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Eco-Flow: Water Management SystemUsing UV Sterilization

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Abstract: In our contemporary world, the accessibility of clean and potable water is a pervasive issue, particularly in residential complexes and apartment buildings where shared waterstorage facilities pose a significant challenge. The lack of awareness and diligence in maintaining these communal tanks exposes residents to waterborne diseases. The current hurdle in water monitoring and filtering systems is the creation of a cost- effective, scalable solution that can be easily implemented across diverse environments.

This project introduces EcoFlow, an innovative and budget- friendly solution for water level monitoring and purification. The system utilizes UV lights and activated carbon to efficiently filter water, eliminating harmful microorganisms and removing impurities, chemicals, and odors. By addressing the unique challenges of different regions, EcoFlow aims to contribute to the broader adoption of UV and activated carbon-based water treatment systems. Beyond its filtration capabilities, EcoFlow incorporates a real-time water level monitoring system, empowering users with vital information for sustainable and equitable access to clean water.

Keywords: Clean water access, UV lights, Activated carbon, Water treatment systems, Monitoring System

I. INTRODUCTION

In a world confronted by escalating environmental challenges, the fundamental need for accessible and uncontaminated water stands as a critical concern. Nowhereis this more evident than in the intricate web of residential complexes and apartment buildings, where a shared water storage facility becomes a nexus of both convenience and potential hazard. The urgency to address the pervasive issue of clean water accessibility is underscored by the unfortunate reality that deficiencies in awareness and diligence among society managements often result in inadequate maintenance of communal tanks.

This lack of attention to proper water storage maintenance exposes a considerable number of residents to the looming threat of waterborne diseases. From the debilitating impact of cholera and dysentery to the insidious spread of hepatitis A and typhoid, the potential health risks associated with compromised water quality within these shared environments are significant and far-reaching. It is within this challenging landscape that the need for innovative, efficient, and scalable water treatment solutions becomes paramount.

The contemporary hurdles in water monitoring and purification systems further compound the complexities of this issue. Despite the advancements in technology, the development of cost-effective and easily implementable solutions that cater to the diverse environments of residentialcomplexes remains an unmet challenge. Bridging this gap between necessity and implementation is the driving force behind the EcoFlow project, a groundbreaking initiative poised to revolutionize water management in shared living spaces.

EcoFlow represents a beacon of hope in the realm of water treatment, offering an innovative, budget-friendly solution tailored to the unique challenges posed by residential complexes. At its core, the project harnesses the synergisticpower of UV lights and activated carbon to ensure the efficient filtration of water. The incorporation of UV lights provides a robust mechanism for disinfection, targeting andeliminating harmful microorganisms that pose a constant threat to public health.

Simultaneously, the integration of activated carbon, recognized for its exceptional adsorption properties, plays apivotal role in the removal of impurities, chemicals, and odors from the water. This dual-action approach not only guarantees a clean and safe water supply but also addressesthe nuanced contaminants that often evade conventional purification methods.

Beyond its formidable filtration capabilities, EcoFlow distinguishes itself through the incorporation of a real-time water level monitoring system. This innovative feature empowers users with the ability to stay informed about waterlevels, transforming water resource management from a passive necessity to an active and informed process. The user-friendly design and low-maintenance attributes of EcoFlow contribute to its viability as a comprehensive solution, ensuring not only the purification of water but also the sustainable and equitable management of this precious resource.

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In essence, EcoFlow emerges as a transformative force, not merely addressing the immediate challenge of water purification but also laying the foundation for a holistic and sustainable approach to water management in residential environments. As the world grapples with the imperative of securing clean water access for all, EcoFlow stands as a beacon of innovation, demonstrating that through thoughtful design and technology, we can surmount the barriers to a future where clean water is not a privilege but a universally accessible necessity.
The LCD display incorporated into the water level monitoringsystem accurately depicts the percentage of water level withinthe tank.

