JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

LOW-COST WATER PURIFIER

ESHWAR BIRADAR
ECE department
K. S. Institute of Technology

KIRAN DEV D
ECE department
K. S. Institute of Technology

KUSUMA V R
ECE department
K. S. Institute of Technology

MAHESH BIRADAR
ECE department
K. S. Institute of Technology

Dr. P N SUDHA
HOD, ECE Dept
K. S. Institute of Technology

ABSTRACT

A water purifier is a device that removes impurities from your drinking water. These impurities can include things like bacteria, viruses, chlorine, and lead. There are a few different types of water purifiers available, each with its own advantages and disadvantages. The most common type is a reverse osmosis (RO) system, which uses a semi-permeable membrane to remove contaminants. Other types of purifiers include ultraviolet (UV) filters, which use ultraviolet light to kill bacteria and viruses, and carbon filters, which remove chlorine and other taste and Odor-causing contaminants. Choosing the right water purifier for your home will depend on your specific needs and budget. Human activity has contaminated the world's water supplies. These human endeavors entail the discharge of industrial chemical waste into rivers and lakes. Water contamination is caused by a multitude of sources, including industrial waste disposal, population growth, and oil leaks. The earth's water resources include rivers, ice caps, glaciers, seas, and oceans.

Tainted water from taps or unclean sources can lead to cholera, dysentery, typhoid, diarrhea, and polio. Large pores in the membrane are employed in a technique akin to reverse osmosis.

Keywords: **Reverse osmosis, ultraviolet (UV) filters, carbon filters, contaminants.**

INTRODUCTION

The process of purifying water involves taking out unwanted chemicals, biological impurities, suspended solids, and gases. The waters and marine life are seriously threatened by unintentional oil leaks. Tainted water from taps or unclean sources can lead to cholera, dysentery, typhoid, diarrhea, and polio.Because arsenic and fluorides are components of contaminated water, diseases like arsenicosis are brought on by their presence. Water purification is the process of eliminating bacteria, unwanted chemicals, and suspended particles. Sand and suspended particles are eliminated from the water using a sediment filter, which is the main step in the purification process. Water colorants and unpleasant odors are eliminated from the water by using a carbon filter. The next step, known as UF filtering, removes germs, colloidal debris, and smaller pollutants. Large pores in the membrane are employed in a technique akin to reverse osmosis. UF filtration operates on regular water pressure; energy is not needed for it to function.

LITERATURE SURVEY

According to Raj. Kishore.S.(2021)[1], Naturally occurring materials, such as plane sand that has been passed through an IS sieve measuring 425 to 600 microns, and wood charcoal that has been gathered and ground into particles no larger than 10 mm, are used to remove iron. Additionally, anthracite with a size of 625 microns and below as well as manganese-modified sand of 850 microns were employed. In order to produce drinking water, the zinc, copper, and iron solution was prepared and passed through various adsorption processes. The result was that the heavy metal solution, which had a concentration of 6.00 to 5.00 ppm, was filtered out of the water to leave up to 0.3 to 0.1 ppm and maintain a pH of 6.5-8.5. Therefore, utilizing materials that are readily available locally, the oxidation-reduction method is utilized as a tool for evaluating and determining the concentration of residual iron and dissolved oxygen in the infiltrate. The primary disadvantage of this procedure was its increased power consumption.

Feedback Control for Drinking Water Purification Alvaro E. Gil and Kevin M. Passino [2]. The writers of this research study examine a few methods for treating raw water as well as the control measures that have been put out thus far to attempt and provide drinking water in a dependable manner. The variable raw water quality, seasonal variations in pH and temperature that affect disinfection efficacy, transport delays related to water transportation times, and the multiple-input, multiple-output nature of the issue (i.e., multiple chlorine sources and multiple water consumption points via multiple pipe paths) all contribute to the complexity of the control strategies suggested. The primary disadvantage of this procedure was the extremely high rate of corrosion.

