A

Project report

on

HARNESSING SOLAR ENERGY FOR WATER PURIFICATION SYSTEM

Submitted in partial fulfillment of the requirements for

the award of the degree of

BACHELOR OF TECHNOLOGY

in

ELECTRICAL AND ELECTRONICS ENGINEERING

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Rotarypuram Village, B K Samudram Mandal, Ananthapuramu – 515701

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SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY

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(Affiliated to JNTUA, accredited by NAAC with 'A' Grade, Approved by AICTE, New Delhi & Accredited by NBA (EEE, ECE & CSE)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Certificate

This is to certify that Project entitled **HARNESSING SOLAR ENERGY FOR WATER PURIFICATION SYSTEM** is the bonafide work carried out by **K.MOHAMMAD AKTAR** bearing Roll number **214G5A0210, K.NAMEERA ANJUM** bearing Roll number **204G1A0254, B.NANDHINI** bearing Roll number **204G1A0256, R.CHARITHA** bearing Roll number **204G1A0212, T.HITHENDRA** bearing Roll number **214G5A0205** in partial fulfillment of the requirements for of the degree of in **Bachelor of Technology** in ELECTRICAL AND ELECTRONICS ENGINEERING during the academic year 2023-24.

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Assistant Professor	Associate Professor & HOD

Date:

Place: Rotarypuram

EXTERNAL EXAMINER

DECLARATION

We hereby declare that the project report entitled "**Harnessing Solar Energy For Water Purification System**" submitted for the award of degree of Bachelor of Technology in our original work and the project report has not formed the basis for the award of any degree, diploma, associateship, orfellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any degree or diploma.

Place: Rotarypuram   Project Associates

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ABSTRACT

The integration of solar energy into a water purification system, aiming to enhance sustainability and efficiency. By leveraging photovoltaic technology, the system harnesses solar power to drive water treatment processes, reducing reliance on conventional energy sources.

The research investigates the synergies between solar energy utilization and water purification methods, evaluating the environmental and economic benefits. The Results indicate a promising approach for developing eco-friendly water treatment solutions, addressing both energy and water challenges concurrently.

Through the utilization of advanced materials and technologies, such as high-efficiency solar panels and innovative water treatment modules.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVATIONS

RO	Reverse-Osmosis
UV	Ultra-Filtration
UNICEF	United Nations Childers Fund
FISH	Fish Fluorescence in Situ Hybridization
PCR	Polymerase Chain Reaction
GAC	Granular Activated Carbon
RHA	Rice Husk Ash
TDS	Total Dissolved Salts
PV	Photo-Voltaic
SoC	System on Chip
IDE	Integrated Development Environment
VOC	Voltage Organic Compound
DC	Direct Current
MPPT	Maximum Power Point Tracking
AC	Alternate Current
UPS	Uninterrupted Power supplies
LED	Light Emitting Diode
LCD	Liquid Crystal Display

CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1 INTRODUCTION

In recent years, the intersection of renewable energy and water purification has gained significant attention as global concerns about energy sustainability and access to clean water escalate. This introduction outlines the pressing need for innovative solutions by presenting the challenges associated with traditional water treatment methods and the environmental impact of conventional energy sources.

Emphasizing the potential of harnessing solar energy, the introduction sets the stage for exploring how solar technologies can be integrated into water purification systems to create a more sustainable and efficient approach. It outlines the goals of designing a solar-powered water purificationsystem that not only addresses environmental concerns but also enhances the overall efficiency and accessibility of clean water.

Harnessing solar energy for water purification systems serves a dual purpose of addressing water scarcity while promoting sustainable energy usage. The unique objective lies in leveraging the sun's abundant and renewable energyto provide clean drinking water in an environmentally friendly and economically viable manner. By combining solar power with advanced purification technologies, the aim is not only to ensure access to safe water but also to reduce dependence on non-renewable energy sources, mitigating climate change impacts in the process. This inventive strategy not only meets immediate water demands but also fosters long-term environmental sustainability. andresilience, making it a transformative solution for communities worldwide.

All we know that solar energy is universal energy which is renewable source of energy. The sun creates its energy through a thermonuclear process that converts about 650,000,000[1]tons of hydrogen to helium every second. The process creates heat and electromagnetic radiation. The heat remains in the sun and is instrumental in maintaining the thermonuclear reaction. The electromagnetic radiation (including visible light, infra-red light, and ultra- violet radiation) streams out into space in all directions.

Methods of collecting and storing solar energy vary depending on the uses planned for the solar generator. The three types of collectors:

1. flat-plate collectors
2. focusing collectors
3. passive collectors

Flat-plate collectors are the more commonly used type of collector today. In this project also I am going to use flat plate collectors to produce electricity through solar energy. Most of our tools are designed to be driven by electricity, so if you can create electricity through solar power, you can run almost anything with solar power. The solar collector converts radiation into electricity.

In this project I am going to run water RO-UV water purification system by using solar energy. Among the renewable resources, only in solar power do we find the potential for an energy source capable of supplying more energy than is used.

Unpredictable negative environmental effects: If all the solar collectors were placed in one or just a few areas, they would probably have large effects on the local environment, and possibly have large effects on the world environment. The problem lies in the change of temperature and humidity near a solar panel; if the energy producing panels are kept non-centralized, they should not create the same local, mass temperature change that could have such bad effects on the environment. Unpredictable negative environmental effects:

If all the solar collectors were placed in one or just a few areas, they would probably have large effects on the local environment, and possibly have large effects on the world environment.

1.2 OBJECTIVE

The aim of my project is to purify water by using solar energy. Same for the purification I have selected two methods; those are UV & RO Processes. This project will be more beneficial in the rural areas where amount of energy is not sufficient. And purified water certainly neglected in such areas. Because of those many old people children are affected by water borne diseases.

According to the World Summit of Sustainable Development, the major reason for lack of safe water is either scarcity of water or contamination of water sources. Lack of safe drinking water is due to both lack of investment in water systems and inadequate maintenance of existing systems. About half of the water in drinking water supply systems in the developing world is lost to leakage, illegal hook-ups and vandalism. In some countries, drinking water is highly subsidized for those connected to the system, generally well-to-do people while poor must rely on either expensive private sellers or unsafe sources.

According to the UNICEF, lack of access to safe water is having a disastrous impact on children across the world. Reasons for this include shortage of water, poverty, and lack of education about the impact of drinking unpurified water. Nearly, 2.2 million children die annually from water borne diseases. The World Health Organization estimates that at any given moment, approximately one half of all peoples in the developing world are suffering from one or more of six primary diseases caused by poor water supply and suboptimal sanitation.

These six diseases are diarrhea, acaras, dracunculiasis, hookworm, schistosomiasis and trachoma. The economic impact on developing countries of large proportions of people suffering from such diseases is understandably dreadful. With an eye on developing nations, this project seeks to find sustainable, yet economically and socially practical solutions to the problems associated with polluted water. Many techniques such as chlorination, distillation, boiling, sedimentation, and use of high-tech filters have been utilized to purify water.

These methods, however, face major barriers such high price, maintenance, conservation of fossil fuels, and unhygienic waiting periods. Our proposed solution to this problem involves production of a low cost and effective water filter (Klar Aqua), which requires no electricity, besides being sustainable, it is environmentally friendly, easily implemented, and easily produced by a local Artisan.