A. Materials/Components/Flowchart/BlockDiagram/Theory

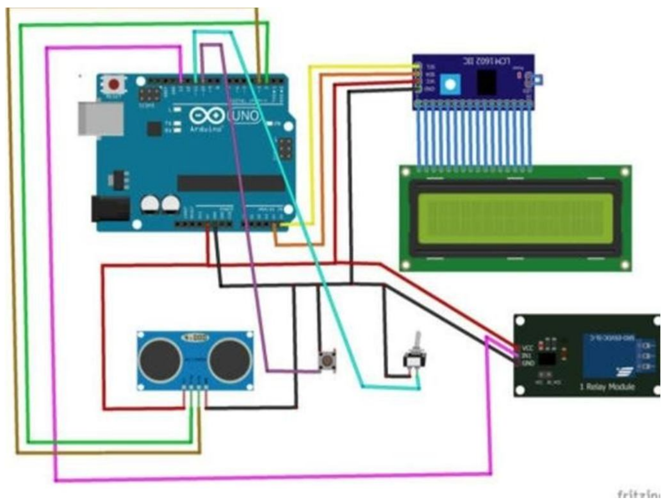

Fig 1.1 – Circuit diagram to measure the water level.

B. Design

1) Arduino Microcontroller

As the central processing unit of the system, the Arduino microcontroller plays a pivotal role in orchestrating the operations. Its versatility and ease of programming enableit to serve as the primary interface between the various hardware components. Through custom-coded routines, the Arduino facilitates data acquisition from the voltage sensor and manages communication with the ESP 8266 module.

2) Ultrasonic Sensor

An ultrasonic sensor is a device that uses ultrasonic soundwaves for various sensing applications. It operates on the principle of sending out ultrasonic waves and then measuring the time it takes for the waves to bounce back after hitting an object. The sensor uses the speed of soundin the air to calculate the distance to the object.

3) Relay Module

A relay module is an electronic device that consists of one or more relays, switches, and other supporting componentsintegrated onto a single circuit board. The primary purposeof a relay module is to control high-voltage or high-current circuits using low-voltage microcontroller signals or other low-power control signals.

C. Interconnection and Communication Protocols

The amalgamation of Arduino with the ultrasonic sensor, relay module, and LCD display ensures a robust, adaptable, and error-free data transfer system, contributingto heightened reliability in its overall performance.

1) *Data Visualization:* The ultrasonic sensor positioned at the apex of the tank is designed to monitor the water level.In the event of the tank being empty, an indicator bulb willilluminate, signifying the depleted state of the tank.
   Conversely, when the water level reaches its maximum capacity within the tank, the indicator bulb will remain inactive, serving as an indication that the tank is full. This configuration ensures a clear and intuitive visual representation of the tank's status, enhancing user awareness and facilitating timely actions in response to thewater level conditions.

2) *Remote Control and Monitoring:* Users have the capability to assess the water quality and ascertain the percentage of water content through a prominently displayed LCD interface. Additionally, users can remotely monitor the system's performance, enabling them to make well-informed decisions based on the comprehensive results provided by the system. This feature enhances the user's ability to stay apprised of the water quality status, fostering proactive decision-making for optimal system management..

II. LITERATURE REVIEW

Performance of activated carbon in water filters by Y. K. Siong, J. Idris, and M. Mazar Atabaki presents a conceptual model for water and wastewater filtration processes. The model is compared with laboratory experiments, highlighting the importance of both particle destabilization and particle transport in achieving efficient filtration. Drawing parallels with coagulation and flocculation processes, the study underscores the role of effective coagulants as "filter aids" and identifies a critical particle size threshold for optimal filtration. The abstract concludes by outlining the applications of these concepts to water and wastewater treatment. [1]

Das and Nath present an automated marine surface trash cleaner designed to address water pollution in national rivers. The system, operated via remote control, targets various pollutants such as wastes and plastics, inaccessible to manual cleanup efforts. Utilizing RF remote connection and GSM technology, along with an Arduino interface, the cleaner efficiently navigates and collects trash. With a motorized conveyor belt and sensor-equipped bin, the system reduces the need for manual labor, making it cost-effective. This innovation holds promise for mitigating water pollution and promoting environmental sustainability.[2]

Paidalwar and Khedikar provide an overview of water disinfection using UV technology, highlighting its common use in developed countries. UV irradiation, generated through electric arcs in mercury or xenon vapor, effectively inactivates most microorganisms with the optimal wavelength falling between 200 and 280 nm. While viruses and certain protozoa exhibit higher UV resistance, bacteria and cysts of Cryptosporidium and Giardia are more susceptible. The dose-response relationship in UV disinfection is governed by factors like lamp output, distance, water transmittance, and flow rate.[3] The study aims to analyze the literature on UV disinfection, emphasizing the effectiveness against various pathogens.