Zahra Aghalarietal gathered information based on the inclusion and exclusion criteria as well as by doing a keyword search in publications published between 2008 and 2018 with an emphasis on the efficiency of waste water treatment systems in getting rid of bacterial agents [3]. Preferred reporting items for the systematic evaluations and meta-analyses (PRISMA) standards checklists were used to gather qualitative data. Information was added into the checklist after the accuracy of the articles was confirmed, including the initial author's name, the year the report was published, the types of analysis, sample numbers, purification technique, types of microbiological agents, and rates of microbial agent removal. Additionally, the United States Environmental Protection Agency (USEPA) requirement was compared to the clearance rate of the microbial agent mentioned in the study. The primary disadvantage of this procedure was the high rate of pipe clogs.

Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled “Industry4.0 as a Part of Smart Cities” [4] suggested a notion utilizing industry 4.0.The Internet of Things (IoT) will be utilized to produce so-called smart products, according to the industry 4.0 idea. The product's subcomponents each had their own intelligence. Enhanced intelligence is employed throughout a product's lifecycle, from its creation to its handling and disposal (smart processes). Additional significant elements of Industry 4.0 encompass the Internet of Services, specifically encompassing intelligent transportation and logistics (smart mobility, smart logistics), and the Internet of Energy (IoE), which establishes the appropriate utilization of natural resources (such as electricity, water, and oil). Industry 4.0 can be seen as a component of smart cities, and IoT, IoS, IoP, and IoE can be considered as an element that can connect the Smart City Initiative and Industry 4.0. The primary disadvantage of this procedure was the extremely high cost of model development.

Zhanwei Sun, Chi Harold Li, Chats Chik Bisdikian, Joel Branch and Bo Yang entitled “QOI-Aware Energy Management in Internet-of- Things Sensory Environments” [5]. This research examines an effective framework for energy management that can yield a good quality of experience (QOI) in IOT sensory contexts. In contrast to previous efforts, it maintains energy efficiency over time without compromising any achieved QOI levels and is transparent and compatible with lesser protocols in use. In particular, the novel idea of "QOI-aware sensor-to-task relevancy" takes into account both the QOI needs needed by a job and the sensing capabilities provided by a sensor to the IOT sensory environments. a brand-new idea for choosing the sensors to support a task over time: the "critical covering set" of every particular task. Decisions about energy management are done dynamically during runtime in order to maximize long-term traffic statistics while limiting service latency. The concepts and techniques presented in this paper are finally illustrated using a comprehensive case study that uses sensor networks to monitor water levels. Additionally, a simulation is created to illustrate the effectiveness of the suggested approach. The primary disadvantage of this procedure was its increased power consumption.

B.K. Nandi[6], This researcher talked about a low-cost ceramic percussor creation that was created utilizing affordable inorganic raw materials that were readily available locally, like sodium carbonate, quartz, boric acid, and sodium meta silicate, which are in the range of ceramic membranes that are below 75 microns. In order to create the ceramic filter, thermal, structural, and morphological analyses of the prepared membrane were conducted. The ceramic membrane was sintered at 800°C to 950°C in an oven to filter water from a solid, insoluble membrane. Water was passed through ceramic holes with sizes ranging from 0.185 to 0.323 µm and membrane porosities between 34.6 and 19.6% in order to test this. The oil rejection effectiveness of the membrane was found to be 98.8%. Pipe obstructions were the primary disadvantage of this procedure.

Mr. Anil K[7]. Rajvanshi and Amol Dalvi, Rural households can purchase an affordable solar water purifier from the Nimbkar Agricultural Research Institute in Phaltan, Maharashtra, India. The author has talked about a solar-powered water purifying technique. They purified the water in their system using a basic solar gadget. They began utilizing tubular solar collectors to heat water. By employing solar energy to heat water, all dangerous deposits were removed; however, in order to reach the appropriate temperature, the water must be heated till the following morning. The following morning, they had to pick it up. The water purification procedure requires a lot of time, just like this process. Furthermore, useless for this strategy are the wet seasons and the colder months. As a result, the time needed is extremely high, as though we desire a purifier with quick service. They also conducted an analysis and a survey on the number of days when the temperature will be over 45 degrees. The primary flaw with this technique was that it was affected by temperature.