The system eliminates bacteria, removes turbidity, has strong potentials to remove other common surface and ground water pollutants, requires no extra equipment to store pure water and its application can be tailored to regional social and cultural factors. The main objectives of the project are to produce filters that:

- Can effectively remove bacteria and other contaminants from drinking water
- Are easy for people to use
- Are easy for local potters to produce
- Have an acceptable flow rate (one that will not make people too impatient to us
- Are of little or no cost to users
- Can be easily implemented with an effective educational system
- Inspire users to practice good hygiene
- Inspire economic growth by promoting health and creation of jobs

1.3 PROBLEM SPECIFICATIONS

1.3.1 Water Borne Diseases

Class	Route Cause	Disease
Water-borne	Drinking contaminated water	Cholera, Amoebic dysentery, Bacillary dysentery (shigellosis), Cryptosporidiosis, Typhoid, Giardiasis, Paratyphoid, Balantidiasis, Salmonellosis, Campylobacter enteritis, Rotavirus diarrhoea, *E. coli* diarrhoea, Hepatitis A, Leptospirosis and Poliomyelitis [21] [22] [24].
Water-Washed	Lack of clean water for washing.	Scabies, Typhus, Yaws, Relapsing fever, Impetigo, Trachoma, Conjunctivitis and Skin ulcers.
Water-Based	Host organisms that develop to human parasites.	Schistosomiasis, Dracunculiasis, Paragonimiasis and Clonorchiasis.
Insect-Vector	Organisms that need water to breed.	Mosquito-borne diseases; Malaria, Yellow fever, Dengue fever, Filariasis and Fly-borne diseases; Onchocerciasis (river-blindness), Trypanosomiasis (West African sleeping sickness), Leishmaniosis (Kala-azar), Loiasis, [21]

Table-1.3.1 Water Borne Diseases

1.3.2 Water Purification Issues

COMMUNITYWATER	BOTTLED WATER
1. Quality at the treatment different from quality at	1.Unavoidable Cost of bottling and transportation
2. Uncontrolled do sage of chemicals	2.non-biodegradable
3. Common Supply for Drinking and bulk household usage	3. Not all bottled water is verified by independent agency
4. Not a cost-effective supply for drinking	4. Wait for bottled water delivery or got themarket for buying

Table-1.3.2 Water Purifications Issues

1.4 IMPLEMENTATION ISSUES

Do you face some of the water problems listed below, but do not know the causes of the problems? Read on for some explanations, causes and advice on what you can do to resolve them

1.4.1 Chlorine taste

What: Chlorine taste and do rescue by compounds containing chlorine added to municipal water supplies.

Problems: These compounds can cause odors and as many people find objective also affects the taste of food and beverages.

Solutions: All of the 3M clean water solutions drinking water systems are tested and certified to effectively reduce chlorine taste.

Fig-1.4.1 chlorine taste

1.4.2 Off-Taste or poor-tasting

What: Off-taste or poor tasting water can be take many forms and have causes

Problems: Deterrence from drinking water due to bad-taste and effects the taste of food and beverages

Solution: Most contaminants causing off-taste can be reduced by installing any of the 3M advanced house flirtation system to improve the taste of all of your water.

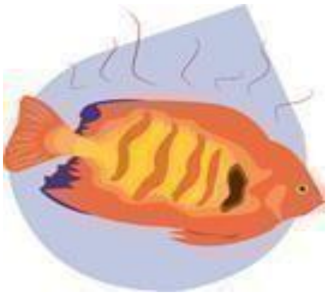

Fig-1.4.2 Off-taste or poor-tasting

1.4.3 Natural Formation

What: Natural formation due to water in contact with rock in the earth's crust.

Problems: Causes white scaling and waters potting on glassware and can also cause damage to appliances, clothing and even the pipes in the walls of your home.

Solution: Reducing the hardness in your water help keep your hot water appliances running at high levels. 3M brand water softener systems are an effective way to reduce the presence of hardness in your household

Fig-1.4.3 Natural formation

1.4.4 Concentration of hardness

What: The higher the concentration of hardness chemicals in your water, the whiter scale you will notice on the ends of faucets and other fixtures.

Problem: This scale is not easily cleaned with water and requires more aggressive cleaning chemicals to clean off your fixtures. Scale can also develop in appliances, pipes and in your water heater, possibly decreasing the life span of these costly appliances and plumbing fixtures.

Solution: 3M has a selection of filters with scale inhibitor. Contact us for a suitable filter for scaling problems.

Fig-1.4.4 Concentration of hardness

1.4.5 Presence of copper

What: Presence of copper in the water. When Ph is below 7, water is considered acidic. Acidic water causes damage to the insides of pipes, resulting in the release of copper from copper pipes.

Problem: Causes blue/green staining on white fixtures and clothing. Low Ph can lead to long term pin-hole leaks in piping.

Solution: 3M backwash filtration system series models with calcite

media can raise the Ph of water, effectively reducing damage and staining.

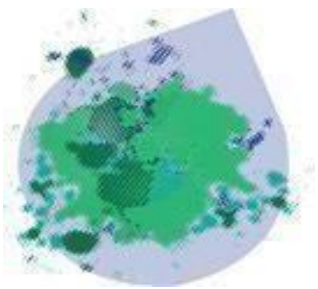

Fig-1.4.5 Presence of copper

1.4.6 Presence of Iron

What: Indicates the presence of iron in water.

Problem: Typically, not a health concern, but most find it very annoying and hard to clean. **Solution:** Some level so for one can be effectively treated by installing a 3M water softener series model for some homes with higher concentration of iron, our 3M iron reduction filtration series Red\Orange staining models would be prescribed.

Fig-1.4.6 Presence of iron

1.4.7 Presence of manganese

What: Presence of Manganese in water.

Problem: Manganese is rare and is quite nuisance. Like iron, manganese is an element of the Earth's crust. When found, it is not unusual to also find iron present in the water.

Solution: 3M iron reduction filtration series models may provide a Black staining solution for some manganese problems.

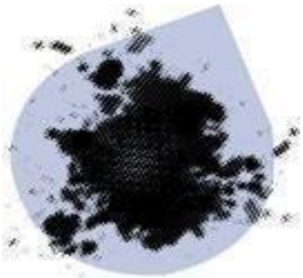

Fig-1.4.7 Presence of manganese

1.4.8 presence of Hydrogen sulphide gas

What: Caused by the presence of hydrogen sulphide gas in the water. Hydrogen sulphide gas is naturally occurring.

Problems: It can cause very objectionable smells and can even damage copper pipes and other metal fixtures due to the corrosive nature of hydrogen.

Solution: A special test is required to confirm the presence of rotten egg smell hydrogen sulphide. If it is present in your water, one of our 3M iron reduction filtration systems is a good solution.

Fig-1.4.8 presence of H_2S

1.5 Future enhancement

Concepts are being developed for drinking water filtration systems in automobiles, which would collect outside air and water, run it though filtration systems and deliver it to drivers, chilled, at the dashboard. And of course, on- the-go bottles with filtration systems offer consumers instant portability with their choice of filtration options. The future of drinking water treatment systems is advanced technologies in designer packaging.

Drinking water treatment systems that are either integrated in to appliances or as stand-alone appliances have already heavily penetrated the consumer market. Product design and functionality are no longer second to product performance; in a consumer’s mind, product design often takes first precedence for purchasing decisions and may even reshape product performance definitions.

1.6 Innovativeness and usefulness

There are four main types of solar water treatment: solar water disinfection (SODIS), solar distillation, solar water pasteurization, and solar water treatment systems. Some of these technologies have been around for a very long time, but most are new adaptations to the concept of solar energy. These technologies are quite impelled and easy to understand, usually require low financial input, and are proven effective.

