FROM THEORY TO IMPACT: NEW VISIONS ACROSS DISCIPLINES

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Editor-in-Chief
Daniel James

ASDF UK

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AUTOMATIC WATER TANK CLEANER

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ABSTRACT

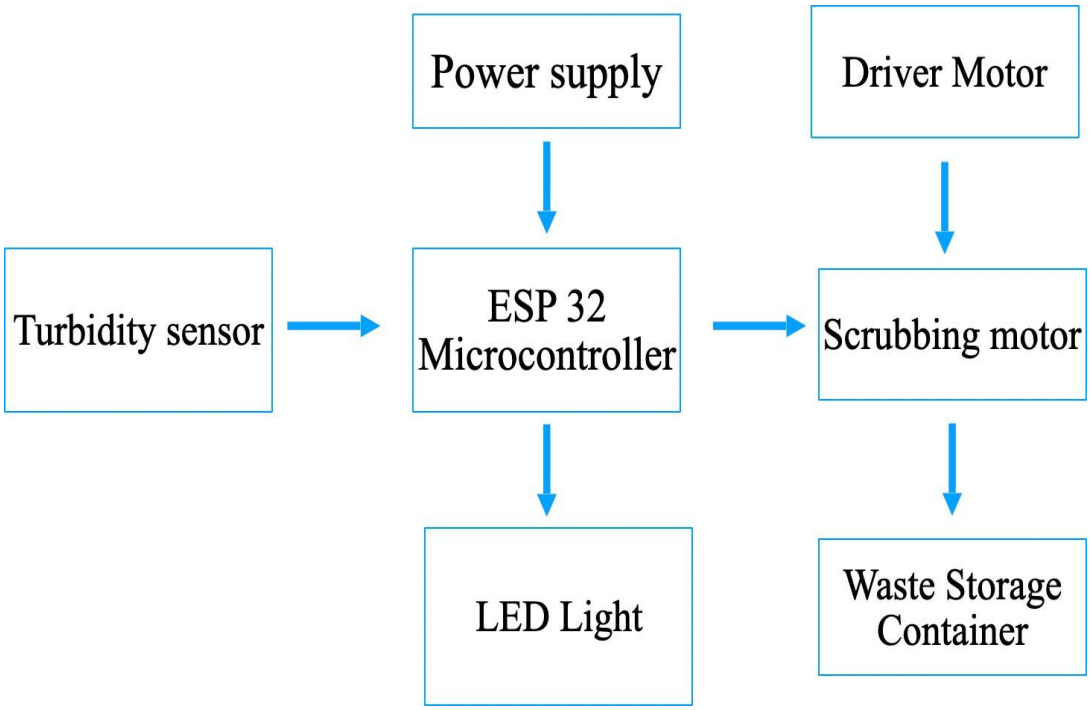
The accumulation of algae and impurities in water tanks is a common issue in domestic and industrial sectors, impacting water quality and hygiene. This system proposes an Automatic Tank Cleaner System that uses advanced sensors to detect algae growth and manage tank cleanliness efficiently. This system is designed to operate autonomously, reducing manual effort and ensuring consistent cleaning schedules. It enhances water quality while conserving resources by minimizing water wastage during cleaning. This innovative solution is scalable for both small domestic tanks and large industrial water storage systems, ensuring safe and hygienic water storage. This project presents an Automatic Tank Cleaning System that works, when the turbidity sensor sense the algae, sends a data to ESP32 Microcontroller and starts the scrubber to clean after the cleaning process over suck the all water and transfer the dirty water to container on the same time the cleaning process duration was indicate through LED display. This process was continuously repeating periodically. The benefit of this system is to reduce the human intervention, eliminate bacterial infection and maintain the water purity that influences a human health.

Keywords: Microcontroller, ESP 32, Motor Driver, Sensor

INTRODUCTION

Water tanks are prone to algae buildup, sediment accumulation, and bacterial growth, which can affect water quality and hygiene. In Earlier days, the tank cleaning process is to enter the human in to the overhead tank and scrubbing the tank by using scrubber with chemicals. Before that the tank is completely drained out, this whole process is time consuming and wastage water. The solution of this, I propose an Automatic Tank Cleaner a smart, self-operating system that detects water turbidity and efficiently removes impurities using a scrubbing mechanism. This system utilizes an ESP32 microcontroller, a turbidity sensor to monitor water quality, a lead screw- driven scrubbing mechanism, flow sensors, and a pump motor to remove dirty water. By automating the cleaning process, the device ensures better water hygiene, reduces maintenance efforts, and extends the lifespan of water storage systems. Most of infections are caused by consuming impure water. Even though we use RO system and water purifier, the main source of water is a tank that we use in domestic and industrial sectors. Most of us don't know the main cause of these infections. My automatic tank cleaner project eliminates the problem and brings up a lifesaving solution too.