Vishal. L[8], Presented is a water filter constructed of wooden charcoal, sand, and a plastic container. A cheap water filter made of sand and wooden charcoal is available. As a result, it is determined that the most straightforward and affordable method for removing iron is adsorption. Since sand is the least expensive adsorbing surface, it removes dissolved iron from drinking water very well and filters at a very high rate. The only drawback is the bacterial layer that later develops as a result of frequent use. Thus, washing is occasionally necessary. The primary disadvantage of this procedure was its increased power consumption.

The "LifeStraw" technology was initially established in 2005 for usage in emergency situations. It is being employed to purify water in both areas with a severe lack of clean water and in settings that are generated during tourist visits[9]. Membrane modules, activated carbon, prefilter grids, and plastic or metal enclosures make up this device. The filter's efficiency exceeds 1000 dm3, which is sufficient to give one person access to clean water for an entire year. The research done between 2010 and 2015 verified that 99.9% of the parasites (schistose, ascarids, etc.) and 99.9999% of the bacteria (Brucella melitensis, pyogenes Streptococcus) had been removed. The device's more intricate adjustments worked well against viruses. The device's high degree of water filtration can be explained by the usage of a cartridge membrane element with a hollow fiber structure. The primary disadvantage of this procedure was the extremely high rate of corrosion.

Department of Chemistry, J.L Chaturvedi College of Engineering, Nagpur, India. S.S Turkar, D.B Bharti and G.S Gaikwad[10]. There are several techniques used in water treatment to reduce pollution. The author suggests a number of waste water treatment techniques to reduce water contamination. The study delves into the various attributes of water, including its physical, chemical, biological, and radioactive properties. The physical characteristics that they established were hue, turbidity, and temperature. The chemical properties of water, such as its pH, hardness, and ability to dissolve substances. Biological features included viruses, bacteria, and protozoa. Additionally, they have distinguished between the criteria of waste water and natural water. There were various techniques, including thermal and fixation procedures, for treating hazardous pollutants in water. They also offer some data on the quantity of water contamination by state, broken down by year.

In a study Tanushree [11], Presented Tulsi and Neem leaves are used to purify water and reduce cheek coli-form in water samples by the use of fresh leaf juice, alcoholic leaf extract, and aqueous leaf extract. The antibacterial activity of plant leaf extract can be effectively achieved by the synergistic impact of the active components found in plant leaves. These provide sand and charcoal filtering in advance to lessen load contamination. The usage of carbonic acids was the primary flaw in this procedure.

Katadyn Group[12] is a Swiss company whose responsibility it is to supply food and drink to people in the field during conflicts and emergencies. The company sells water filters that are universal in nature, as well as tablets and gadgets that are used to cleanse surfaces. Among them are several gadgets meant for individual usage. The most common ones are the "KATADYN HIKER PRO" models, which have an activated carbon cartridge, a glass fiber cartridge, a ceramic prefilter, and a mechanical intake filter. - "KATADYN VARIO" is made up of an activated carbon cartridge, a glass fiber cartridge, a ceramic prefilter, and a mechanical intake filter. The "KATADYN POCKET" is made up of a ceramic filter with a 0.2-micron filtering rating and a mechanical filter mesh All of these filters get rid of dissolved particles, cysts, bacteria, protozoa, and algae. These ergonomic devices offer safe, high-quality drinking water. distributed for use by tourist groups, armed forces units, and philanthropic organizations. The primary flaw with this technique was that it was affected by temperature.

Ranjan Pandhare[13], Dr. Isha Khedekar conducted feasibility research on domestic water purifiers for rural areas. The study's main focus is on the viability of installing water purifiers in rural areas to shield family members—especially children—from water-borne illnesses. The Bhabha Atomic Research Centre designed the water filter utilized in this investigation, with design inputs from IIT Bombay. The utilization of nano membrane technology in purification is what sets this filter apart from others. It is affordable and practical for long-term use thanks to this membrane filter. This study is conducted in four villages in Gadchiroli's isolated and tribal districts, where the issue of water-borne illnesses is a serious concern. The primary disadvantage of this procedure was the extremely high cost of model development.