Updhya, Kumar, P, and Naik from KSIT, Bangalore, propose a miniature water purifier based on IoT to address global water pollution concerns. Utilizing a TDS sensor, [4] the system continuously measures water. purity levels, triggering alerts via IoT technology if the values fall below pre-defined thresholds. Additionally, temperature sensors monitor water temperature, while a water flow sensor tracks flow rate and quantity. Information on temperature, ppm values, and water flow is displayed on an LCD and communicated to users via mobile apps. Keywords: TDS, PPM.

Yao, Habibian, and O'Melia of the University of North Carolina present a conceptual model for water and wastewater filtration processes, comparing it with laboratory experiments. They emphasize that efficient filtration requires both particle destabilization and transport. Similar to coagulation, effective coagulants act as "filter aids." Particle transport mirrors flocculation processes, with particle size dictating the mode of transport: smaller particles diffuse while larger ones are intercepted and settle. The paper discusses the application of these concepts to water and wastewater filtration, offering insights for improved water treatment practices.[5]

[6] Provide an overview of membrane and filtration techniques for surface water treatment, addressing the increasing pressure on natural water resources due to population growth. Microfiltration/Ultrafiltration (MF/UF) effectively removes bacteria and acts as pre-treatment for Nanofiltration/Reverse Osmosis (NF/RO) to prevent fouling. [6] However, MF/UF membranes entail intensive production processes and may have limited applicability in less developed countries. NF is effective against certain contaminants, while RO is essential for desalination. Both NF/RO systems require significant pre-treatment and technical expertise, making them costly for developing countries. Slow Sand Filtration (SSF) and Rapid Sand Filtration (RSF) offer simpler alternatives, with SSF retaining solids and microorganisms and RSF optimizing land use. Granular activated carbon (GAC) adsorbs organic compounds and can complement other methods in treating polluted water. Future research could explore GAC production potential further.

Introduce a novel membraneless water filtration method utilizing CO2. Traditional methods like microfiltration/ultrafiltration and reverse osmosis rely on membranes, leading to high pumping costs and fouling issues. In contrast, their approach exposes colloidal suspensions to CO2, inducing phoretic motion of particles through solute gradients. This directed motion enables scalable, continuous flow filtration with significantly lower energy consumption compared to conventional methods and minimal fouling. [7] The process offers a promising alternative for efficient water purification.

Evaluate the effectiveness of the SteriPEN, a handheld UV radiation device, for disinfecting drinking water for travelers. The study confirms a reduction of over 99.9% in bacteria, viruses, and protozoa, meeting manufacturer claims.

Various bottle geometries and water movement scenarios are examined to optimize effectiveness. Results show a mean reduction of over 99.99% of bacteria and 99.57% of spores when used correctly. However, trials without water agitation yield a slightly lower germ reduction rate. Spectral analysis reveals the device's maximal radiation intensity at 254 nm, ideal for bacteria inactivation. While UV-C rays are filtered out by bottle materials, larger containers may allow some UV-C to exit the water surface.
These findings emphasize the device's efficacy and provide insights for safe and efficient water disinfection during travel. [8]
Assess optimization techniques for improving water quality models, particularly focusing on the Water Quality Index (WQI) model for coastal waters. They highlight the importance of accurate indicator selection within the WQI framework to maintain good water quality status. The study evaluates eighteen feature selection (FS) techniques, including filter, wrapper, and embedded methods, to develop an efficient WQI model. Fifteen combinations of water quality indicators are constructed and assessed using various machine learning algorithms. Results suggest that the random forest algorithm is effective for selecting crucial indicators, while the deep neural network algorithm improves prediction accuracy when incorporating subsets identified by random forest. [9] .
The Multi-Stage Organic Water Filter System, developed by Eobin Alex George and Gaurav Tiwari of the Mansarovar Institute of Science and Technology in Bhopal, India, presents a sustainable and modular solution for purifying water contaminated with organic and biodegradable pollutants. [10] System offers an efficient and cost-effective approach that can be seamlessly integrated into existing water purification processes or implemented as a standalone system. The filtration system comprises multiple stages of filtration beds featuring plants tailored for treating the water passing through them. Key bio-pollutants targeted include food residue, animal wastes, and cooking wastes. Drawing inspiration from Root Zone Technology (RZT) for sewage water treatment, the system incorporates enhancements to address other shortcomings in RZT.