. Methodology:



The Automatic Tank Cleaner operates by continuously monitoring water quality and initiating the cleaning process when necessary. A turbidity sensor detects the level of impurities in the water, and when it exceeds a predefined threshold, the ESP32 microcontroller activates the cleaning mechanism. The system uses a lead screw-driven scrubber, which moves along the inner walls of the tank, effectively dislodging accumulated dirt, algae, and sediments. The scrubbing motor rotates the brush to ensure thorough cleaning. As the scrubbing process takes place, flow sensors monitor water movement, and a pump motor is activated to remove the contaminated water from the tank. Once the cleaning process is complete, fresh water is refilled to restore the tank's water level. The turbidity sensor then rechecks the water quality, and if the clarity is still below the desired level, the system repeats the cleaning cycle until the water is clean. The system can function on a scheduled cleaning cycle or be manually triggered as needed. Additionally, the cleaning duration and sensitivity settings can be customized based on tank size and contamination levels. This automated process ensures efficient cleaning, reduces water wastage, and eliminates the need for manual intervention while maintaining high water hygiene standards.

Hardware Aspects:

The following components are used in the system, such as ESP 32 Microcontroller, Turbidity sensor, driver motor, Scrubber Motor, water pump motor and LED.

ESP8266 is a smaller sibling of the ESP32 that also features built-in Wi-Fi. It is widely used for IoT applications and supports the Arduino IDE. A **sensor** is a device that detects changes in physical conditions—such as temperature, light, pressure, motion, or chemicals—and converts that information into an electrical signal that can be read and processed by a controller like a microcontroller or computer.

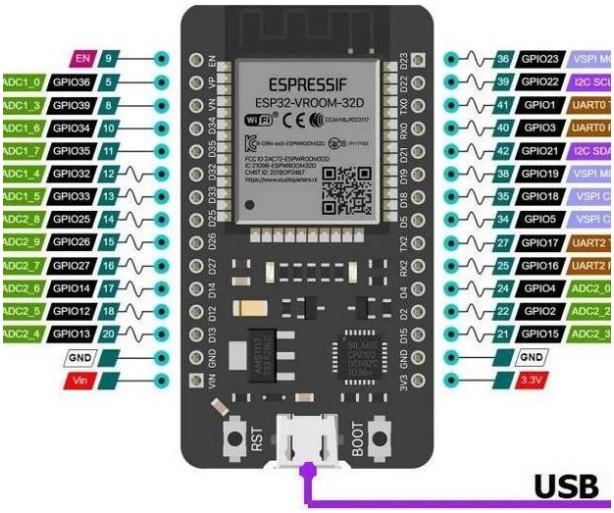


Fig 6.1 Esp32 Microcontroller

A turbidity sensor is a device used to measure the cloudiness or haziness of a liquid, caused by suspended particles such as dirt, algae, and sediments. It works by emitting light (usually infrared or laser) through the liquid and measuring how much light is scattered or absorbed.