N. Corderio[14], Investigate the raw material as well as the outer bark layer, which has a higher cellulose fiber content. The primary component of the two types of materials, cooked banana trash, had a polysaccharide content that was high enough—between 60 and 70 percent—to warrant the pulping precautions. Moreover, there was relatively little lignin present. The comparatively high concentration of ashes and extractives was the only startling discovery. These residues were pulped by using soda, kraft, and soda-anthraquinone cooking methods. The optical pulping conditions involved cooking the residues for a brief period of time at 120°C in the presence of 0.25–0.35% anthraquinone. This takes thirty minutes. The use of Kraft pulping conditions, longer cooking durations, and higher cooking temperatures did not improve the performance of the rice. The primary disadvantage of this procedure was its increased power consumption.

Nerox Filters The NPP[15] "Simplex" firm started producing these filters more than 20 years ago. The Joint Institute for Nuclear Research invented the track membrane, which serves as the primary structural component of this filter. Studies show that these membranes are quite effective at removing heavy metals and microbiological pollutants. The polymeric films with a thickness of 10-23 microns are used to create the track membrane by subjecting them to high-energy krypton ions that penetrate the film. Individual ions of the destroyed material form channels in the route, with their physical and chemical characteristics different from those of the undamaged material the film treated with ions in the alkaline solutions at the track site produces identical cylindrical through holes during additional etching. Depending on the etching circumstances, the diameter of these apertures might vary from 0.05 to 3 microns. Utilizing a U-400 ion accelerator, which can produce up to 1012 ions per second for the JNII's nuclear processes, track membranes with pore densities between 105 and 109 pores per centimeter2 can be produced in large quantities. These membranes have a porosity of 10–15%. The primary characteristic of track membranes that sets them apart from other membrane types is their extreme selectivity. The primary disadvantage of this procedure was the extremely high cost of model development.

METHODOLOGY

The process of purifying water involves taking out unwanted chemicals, biological impurities, suspended solids, and gases. The waters and marine life are seriously threatened by unintentional oil leaks. Tainted water from taps or unclean sources can lead to cholera, dysentery, typhoid, diarrhea, and polio.Because arsenic and fluorides are components of contaminated water, diseases like arsenicosis are brought on by their presence. Water purification is the process of eliminating bacteria, unwanted chemicals, and suspended particles. Sand and suspended particles are eliminated from the water using a sediment filter, which is the main step in the purification process.

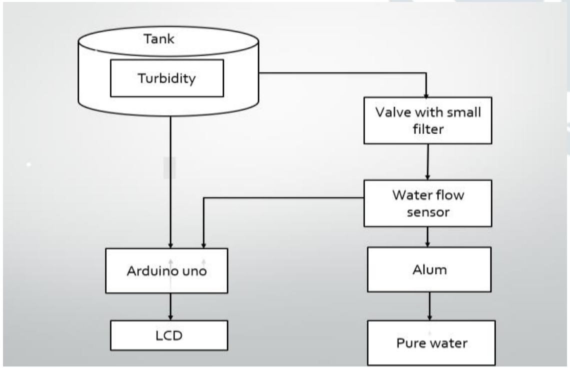


FIG 1: BLOCK DIAGRAM

In the block diagram we can see the sensor and turbidity being interfaced with the Arduino Mega board. Impure water is taken in a small container or tub. The turbidity of water is checked using Turbidity liquid particle detection sensor, if the water is of high turbidity, then it's taken out through an outlet and used for other utilities. And the obtained value of turbidity is displayed on LCD. Further mud particles or any impurities present is filtered. Then flow of the water from the filter is sensed and the obtained values are displayed on the LCD. Any mud particles or impure water can be further purified by using Alum. The obtained pure water is stored in a tank and used accordingly.