1.7 Physio-chemical analysis

Chlorine has a number of advantages as disinfectant, including its relative cheapness, efficacy, and ease of measurement, both in laboratories and in the field. An important additional advantage over some other disinfectants is that chlorine leaves a disinfectant residual that assists in preventing recontamination during distribution, transport, and household storage of water. The absence of a chlorine residual in the distribution system may, in certain circumstances, indicate the possibility of post-treatment contamination. Three types of chlorine residual may be measured: free chlorine (the most reactive species, i.e., hypochlorous acid and the hypochlorite ion); combined chlorine (less reactive but more persistent species formed by the reaction of free chlorine species with organic material and ammonia); and total chlorine (the sum of the free and combined chlorine residuals).

Free chlorine is unstable in aqueous solution, and the chlorine content of water samples may decrease rapidly, particularly at warm temperatures. Exposure to strong light or agitation will accelerate the rate of loss of free chlorine. Water samples should therefore be analyzed for free chlorine immediately on sampling and not stored for later testing. The method recommended for the analysis of chlorine residual in drinking water employs N, N-diethyl-p-phenylenediamine, more commonly referred to as DPD. Methods in which o-tolidine is employed were formerly recommended, but this substance is a recognized carcinogen, and the method is inaccurate and should not be used. Analysis using starch–potassium iodide is not specific for free chlorine, but measures directly the total of free and combined chlorine; the method is not recommended except in countries where it is impossible to obtain or prepare DPD. Procedures for the determination of free chlorine residual are described in Annex 9.

1.8 pH

It is important to measure pH at the same time as chlorine residual since the efficacy of disinfection with chlorine is highly pH-dependent: where the pH exceeds 8.0, disinfection is lesseffective. To check that the pH is in the optimal GUIDELINES FOR DRINKING-WATER QUALITY 68 range for disinfection with chlorine (less than 8.0), simple tests may be conducted in the field using comparators such as that used for chlorine residual. With some chlorine comparators, it is possible to measure pH and chlorine residual simultaneously. Alternatively, portable pH electrodes and meters are available.

Procedures for measuring pH using a comparator are described in Annex 10. 4.3.3Turbidity Turbidity is important because it affects both the acceptability of water to consumers, and the selection and efficiency of treatment processes, particularly the efficiency of disinfection with chlorine since it exerts a chlorine demand and protects microorganisms and may also stimulate the growth of bacteria. In all processes in which disinfection is used, the turbidity must always be low—preferably below 1 NTU or JTU (these units are interchangeable in practice). It is recommended that, for water to be disinfected, the turbidity should be consistently less than 5 NTU or JTU and ideally have a median value of less than 1 NTU. Turbidity may change during sample transit and storage, and should therefore be measured on site at the time of sampling.

For the monitoring of small-community water supplies, however, high sensitivity is not essential, and visual methods that employ extinction and are capable of measuring turbiditiesof5 NTU and above are adequate. These rely on robust, low-cost equipment that does not require batteries and is readily transportable in the field, and are therefore generally preferred. Procedures for measuring turbidity in the field using a simple “turbidity tube” are described in Annex 10.

Solar water disinfection is usually accomplished using some mix of electricity generated by photovoltaics panels (solar PV), heat (solar thermal), and solar ultraviolet light collection.

Solar disinfection using the effects of electricity generated by photovoltaics typically uses an electric current to deliver electrolytic processes which disinfect water, for example by generating oxidative free radicals which kill pathogens by damaging their chemical structure. A second approach uses stored solar electricity from a battery, and operates at night or at low light levels to power an ultraviolet lamp to perform secondary solar ultraviolet water disinfection.

Solar thermal water disinfection uses heat from the sun to heat water to 70–100 °C for a short period of time. A number of approaches exist. Solar heat collectors can have lenses in front of them, or use reflectors. They may also use varying levels of insulation or glazing. In addition, some solar thermal water disinfection processes are batch-based, while others (through-flow solar thermal disinfection) operate almost continuously while the sun shines. Water heated to temperatures below 100 °C is generally referred to as pasteurized water.

The ultraviolet part of sunlight can also kill pathogens in water. The SODIS method uses a combination of UV light and increased temperature (solar thermal) for disinfecting water using only sunlight and repurposed PET plastic bottles. SODIS is a free and effective method for decentralized water treatment, usually applied at the household level and is recommended by the World Health Organization as a viable method for household water treatment and safe storage.[1] SODIS is already applied in numerous developing countries.

Solar water purification' involves purifying water for drinking and household purposes through the usage of solar energy in many different ways. Using solar energy for water treatment has become more common as it is a usually low-technology solution that works to capture the heat and energy from the sun to make water cleaner and healthier for human use and consumption. Solar water treatment is particularly beneficial for rural communities, as they do not have other forms of water purification infrastructure and more importantly, electricity to run such structures. The most positive feature about solar water purification is that there is no requirement of fuel. It's precisely due to the lack of fuel that makes solar applications relatively superior than conventional sources of energy as it does not cause pollution (global warming, acid rain, ozone depletion) or health hazards associated with pollution.

There are four main types of solar water treatment: solar water disinfection (SODIS), solar distillation, solar water pasteurization, and solar water treatment systems. Some of these technologies have been around for a very long time, but most are new adaptations to the concept of solar energy. These technologies are quite simple and easy to understand, usually require low financial input, and are proven effective.

Solar Water Disinfection (SODIS)

Solar water disinfection is a low technology, simple process of purifying water using solar energy and solar radiation. SODIS as a technology was first introduced in 1980 by Aftim Acra et al. from the American University of Beirut. The process involves contaminated water being filled in transparent PET or glass bottles which are then exposed to the sun for approximately 6 hours. The UV rays of sun eliminate the diarrhoea-causing pathogens, thereby making the water fit for consumption.

Solar Water Distillation

Solar water distillation uses a solar still to condense pure water vapour and settle out harmful substances to make clean, pure drinking water. This process is used when the water is brackish containing harmful bacteria, or for settling out heavy metals and also for desalination of sea water.

Solar Water Pasteurization

Solar water pasteurization involves the use of moderate heat or radiation to kill disease - causing microbes. This heat is provided from cookers that trap solar energy. This method has proven to kill bacteria, viruses, worms and protozoa.

Solar Water Purification

This method integrates electricity generated from solar energy for water purification. Solar panels generate power for a battery which is used for filtration and purification systems. These structures are generally mobile and are immensely helpful for disaster - relief efforts. They also come in various sizes meant for small scale use to commercial/community supply.

CHAPTER 2

LITERATURE SURVEY

CHAPTER 2
LITERATURE SURVEY

2.1 LITERATURE SURVEY

Has an in 1990 studied the contact aeration for iron removal method. Their on-removal process utilized the catalytic effect of ferric iron. Again, in this experiment it was theoretically demonstrated that by keeping high concentration of ferric iron, the volume of the aeration tank can be significantly reduced and it was according to the oxygenation rate equation. Ferric iron is very much effective in decreasing the reactor volumes at lower Ph values. It is proposed to recycle the ferric sludge to maintain the high ferric iron concentrations in the reactor.

William, et al. in 1992 studied the impact of dissolved organic carbon on the removal of iron during water treatment. He used the iron removal process by oxidation and coagulation method. Humic and folic acids, tannic acid and oxalic acid were estimated in the organic content. Potassium permanganate, chlorine dioxide and free chlorine were used as oxidizing agent.

Catherine in 1988 studied the control of biological iron removal from drinking water using oxidation-reduction potential. In this study a pilot plant was used for treating raw water with Ph 5.7 for biological removal of iron to produce drinking water. Here oxidation- reduction potential was used as a tool for evaluation and determination of relationship with dissolved oxygen and residual iron concentration in the infiltrate by using a biological filter.