III. METHODOLOGY

Developing a water monitoring and filtering system using UV rays and activated carbon involves a systematic methodology. Here's a step-by-step guide:

1) Project Definition and Objectives
- Clearly define the goals of the water monitoring and filtering system, considering the targeted water quality parameters and the specific contaminants to be addressed.

2) Preliminary Research
- Conduct a literature review to understand existingtechnologies, best practices, and challenges in water treatment using UV rays and activated carbon.
- Identify any innovations or advancements in the field.

3) Site Assessment
- Evaluate the characteristics of the water source where the system will be deployed, including water quality, flow rates, and environmental conditions.
- Consider the specific needs and challenges of thecommunity or area.

4) Design Planning
- Develop a detailed system design, specifying the components, their configuration, and the integration of UV disinfection and activated carbon filtration.
- Consider factors such as energy requirements, spaceconstraints, and ease of maintenance.

5) Component Selection
- Choose UV lamps and activated carbon based on theirefficiency, durability, and compatibility with the water source.
- Consider factors such as UV dosage requirements foreffective disinfection.

6) Sensor Integration
- Integrate sensors for water quality monitoring, such asturbidity sensors, pH sensors, and temperature sensors.
- Choose sensors that provide real-time data and aresuitable for the targeted water quality parameters.

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7) Filtration System Setup

- Configure the activated carbon filtration system to ensureoptimal adsorption of impurities and contaminants.
- Design the UV disinfection chamber for effectivepathogen inactivation.
- Test the filtration system under controlled conditions.

IV. FUTURE SCOPE

1) Integration of IoT and Smart Technologies

Incorporate Internet of Things (IoT) technology for enhanced connectivity and remote monitoring. Smart sensorscan provide real-time data on water quality, filter status, and system performance, allowing for proactive management and preventive maintenance.

2) Renewable Energy Integration:

Focus on enhancing the sustainability of the system by integrating renewable energy sources such as solar or windpower to meet the energy demands of the UV filtration component. This can contribute to reducing the environmental impact and operational costs.

3) Customized Filtration Solutions:

Develop filtration systems that can be tailored to specific water quality challenges in different regions. Customizationbased on the unique composition of local water sources ensures the adaptability of the technology to diverse environmental conditions.

4) Water Quality Certification and Standards:

Work towards obtaining certifications and adhering to international standards for water quality. This can enhance the credibility of the technology and promote its adoption invarious sectors, including municipal water treatment and industrial applications

V. RESULTS AND DISCUSSIONS

A. Before Filtration:

1) Suspended Particles: The water sample from the societytank might contain suspended particles, sediment, and debris.
2) Microorganisms: Presence of bacteria, viruses, and othermicroorganisms may be possible, especially if the water source is not adequately treated.
3) Chemical Contaminants: Depending on the source, therecould be dissolved chemicals or contaminants in the water.
4) Turbidity: The water may appear cloudy or turbid due tothe presence of particulate matter.

B. After Filtration:

1) Removal of Particles: Activated carbon and filter spongeare effective in removing suspended particles and sediment,resulting in clearer water.
2) Microbial Inactivation: UV filtration is known for its ability to inactivate bacteria, viruses, and other pathogens,contributing to improved microbial quality.
3) Chemical Adsorption: Activated carbon is excellent atadsorbing organic compounds and certain chemicals, enhancing the taste and odor of the water.
4) Turbidity Reduction: Filtration, especially through thefilter sponge, aids in reducing turbidity and
5) improving water clarity.