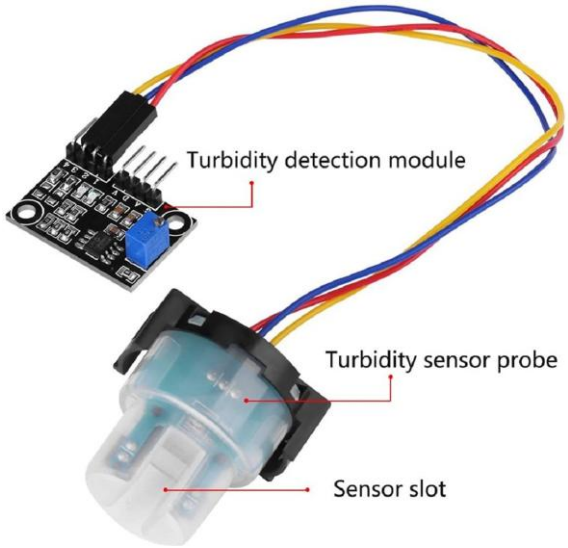


Fig 7.1 Turbidity Sensor

Real-Time Water Quality Monitoring – It continuously checks the clarity of the water, ensuring that cleaning is only triggered when necessary. Automated Cleaning Activation – When turbidity levels exceed a preset threshold, the system automatically starts the cleaning process, reducing manual effort. Efficient Water Management – The sensor ensures that only contaminated water is removed, minimizing water wastage. Ensures Hygiene and Safety – By detecting impurities like dirt and algae, it helps maintain clean water for longer periods, preventing bacterial growth. Customizable Sensitivity – The sensor's sensitivity can be adjusted to different tank conditions, making it flexible for various water storage needs.

A turbidity sensor measures the cloudiness (impurity level) of water by detecting the amount of light scattered by suspended particles. The L298N motor driver is a dual H-Bridge motor driver IC used for controlling the direction and speed of DC motors and stepper motors. It is widely used in robotics, automation, and embedded system applications. The module can handle high currents and voltages, making it suitable for driving medium-power motors

The L298N motor driver is a dual H-Bridge motor driver IC used for controlling the direction and speed of DC motors and stepper motors. It is widely used in robotics, automation, and embedded system applications. The module can handle high currents and voltages, making it suitable for driving medium-power motors. The L298N motor driver operates based on the H- Bridge configuration, which allows motors to rotate in both forward and reverse directions by controlling the polarity of the voltage applied to the motor terminals. Each motor channel has two input pins (IN1 & IN2 for Motor A, IN3 & IN4 for Motor B), which determine the motor's direction. If IN1 is HIGH and IN2 is LOW, the motor moves forward, whereas if IN1 is LOW and IN2 is HIGH, the motor moves in reverse. When both inputs are LOW or HIGH, the motor stops. Additionally, the ENA (Enable A) and ENB (Enable B) pins control the speed of Motor A and Motor B, respectively, using Pulse Width Modulation (PWM). A higher PWM duty cycle results in a higher speed, while a lower duty cycle slows the motor down.

A scrubber is a cleaning mechanism that physically removes dirt, algae, and sediments from surfaces using a brush, sponge, or abrasive material. In your Automatic Tank Cleaner, the scrubber is responsible for cleaning the inner walls of the tank by scrubbing away accumulated impurities.

USES OF SCRUBBER

- Effective Cleaning – Unlike chemical treatments or just flushing water, a scrubber physically removes dirt, algae, and biofilm buildup from the tank walls.
- Compatible with Automation – When attached to a lead screw mechanism, the scrubber can move systematically across the tank, ensuring complete coverage.
- Customizable for Different Contaminants – The scrubbing material can be chosen based on the level of dirt, from soft sponge-like materials for delicate surfaces to stiff brushes for tough stains.
- Reduces Manual Effort – Instead of manually scrubbing the tank, the automated scrubber ensures consistent cleaning without human intervention.
- Water Conservation – A scrubber reduces the need for excessive water use by efficiently removing dirt before rinsing, minimizing water wastage.

A Light Emitting Diode (LED) is a semiconductor device that emits light when an electric current passes through it. LEDs are energy-efficient, long-lasting, and come in various colors and brightness levels, making them ideal for visual indicators in electronic systems.

Uses of LED

- Status Indication – LEDs can show different states of the system (e.g., cleaning in progress, cleaning complete, water dirty, water clean).
- Low Power Consumption – LEDs require minimal power, making them ideal for battery-operated or energy-efficient systems.
- Real-Time Monitoring – Different LED colours can indicate system status, helping users quickly understand the cleaning process.
- Durability and Longevity – LEDs last for thousands of hours, ensuring reliable operation without frequent replacements.

- Easy Integration – LEDs are simple to connect with microcontrollers like ESP32, requiring only a resistor and a GPIO pin.

Water Pump Motor

Fig: Water Pump Motor

A water pump motor is an electrically powered device that moves water from one place to another. It creates pressure to push or pull water, making it useful in various applications, including water filtration, circulation, and drainage.