Tomotad a studied the Current bioremediation practice and perspective in 2001. In the method he used in-situ fluorescence hybridization (FISH), in situ PCR, and quantitative PCR for removal of contamination by bioremediation. In this method the detection and reorganization of bacteria and pathogens is very vivid and these are being directly related to the rate of degradation of contaminants.

Wang, et al. in 2003 studied the removal of heavy metal ions from aqueous solutions using various adsorbents with minimal cost. He used various low-cost adsorbents like Fe2O3, Fe3O4, FeS, steel wool, Magnesium pallets, Copper pallets, Zinc pallets, Aluminum pallets, Iron pallets, coal, GAC for removal of heavy metal ions like cobalt and zinc from ground water.

VChoo, et al. studied in 2005 the removal of iron and manganese in ultra- filtration and also the process of membrane fouling. He also examined to remove the residual chlorine due to pre-chlorination which is opted as a convenient option for safe drinking water. The membrane fouling was caused due to the oxidation of iron and manganese which was also visualized thoroughly at microscopic level and the steps for eradicating the degradation of membrane were proposed.

Takerlekkopoulou, et al. studied in 2006 the physio-chemical and biological iron removal from potable water. He used the technique of trickling filter and constructed a model for it including the pilot-testing. The main mechanism was physio-chemical and biological oxidation of iron. The detailed chemical reaction and extent of each oxidation was studied. Experimentation was done with specified temperature, optimum feed iron concentration and volumetric flow rate. First order kinetics and Monod-type kinetics was observed in physiochemical and biological oxidations respectively.

Gupta studied in 2006 the non-conventional low-cost adsorbents for dye removal. He studied an extensive number of adsorbents for filtration and in the review, he showed the critical analysis of these materials, characteristics, advantages, limitations and mechanisms of adsorption. He used activated carbon of agricultural solid waste, industrial by product, clay and materials containing silica.

Bordoloi, et al. in 2007 studied the removal of iron from water using the ash produced from banana residue. Ashes from different materials

i.e., dry banana leaf, pseudo stem, rind, bamboo, rice husk was produced by controlled combustion. The mechanism of removal includes oxidation of iron at high Ph or alkaline medium produced by potassium present in banana due to subsequent formation of potassium hydroxide. The study included analysis of chemical composition of banana ash and its efficiency in removal of iron from prefabricated water.

Further it has been used in a low-cost household water purification model in which after treated with ash, the water is being filtered with a cotton cloth and being used for drinking.

In 2012 studied the removal of iron for safe drinking water. He used the methods of iron removal from drinking water such as electro coagulation; oxidation filtration, ion exchange, lime softening, adsorption by activated carbon, BIRM media, Anthracite, green sand, pebble and sand mixture, ultra-filtration etc. have been discussed.

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Chaturvedi in 2012 studied the removal of iron for safe drinking water. He used the methods of iron removal from drinking water such as electro coagulation; oxidation filtration, ion exchange, lime softening, adsorption by activated carbon, BIRM media, Anthracite, green sand, pebble and sand mixture, ultra-filtration etc. have been discussed.

Ganvir, et al. in 2011 studied the removal of fluoride from groundwater by aluminum hydroxide coated Rice husk ash. Activated aluminum hydroxide has been used for activating the RHA surface which forms a complex with fluoride ion in water and accelerates the process of removal. RHA was obtained by controlled burning of dry and crushed rice husk and treating with hydrochloric acid before activation. –

Simonisin2012 studied the manufacturing a low-cost ceramic water filter and filter system for the elimination of common pathogenic bacteria and suspended solids. A micro porous ceramic water filter in which clay was mixed with rice husk in a ration 2:1 by weight and a cylindrical shaped filter was manufactured by tradition oven drying and then burning in kiln at specified sintering temperature.

CHAPTER 3
PROPOSED METHOD

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PROPOSED METHOD

3.1 EXISTING METHOD

In the realm of existing water purification methods, Reverse Osmosis (RO) stands as a widely used but sometimes problematic technique. RO systems are known for their efficiency in removing impurities from water. However, they have a notable downside: they can inadvertently strip essential minerals from the water, making it less suitable for consumption. This drawback is a significant concern in regions where the drinking water already has low mineral content.

The Smart Water Purification System we propose aims to address this limitation while also providing a dynamic solution that adapts to varying impurity levels. By monitoring the Total Dissolved Solids (TDS) of incoming water, our system ensures that the purification method chosen is appropriate to the specific water quality, avoiding unnecessary mineral removal and other issues associated with traditional RO systems. This makes our system a significant advancement in water purification technology, overcoming the shortcomings of established methods.

3.2 PROPOSED METHOD

Design and implement a sustainable water purification system that utilizes solar energy for power, ensuring access to clean water in off-grid or remote areas. The system will include a battery level indicator for efficient monitoring and maintenance. This integrated solar-powered water purification system with a battery level indicator aims to provide a sustainable solution for clean water access, addressing both energy efficiency and water qualityconcerns in off-grid areas.