Fig:- 1.2 Contaminated Water (Before filtration)

Fig 1.3 :- Filtered Water (After Filtration)

Sr No.	Position	Units	Results	Maximum Allowable Limits	Remark
1	Turbidity	NTU	12.4	5.0	Above limit
2	Ph	Ph Units	5.9	6.5-8.5	Below limit
3	Nitrates	Mg/L	1.1	10.0	Within limit
4	Phosphates	Mg/L	1.45	5.0	Within limit
5	Conductivity	uS/CM	87	1500	Within limit
6	Faecal Coliform	Cfu/100 ml	30	Nil	Above limit
7	Total Hardness	Mg/L	2.96	100	Within limit
8	Iron	Mg/L	0.109	0.3	Within limit
9	Fluoride	Mg/L	0.07	1.5	Within limit
10	Sulphate	Mg/L	1.3	250	Within limit

Fig:- Contaminated Water Report

Sr No.	Position	Units	Results	Maximum Allowable Limits	Remark
1	Turbidity	NTU	4.3	5.0	Within limit
2	Ph	Ph Units	7.2	6.5-8.5	Within limit
3	Nitrates	Mg/L	1.1	10.0	Within limit
4	Phosphates	Mg/L	1.45	5.0	Within limit
5	Conductivity	uS/CM	87	1500	Within limit
6	Faecal Coliform	Cfu/100 ml	21	Nil	Within limit
7	Total Hardness	Mg/L	2.9	100	Within limit
8	Iron	Mg/L	0.113	0.3	Within limit
9	Fluoride	Mg/L	0.078	1.5	Within limit
10	Sulphate	Mg/L	1.3	250	Within limit

Fig:- Filtered Water Report

VI. CONCLUSION

The water monitoring and filtering system employing filter sponge, activated carbon, and UV rays offers a comprehensive solution to water quality issues. By combining the mechanical filtration of the sponge, adsorption of activated carbon, and disinfection with UV rays, the system ensures the removal of impurities and pathogens, delivering safe and improved water quality. Its modular design allows scalability and customization, while real-time monitoring enhances responsiveness. The system reflects a commitment to sustainability, with potential for future advancements in smart technologies and renewable energy integration. Overall, it not only addresses immediate water quality needs but also sets the stage for evolving water treatment practices with environmental consciousness.