The turbidity module, a compact and powerful tool, plays a critical role in safeguarding water quality. By measuring the clarity of a liquid, it acts as a guardian, raising the alarm on the presence of unwanted particles that can impact everything from our drinking water to industrial processes. Let's delve deeper into the heart of this module, exploring its workings, applications, and the vital role it plays in various fields.

At its core, the turbidity module operates on a fundamental principle: the relationship between light and suspended particles in water. The module typically houses a light source, often an infrared LED, and a light detector positioned on opposite sides within a probe. When light travels through clean water, a large portion of it passes through unobstructed. However, as the water's turbidity increases – meaning there are more suspended particles like clay, silt, algae, or microorganisms – more light gets scattered and absorbed by these particles.

The turbidity module measures the amount of light that reaches the detector. By comparing this to the original intensity emitted by the light source, the module calculates the turbidity of the water sample. There are two main types of turbidity measurement techniques employed by these modules: nephelometry and forward scatter. Nephelometry measures the amount of light scattered by the suspended particles at a specific angle, typically 90 degrees. Forward scatter, on the other hand, focuses on the light that is directly transmitted through the sample but at a slightly forward angle compared to the source. The choice of technique often depends on the specific application and the size range of particles of interest.

For accurate measurements, turbidity modules require calibration. This involves using standards with known turbidity levels to adjust the module's response. Calibration ensures that the module translates the measured light intensity into meaningful turbidity units, often expressed in Nephelometric Turbidity Units (NTU) or Formazan Turbidity Units (FTU).

Turbidity modules don't operate in isolation. They are designed to interface with microcontrollers like Arduino or Raspberry Pi. These microcontrollers provide power to the module, receive the turbidity data, and can be programmed to take actions based on the readings. For instance, a turbidity module monitoring a water treatment plant can trigger an alarm if the turbidity levels exceed acceptable limits.

In the intricate world of fluid control, a unique breed of valves exists – the valve with a small filter. Though seemingly unassuming, these compact marvels play a vital role in protecting sensitive equipment, ensuring product quality, and maintaining system efficiency. Let's delve deeper int diverse applications where they reign supreme. A valve with a small filter combines the functionality of a traditional valve with an integrated filtration element. The valve body, typically constructed from durable materials like brass, stainless steel, or plastic, houses the control mechanism, allowing for flow regulation (opening, closing, or throttling). Nestled within this body is the heart of the filter – a finely meshed screen, sintered disc, or porous element. The specific filter media depends on the intended application and the size of particles it needs to capture.

The valve's control mechanism dictates fluid flow. Depending on the design, it could be a simple ball valve with a rotating handle, a butterfly valve with a pivoting disc, or a more intricate solenoid valve controlled electronically. Regardless of the type, the operator can precisely regulate the flow of fluid. Meanwhile, the integrated filter intercepts unwanted particles, protecting downstream components from damage, contamination, or malfunction.

All these are responsible for transmitting the required information to the authorities. This can be concluded by the following flowchart.