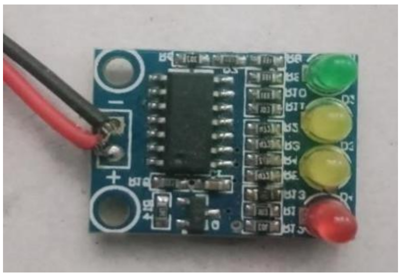

Fig-3.1 Battery Level Indicator

3.2 PROPOSED BLOCK DIAGRAM

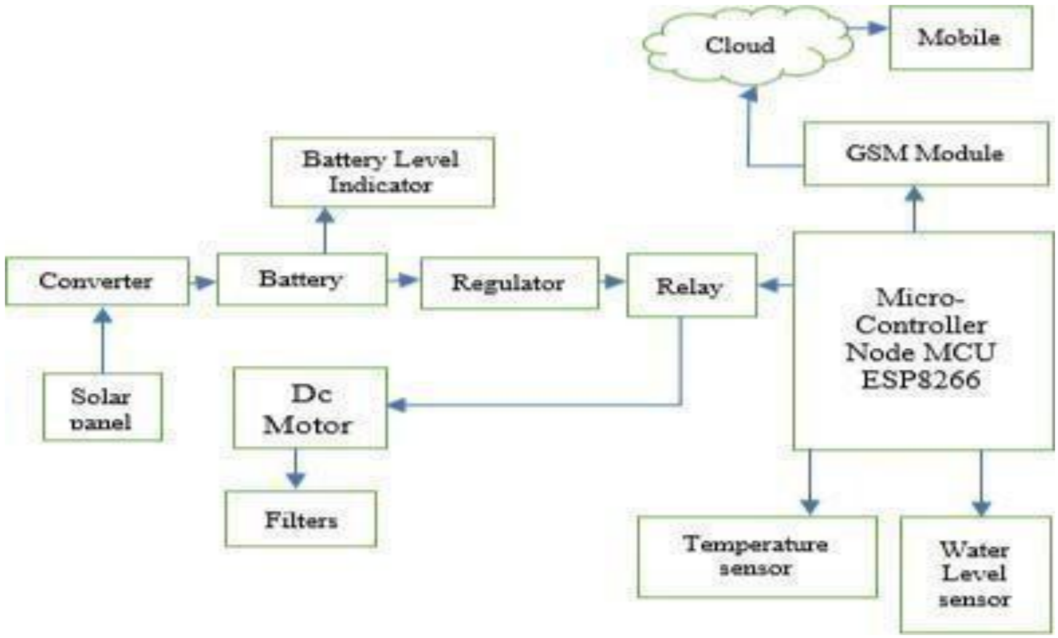

Fig-3.2 Main Block Diagram

3.2.1 ALTERNATE BLOCK DIAGRAM

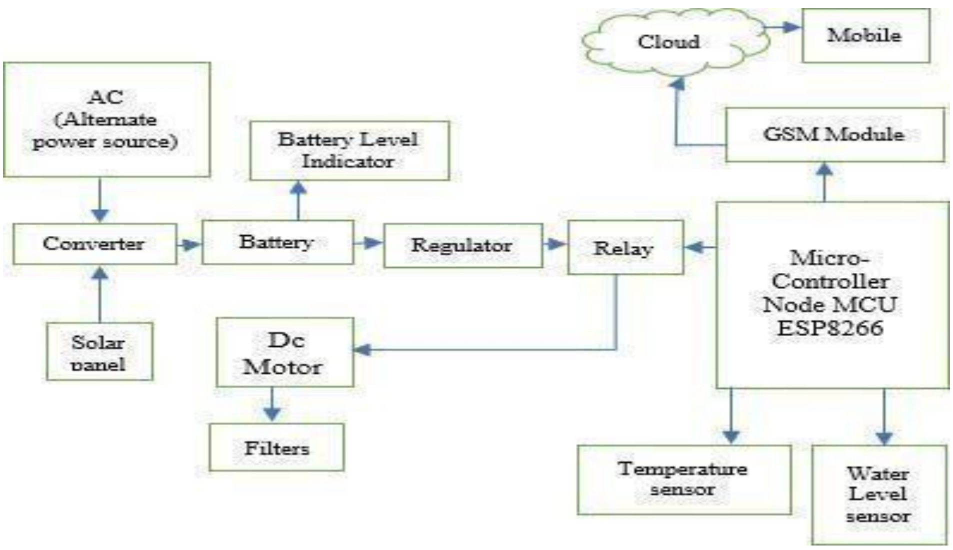

Fig-3.3 Alternate power source

3.3 COMPONENTS REQUIRED

3.3.1 Solar Panel

Fig-3.4 Solar Panel

A solar cell, commonly referred to as a photovoltaic cell (PV cell), is an electronic device that generates electricity directly from light radiation via the photovoltaic process. It falls under the category of photoelectric cells, which are devices that alter their electrical characteristics (such as voltage, current, or resistance) in reaction to light. The amount of electricity a solar panel can generate depends on the size of the panel, the amount of sunlight it receives, and the efficiency of the solar cells. Solar panels are typically mounted on roofs or on the ground. They can be used to power homes, businesses, and even entire communities.

Solar energy is a clean and renewable source of energy. It does not produce greenhouse gases or other pollutants. Solar energy is becoming increasingly popular as the cost of solar panels has decreased and the efficiency of solar cells has increased.

Here are some of the benefits of using solar panels:

- Solar energy is a clean and renewable source of energy.
- Solar panels can help you save money on your electricity bills.
- Solar panels can increase the value of your home.
- Solar panels can help reduce your reliance on fossil fuels.

If you are considering installing solar panels, there are a few things to keep in mind. The upfront cost of solar panels can be high, although there are government incentives available in manyplaces to help offset the cost. You will also need to make sure your roof is suitable for solar.

3.3.2 Micro-Controller Node MCU ESP8266

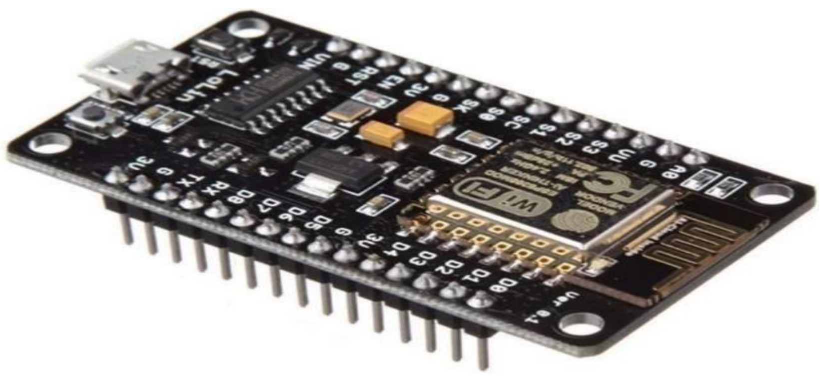

Fig-3.5 Micro-Controller Node MCU ESP8266

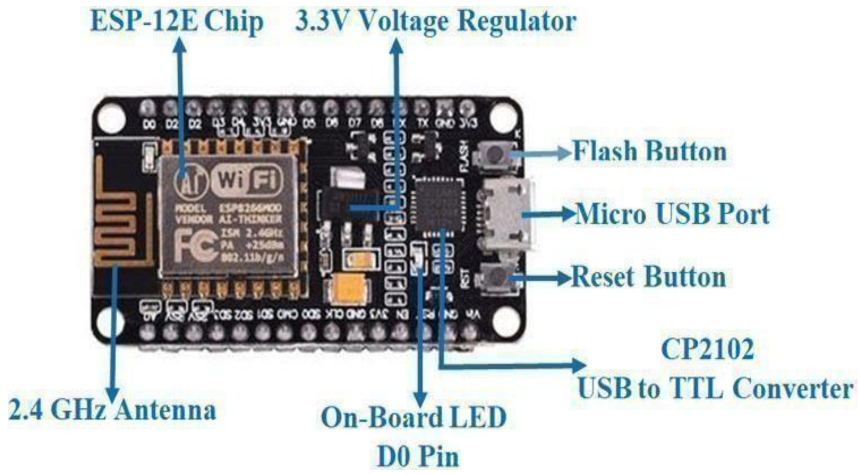

Fig-3.6 Components of Micro-controller MCU ESP8266

The Nodemcu (Node Micro Controller Unit) is a cost-effective System-on-a-Chip (SoC) based open-source software and hardware development platform centered around the ESP8266. With its ESP8266 development board boasting 30 pins, each designated for specific functions, it offers essential features such as integrated Wi-Fi connectivity, 17 GPIO pins, analog input capabilities, a USB-to-Serial converter, and seamless compatibility with the Arduino Integrated Development Environment (IDE) through a type B USB cable.

3.3.3 Reverse -Osmosis Membrane & Carbon Filter

Fig-3.7 RO Membrane

Fig- 3.8 Carbon Filter

A semi-permeable membrane is used in the water purification process known as reverse osmosis (RO) to separate water molecules from other contaminants. In order to overcome the osmotic pressure that promotes even dispersion, RO exerts pressure. Precision of Filtration: 0.0001 microns. Gallons per day, or 75GPD, of water flow.

Sediment, chlorine, volatile organic compounds (VOCs), smells, and bad tastes are all eliminated from water via carbon filters. Because of the activated carbon in them, the link is strengthened when water moves through them. When heavy metals come into touch with the filter's active coal, which is made of a specific substance, they are eliminated together with pollutants including volatile organic compounds (VOCs). Compared to when it entered the filter, the water that emerges is far cleaner. Filters made of carbon are excellent at eliminating contaminants that adhereto carbon. Commercial Filtration Supply offers premium carbon filters since some pollutants, like sodium, might evade the filter and remain in the system, making your health the top priority at all times. Thus, out of the 129 dangerous bacteria detected in tapwater, each carbon filter eliminates 100 of them.