VII. ACKNOWLEDGMENT

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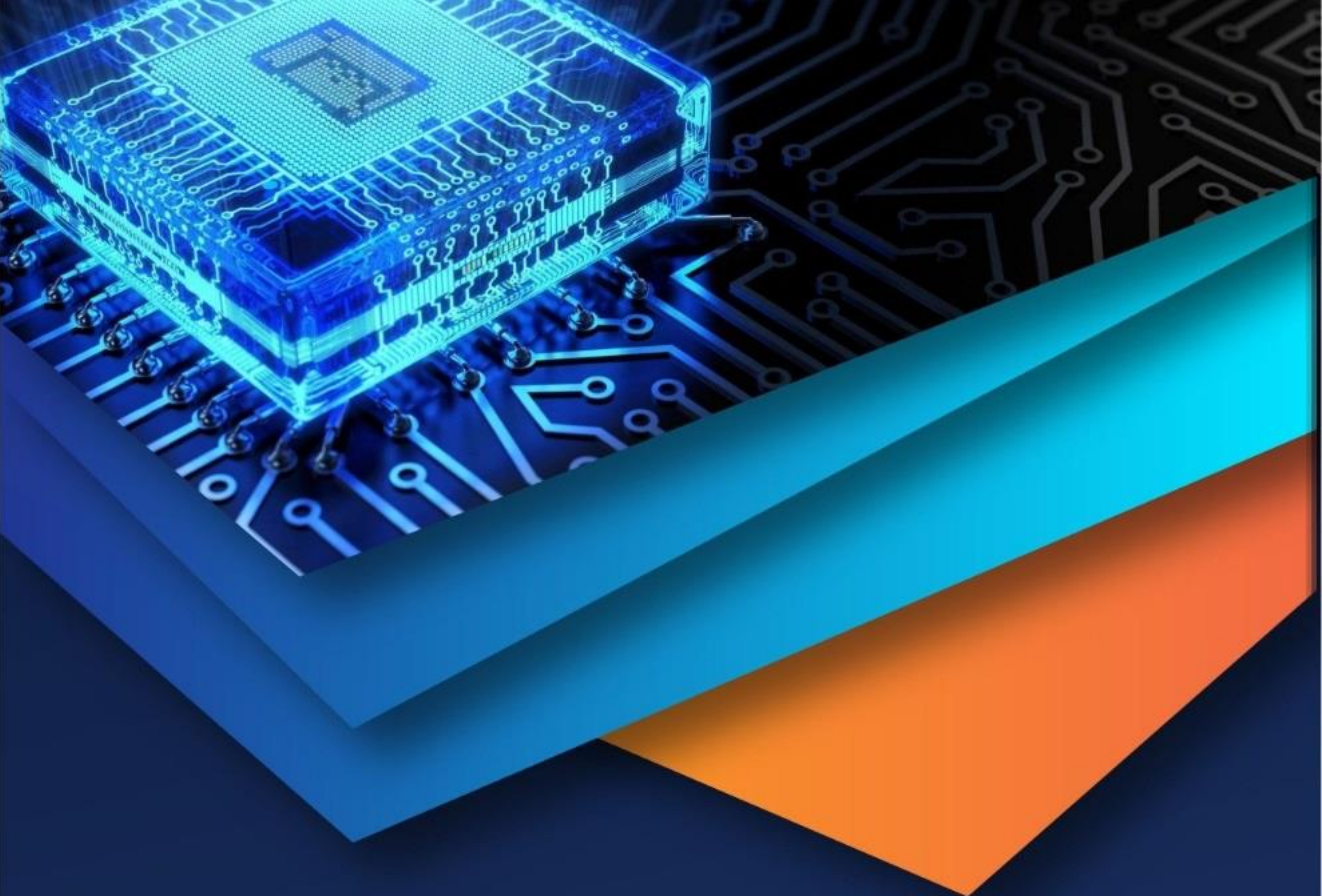
REFERENCES

[1] Eobin Alex George. Performance of Activated Carbon inWater Filters. IEEE 2020.
[2] Mukta Das, Shantanu Kumar Nath Automated marine surface trash cleaner in 2019
[3] Abhijeet Ashok Paidalwar,Isha.P Khedikar. Overview ofWater Disinfection by UV Technology Research Gate 2020.
[4] Vasudev Upadhya K S, Tejas P, Vignesh Kumar V, Praveen Tulsidas Naik, Praveen A. The paper “MiniatureWater Purifier based on IoT.

[5] Water and Waste Water Filtration: Concepts and Applications. Kuan-Mu Yao, Mohammad T. Habibian, and Charles R. O'Melia.
[6] Water and Waste Water Filtration: Concepts and Applications Kuan-Mu Yao,1 Mohammad T. Habibian, and Charles R. O'Melia2 Dept, of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, N. C. 27514
[7] Membraneless water filtration using CO2 by Sangwoo Shin1,*,w, Orest Shardt1,*,w, Patrick B. Warren2 & Howard A. Stone. IEEE
[8] Drinking water treatment with ultraviolet light for travelers — Evaluation of a mobile lightweight system.by Lisa F. Timmermanna,n , Klaus Ritterb , David Hillebrandtc , Thomas Küppera .
[9] Optimization of water quality index models using machine learning approaches. Author links open overlay panelFei Ding a, Wenjie Zhang a, Shaohua Cao b, Shilong Hao a, Liangyao Chen a, Xin Xie c, Wenpan Li c, Mingcen Jiang c.ELSEVER.
[10] Multi-Stage Organic Water Filter System. Eobin Alex George, Gaurav Tiware 2014 IEEE



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