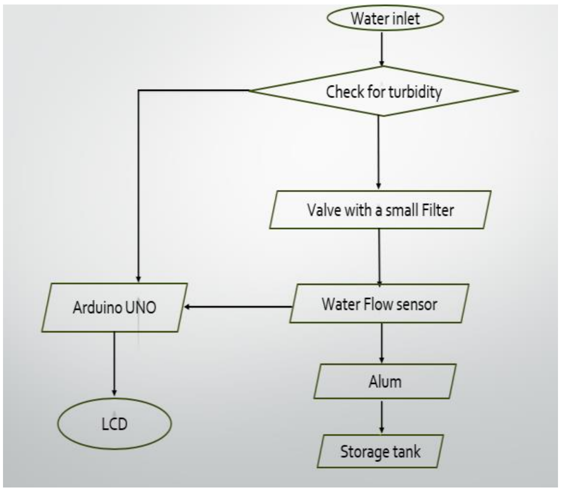


FIG 2: FLOWCHART

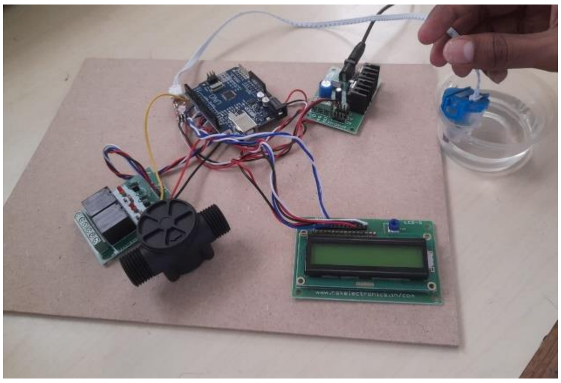
Above shows the flowchart for our proposed work on design of low cost water filter.

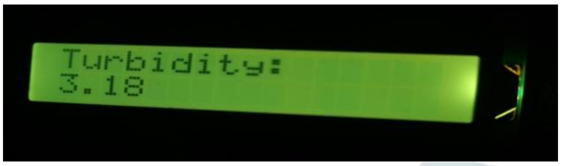
The water inlet consists of impure water. The impure water's turbidity is checked. If the turbidity value is less than 20 ntu then the water won't be the purified and purification is turned off. If the value of turbidity is more than 20, then the water purification process starts. the impure water goes to a valve with a small filter where the dust particles and mud particles are removed and the processed water is sent to the water flow sensor. The water flow sensor received the processed water. The filter checks for the speed of the water and this value is compared with the values dumped in Arduino. This value is displayed on the LCD.

The water from the water flow sensor is then treated with alum which changes the colour of the processed water to a clearer water.

This clean water is then sent to a storage tank where the water is stored and can be used for further applications.

RESULTS





The above picture represents our final working prototype.

The project to check the hardness of water has provided valuable insights in to the quality of water supply. Through rigorous testing and analysis, it was determined that the water source exhibits a certain level of hardness indicating the presence of minerals like calcium and magnesium.

This information is crucial for understanding the water suitability for domestic or industrial use.

In conclusion, designing a low-cost water purifier involves careful consideration of materials, simplicity in design, and effectiveness in purifying water. By utilizing commonly available materials such as plastic buckets, activated carbon, sand, and gravel, it's possible to create a basic yet functional water purification system.

REFERENCES

1. Alberta Environment, (2021). Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems. Pub No: T/840.

2. Alberta Environment, (2020). Guidelines for the Approval and Design of Natural and Constructed Wetlands for Water Quality Improvement. Pub No: T/518.

3. Alaska DEC, 2020. Alaska Department of Environmental Conservation: Division of Water. Accessed October, 2020:

4. AWWMA, 2019. Alaska Water and Wastewater Management Association. Accessed October 2019: http://awwma.org/, last updated October 4, 2019.

5. Barjenbruch, M., Erler, C., (2018). A performance review of small German WSPs identifying improvement options Water Science & Technology 51(12):43-49

6. Cameron, K.C., Madramootoo, C., Crolla, A., Kinsley, C., (2018). Pollutant removal from municipal sewage lagoon effluents with a free-surface wetland Water Research 37:2803-2812.

7. Canadian Council of Ministers of the Environment, (2017) Canada-wide Strategy for the Management of Municipal Wastewater Effluent.

8. The "LifeStraw" technology was initially established in 2005 for usage in emergency situations. It is being employed to purify water in both areas with a severe lack of clean water and in settings that are generated during tourist visits.

9. Department of Chemistry, J.L Chaturvedi College of Engineering, Nagpur, India. S.S Turkar, D.B Bharti and G.S Gaikwad.

10. Nerox Filters The NPP "Simplex" firm started producing these filters more than 20 years ago.

11. Ranjan Pandhare, Dr. Isha Khedekar conducted feasibility research on domestic water purifiers for rural areas.

12. http://www.dec.alaska.gov/water/index.htm; Regulation available at http://www.dec.state.ak.us/commish/regulations/pdfs/18%20AAC%2072.pdf