3.3.4 Buck Booster Convertor

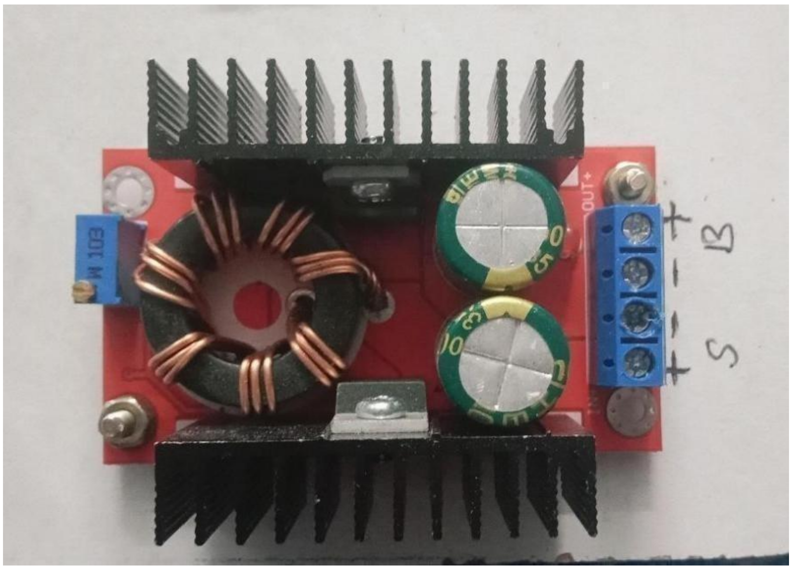

Fig-3.9 Buck Booster Convertor

This is a DC-DC converter that can both increase (boost) or decrease (buck) the input voltage to match the battery's voltage requirement. Solar panels can produce a variable voltage depending on sunlight intensity. The buck-boost converter ensures the battery receives the correct voltage for optimal charging, regardless of the panel's output.

Charge Controller:

Manages the entire charging process to protect the battery and maximize its lifespan. Here's how: Maximum Power Point Tracking (MPPT): (In some advanced models) This feature optimizes the power output from the solar panel by adjusting the input voltage to the buck-boost converter. This ensures the system extracts the maximum available power from the panel under varying sunlight conditions.

Charging Stages: Implements a multi-stage charging process for different battery types (e.g., lead-acid, lithium-ion). This typically involves stages like bulk charge, absorption charge, and float charge, ensuring the battery is charged safely and efficiently.

Overcharge Protection: Prevents the battery from being overcharged, which can damage the battery and shorten its lifespan. The charge controller stops or regulates the charging current when the battery reaches full capacity. Over-discharge Protection: Disconnects the battery from the load if the voltage drops too low, preventing deep discharge which can damage the battery.

Temperature Monitoring: (In some models) Monitors the battery temperature and adjusts the charging current if it gets too hot, protecting the battery from thermal damage.
Benefits of using a Charge Controller with a Buck-Boost Converter:

Efficient Charging: Ensures the battery receives the optimal voltage for efficient charging, maximizing the use of available solar power.
Battery Protection: Prevents overcharging, over-discharging, and thermal damage, extending battery life.
Safe Operation: Provides safety features to protect the system from overload and short circuits.
In conclusion, while the buck-boost converter handles voltage conversion, the charge controller is the brain of the system, ensuring safe, efficient, and optimized battery charging in a solar power application.

3.3.5 Temperature Sensor

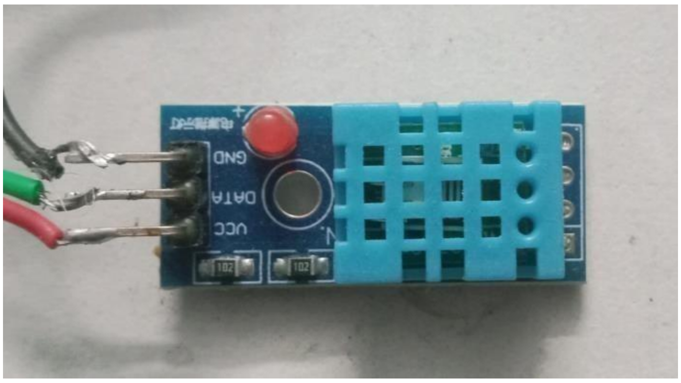

Fig-3.10 Temperature sensor

A temperature sensor is a device that detects and converts changes in temperature into a measurable electrical signal.
Types: Different types of temperature sensors operate based on varying principles:

Thermistors: Electrical resistance changes with temperature.

Thermocouples: Junction of two dissimilar metals creates voltage proportional to temperature difference.
RTDs (Resistance Temperature Detectors): Similar to thermistors but use specific materials like platinum for higher accuracy.

Infrared (IR) sensors: Detect infrared radiation emitted by objects, indirectly measuring temperature.

Output: The electrical signal generated by the sensor can be voltage, current, or frequency depending on the type.

Accuracy and Range: Sensors have a specific operating temperature range and a level of accuracy for their measurements.

Selection: Choosing the right sensor depends on factors like desired temperature range, required accuracy, response time, and cost.

Durability: Some sensors are designed for harsh environments with extreme temperatures or pressure.

By converting temperature into an electrical signal, temperature sensors enable various devices and systems to monitor and control temperature automatically, leading to increased efficiency, safety, and comfort.

Applications they are widely used in various fields like:

HVAC systems: Regulating heating and cooling based on room temperature.

Appliances: Monitoring and controlling temperature in ovens, refrigerators, and freezers.

Industrial processes: Maintaining precise temperature for manufacturing and production.

Weather stations: Measuring ambient air temperature.

3.3.6 Water Level Sensor

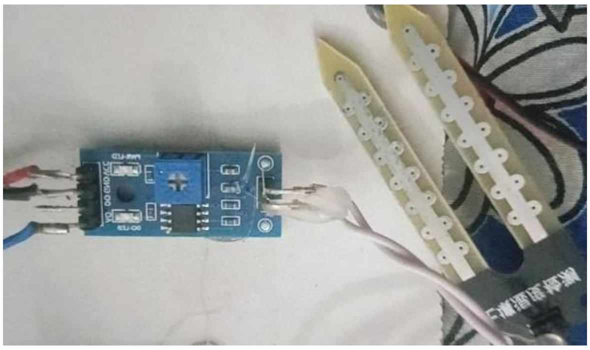

Fig-3.11 Water Level Sensor &Indicator

Water sensors are electronic devices that detect the presence of water. They play a crucial role in preventing water damage in homes and buildings.

Here's a quick rundown Applications:

Leak detection: Placed under sinks, washing machines, or near water pipes to identify potential leaks early on.

Flood prevention: Installed in basements, crawlspaces, or near water heaters to alert homeowners of potential flooding.

Smart home integration: Can connect to smart home systems and trigger automated responses, like shutting off water valves.

Types:

Conductive sensors: Detect changes in electrical conductivity when water makes contact with two electrodes.

Capacitive sensors: Measure changes in capacitance caused by the presence of water.

Float switches: Contain a float that triggers a switch when water rises above a certain level.

Acoustic sensors: Use sound to detect water flow or dripping.

Benefits:

- Prevent costlywater damage from leaks and floods.
- Offer peace of mind byproviding early warnings.
- Can be connected to automatic shutoff valves to minimize damage.
- Considerations:
- Choose the right type based on location and potential water source.
- Consider wireless options for easier installation and flexibility.
- Some models connect to smart home systems for remote monitoring.
- Water sensors are a valuable tool for safeguarding your property from water-related disasters. Their simple yet effective design offers a line of defense against potential threats.

Advanced Features:

Smart sensors: Can differentiate between fresh and saltwater, useful in coastal areas.

Freeze detection: Some models monitor temperature and alert you to potential freezing pipes that could burst.

Remote monitoring: Connect to your smartphone for real-time water detection alerts, even when you're away.

