag in conjunction with features like a suction pipe, thermistor, and Cam Development Board (ESP32), the system ensures thorough cleaning while prioritizing safety and durability. Incorporating SMPS and motor controlling switching enhances power distribution efficiency, while the integration of brushes for algae removal and a buck converter for optimized functionality further solidifies its effectiveness.

5. ACKNOWLEDGEMENT

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