Uses of:

1. Efficient Water Removal – It helps drain out dirty water after the cleaning process, ensuring only clean water remains.
2. Automated Operation – Controlled by the ESP32, the pump activates when needed, reducing manual effort.
3. Maintains Water Hygiene – By removing contaminated water, it prevents bacteria and algae buildup.
4. Customizable Flow Rate – Different pump sizes allow you to control how quickly water is removed or refilled.
5. Compact & Reliable – Small DC pumps are easy to install and consume low power while providing effective performance.

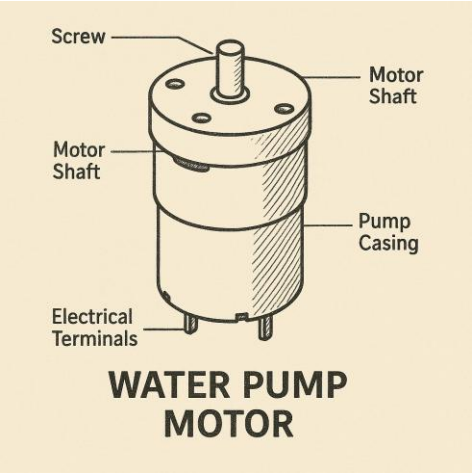


Fig 11.2 Water Pump Motor Sketch

The water pump motor removes dirty water from the tank after scrubbing and can also refill clean water.

Advantages & Applications

Advantages

- **Fully Automated Cleaning** – No need for manual scrubbing; the system detects dirt and cleans the tank automatically.
- **Improved Water Hygiene** – The turbidity sensor ensures the tank is cleaned only when needed, reducing bacterial and algae growth.
- **Efficient Water Management** – The water pump removes dirty water, ensuring minimal wastage while maintaining cleanliness.
- **Time-Saving** – Eliminates the need for frequent manual cleaning, making it ideal for households, industries, and water storage facilities.
- **Low Maintenance** – The lead screw-driven scrubber ensures effective cleaning with minimal wear and tear.
- **Energy-Efficient** – The ESP32-based control system optimizes power usage, ensuring the system runs only when necessary.
- **Customizable & Scalable** – The system can be modified for different tank sizes and cleaning needs by adjusting the scrubber speed, pump power, and sensor sensitivity.
- **Remote Monitoring** (Optional) – Can be integrated with Wi-Fi to send alerts about water cleanliness or system status to a mobile app.
- **Cost-Effective** – Reduces the frequency of professional cleaning services, saving maintenance costs over time.
- **Eco-Friendly** – Uses minimal chemicals and water, promoting sustainable cleaning methods.

Applications

- **Household Water Tanks** – Ensures clean and hygienic water storage in homes by automatically removing dirt, algae, and sediments.
- **Industrial Water Storage** – Used in factories and manufacturing units to maintain clean water tanks for various processes, preventing contamination.
- **Agricultural Water Tanks** – Helps in maintaining clean water storage for irrigation and livestock use, preventing algae buildup.
- **Hospitals & Healthcare Facilities** – Ensures safe and clean water supply, reducing the risk of bacterial contamination.
- **Hotels & Restaurants** – Keeps water tanks clean for cooking, cleaning, and customer use without frequent manual maintenance.
- **School & College Water Tanks** – Ensures safe drinking water for students and staff by preventing dirt and microbial growth.

- **Public Water Supply Systems** – Can be implemented in municipal water storage units to improve water quality before distribution.
- **Swimming Pools & Water Reservoirs** – Helps in keeping water clean by preventing the accumulation of dirt, algae, and biofilm.
- **Aquariums & Fish Tanks** – Can be modified for cleaning large fish tanks or aquariums without disturbing aquatic life.
- **RO Plant & Filtration Systems** – Useful in maintaining clean storage tanks in reverse osmosis (RO) plants and other water treatment facilities.

CONCLUSION

The Automatic Tank Cleaner is an efficient and smart solution for maintaining clean water storage tanks without manual intervention. By integrating an ESP32 microcontroller, turbidity sensor, lead screw-based scrubber, and water pump, this system ensures effective cleaning by detecting dirt levels and automatically initiating the cleaning process. The automation not only improves water hygiene but also saves time, reduces maintenance costs, and conserves water. With its applications in households, industries, hospitals, agriculture, and public water storage, this project offers a practical and scalable approach to water tank maintenance. Further enhancements, such as IoT integration for remote monitoring, can improve functionality and user convenience. Overall, the Automatic Tank Cleaner is cost-effective, eco-friendly, and time-saving solution for ensuring clean and safe water storage.

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