3.3.7 1N4148 Relay (Signal Diode)

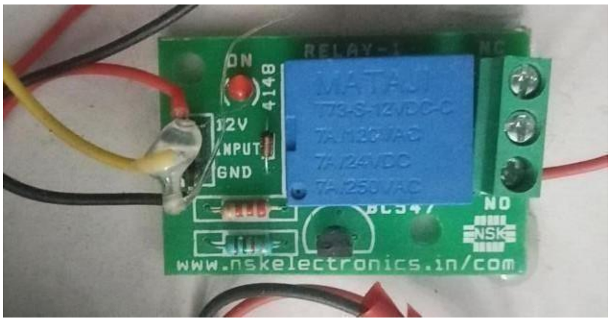

Fig-3.12 1N4148 RELAY

The 1N4148 is a semiconductor diode, often referred to as a switching diode. It's made from silicon and has a glass encapsulation.

It allows current to flow in one direction only, from the anode to the cathode. When forward-biased (voltage applied across the anode and cathode in the forward direction), it conducts current with a very low forward voltage drop. When reverse-biased, it blocks current flow, except for a small leakage current.

Applications:

- Signal rectification: Converting alternating current (AC) signals to direct current (DC).
- Clipping and clamping circuits: Limiting voltage levels in electronic circuits.
- Protection circuits: Safeguarding sensitive components from voltage spikes and reverse polarity.

Benefits:

Fast switching speed: Suitable for high-frequency applications.

Small size: Ideal for compact electronic designs.

Low forward voltage drops: Efficient energy conversion.

Relatively low cost: Economical for various applications.

Overall, the 1N4148 diode is versatile and widely used in electronic circuits for its reliability and performance characteristics.

3.3.8 Lead-Acid Battery

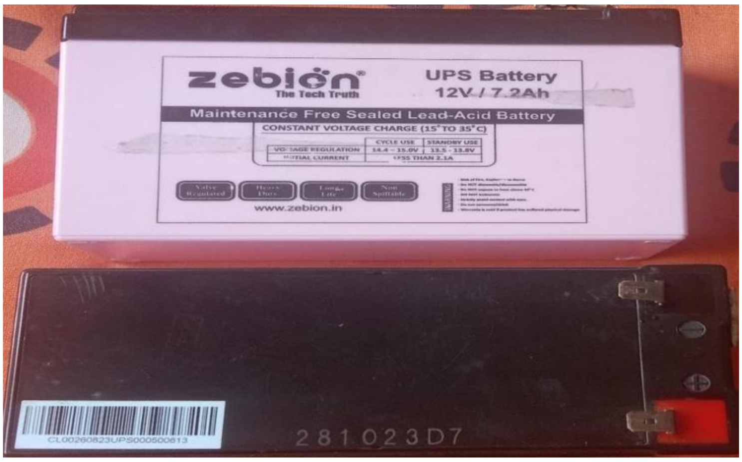

Fig-3.13 Lead-Acid Battery

A lead-acid battery is a type of rechargeable battery that uses lead electrodes and sulfuric acid as the electrolyte. Here's more detail

Working: During discharge, the lead dioxide electrode reacts with sulfuric acid to form lead sulfate and release electrons. At the same time, the lead electrode reacts with sulfuric acid to form lead sulfate and release electrons as well. During charging, the process is reversed, converting lead sulfate back into lead dioxide and lead while consuming electrical energy.

Applications: Lead-acid batteries are commonly used in various applications, including: Automotive starting batteries.Backup power supplies for telecommunications, data centers, and emergency lighting. Renewable energy storage systems, such as solar and wind power.Uninterruptible power supplies (UPS) for critical equipment and systems.

Benefits:

- Relatively low cost compared to other rechargeable battery technologies.
- Mature technology with well-established manufacturing processes.
- High surge current capability, making them suitable for applications requiring a sudden burst of power.
- Easilyrecyclable, with a well-developed recycling infrastructure for lead-acid batteries.

However, they also have some limitations:

Limited energy density compared to other battery types like lithium-ion.

Require regular maintenance, including topping up electrolyte levels and periodic equalization charging.

Sensitive to overcharging and deep discharge, which can reduce lifespan if not properly managed.

Relatively heavy and bulky, which may limit their use in portable applications where weight and size are critical factors.

3.3.9 Water Pump Motor

Fig-3.14 Water Pump Motor

In a DC water pump system with a shunt motor, the shunt plays a crucial role in monitoring and potentially controlling the motor's operation. Here's a breakdown of the key elements:

DC Water Pump:

This is the core component, responsible for converting electrical energy (DC) into mechanical energy to move water. It typically consists of a permanent magnet motor and an impeller that pushes water through the system.

Shunt:

A shunt is a low-resistance electrical conductor placed in parallel with the motor.The current flowing through the motor also flows through the shunt.

Since the shunt has a very low resistance compared to the motor, most of the current will pass through it.

Benefits of using a shunt:

Current Monitoring: The voltage drop across the shunt is proportional to the current flowing through the motor. By measuring this voltage drop, you can monitor the motor's current consumption. This information is valuable for:

Overload Protection: Detecting if the motor is drawing too much current, potentially indicating overload or malfunction. Shutting down the motor in such cases can prevent damage.

Performance Monitoring: Monitoring current consumption can help assess the motor's efficiency and identify potential issues.

Control Systems: In some cases, the current data from the shunt can be used in control systems to adjust the motor's speed or operation based on specific parameters.

Types of Shunts:

Current Shunts: These are the most common type, designed specifically for measuring current. Hall Effect Sensors: While not technically shunts, these sensors can be used to measure current by detecting the magnetic field generated around the conductor.

Considerations:

- The shunt needs to be rated for the maximum current your motor can draw.
- The voltage drop across the shunt is typically small, so a high-precision voltmeter might be needed for accurate measurements.
- Some shunt motor controllers have integrated shunt circuits, eliminating the need for a separate component.

Overall, a shunt plays a vital role in monitoring and potentially controlling DC water pump motors. It allows for current measurement which can be crucial for overload protection, performance analysis, and even control system implementation.

3.4 SOFTWARE REQUIREMENT

```
#define BLYNK_PRINT Serial
#defineBLYNK_TEMPLATE_ID "TMPL39veLUNxL"
#defineBLYNK_TEMPLATE_NAME"QuickstartTemplate"
#define BLYNK_AUTH_TOKEN
"Y0ZwZe1MCPIGlnL6o2bVvGpKusRRvFtk"
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "DHT.h"
// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = " BLYNK_AUTH_TOKEN";
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "murali";
char pass[] = "Pavan@123";
const int motor = D3;
DHT dht(D2, DHT11);
void setup()
{
  // Debug console
  Serial.begin(9600);
  dht.begin(9600);
  pinMode(motor, OUTPUT);
  Blynk.begin(auth, ssid, pass);
}
void loop()
{
  Blynk.run();
  int moist = analogRead(A0);
int level = map(moist, 1024, 0, 0, 100);
 if(level >
   90){ digitalWrite(motor,
   LOW);
   Blynk.virtualWrite(V0, 1);
  }else if(level < 20)
  { digitalWrite(motor,
  HIGH);
  Blynk.virtualWrite(V0, 0);;
   }
  int temperature = dht.readTemperature();
  int humidity = dht.readHumidity();
  Blynk.virtualWrite(V1, level);
  Blynk.virtualWrite(V2, temperature);
  Blynk.virtualWrite(V1, humidity);
  delay(1000);
}
```

CHAPTER 4

RESULTS

CHAPTER 4
RESULTS

4.1 HARDWARE IMPLIMENTATION

The battery level indicator project utilizes both LED and LCD displays to provide real-time status updates on battery levels, allowing users to monitor remaining battery capacity. Similarly, the water level indicator alerts users when the tank reaches maximum capacity. Additionally, a temperature sensor is employed to monitor the solar panel's temperature. In the system, a buck-boost converter is employed as a DC-DC converter capable of adjusting output voltage levels either higher or lower than the input voltage. Meanwhile, a power regulator is utilized to establish and sustain a consistent output voltage, regardless of input voltage fluctuations or load changes. The Arduino unit receives input data from various sensors, facilitating seamless integration and data processing. Operating within a frequency range of 8 to 160MHz and voltage range of 3 to 3.6V, the NODEMCU ensures reliable performance. Furthermore, the Wi-Fi module boasts an operational range spanning from 46 to 96 meters, enhancing connectivity options for the system.

The solar panel takes the sunlight and converts into electrical energy, that electrical energy stored in the battery to purify the water. The battery level indicator indicates the amount of energy stored in the battery which means the green led shows the 100 percent of energy stored in the battery and yellow indicates the 75 percent of energy, orangeled indicates the 50 percent of energy, and red led indicates the 25 percent of energy stored in the battery. After that the supply connected to buck booster to convert or maintain constant voltage and connected to motor to run. The sedimentation filter acts as a barrier against different types of sediments or suspended soils, after that Ro filter removes chlorine from water with a semipermeable membrane to remove dissolved salts after that, Carbon filter removes certain chemicals, from water and finally we get a purifier water. And also, when the water level indicator reaches themaximum point, it gives a notification through the Arduino NODEMCU8266 it indicates the level of water temperature of the water

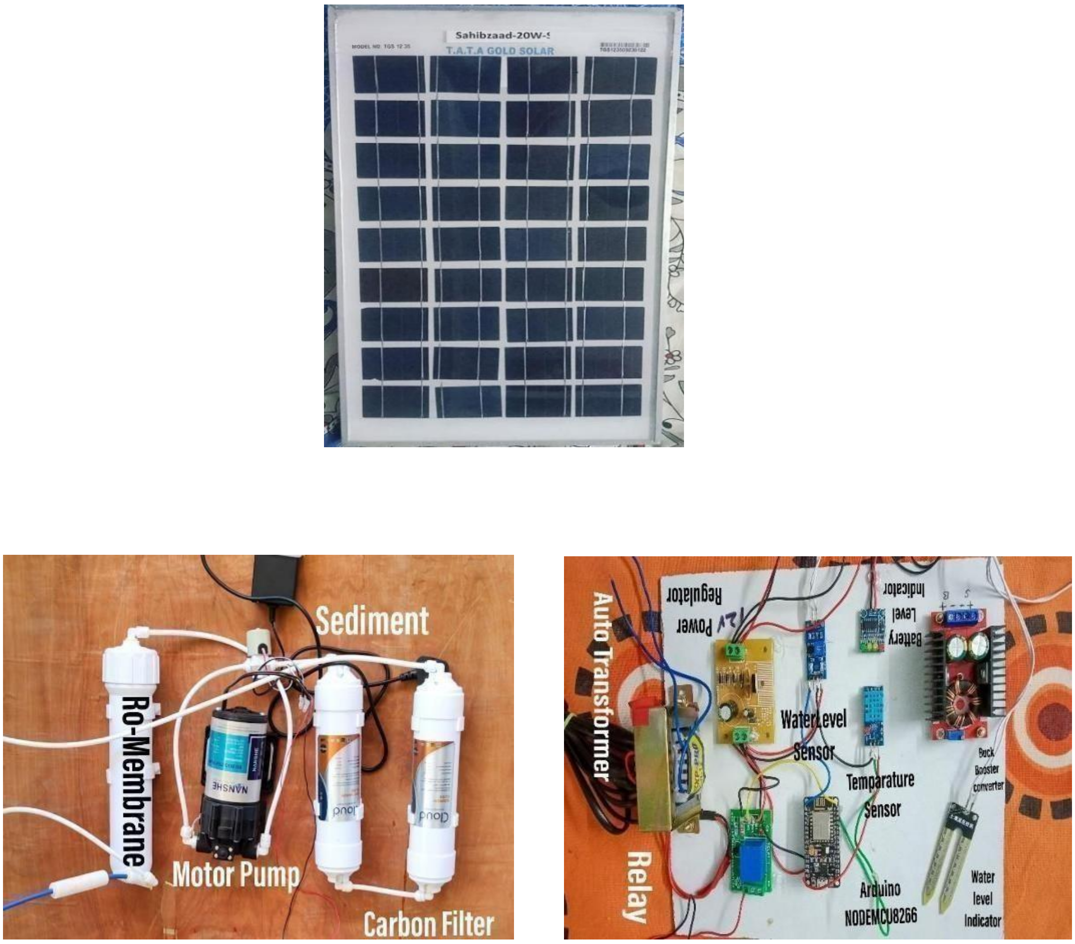

Fig-4.1 Total Project Setup

The solar panel takes the sunlight and converts into electrical energy, that electrical energy stored in the battery to purify the water. The battery level indicator indicates the amount of energy stored in the battery which means the green led shows the 100 percent of energy stored in the battery and yellow indicates the 75 percent of energy, orangeled indicates the 50 percent of energy, and red led indicates the 25 percent of energy stored in the battery. After that the supply connected to buck booster to convert or maintain constant voltage and connected to motor to run. The sedimentation filter acts as a barrier against different types of sediments or suspended soils, after that Ro filter removes chlorine from water with a semipermeable membrane to remove dissolved salts after that, Carbon filter removes certain chemicals, from water and finally we get a purifier water. And also, when the water level indicator reaches the maximum point, it gives a notification through the Arduino NODEMCU8266 it indicates the level of water temperature of the water.

4.2 TDS LEVLS ABOUT FILTRATION AND MOBILE NOTIFICATIONS

Fig-4.2 Showing TDS levels of water before and after filtration.

Fig-4.3 Showing mobile notification about water overflow and there is an indicator whichshows battery level.

CHAPTER 5

CONCLUSION

AND

FUTURE SCOPE

CHAPTER -5

CONCLUSION AND FUTURE SCOPE

CONCLUSION

Harnessing solar energy for water purification systems offers a sustainable and efficient solution to address global water scarcity. Utilizing ample sunlight for purification processes, these systems diminish dependency on fossil fuels and mitigate environmental harm. Moreover, they offer clean drinking water access in distant or underprivileged regions, thus addressing critical needs sustainably, contributing to improved public health and socioeconomic development. Overall, integrating solar energy into water purification systems represents a crucial step towards achieving a more sustainable and equitable future for all.

FUTURE SCOPE

Looking ahead, the future scope for harnessing solar energy in water purification systems is promising. Advances in technology and research are likely to lead to more efficient and cost-effective solar-powered purification methods, making them more accessible to a wider range of communities. Additionally, the integration of smart technologies and data analytics could optimize system performance and enhance reliability. Furthermore, the scalability of solar-powered purification systems make them suitable for both small-scale household use and large-scale industrial applications, offering versatility in addressing diverse water purification needs. Overall, the continued development and adoption of solar-powered water purification systems hold significant potential for sustainable water management and environmental conservation in the years to come.

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HARNESSING SOLAR ENERGY FOR WATER PURIFICATION SYSTEM

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***Abstract*—This project addresses the critical need for reliable power sources in remote areas by introducing a Solar-Powered Charging Station with IOT Control. The primary focus is on providing illumination, battery charging and powering small communication stations in off-grid locations. The project aims to design a flexible charging station equipped with both AC and DC outlets, offering user convenience. With an approximate loading capacity of 150W, the system ensures optimal performance and safety to meet daily energy demands. Incorporating Internet of Things (IOT) technology, the charging station enables real- time monitoring of battery status and remote load control through a mobile application. This innovative solution seeks to enhance accessibility to clean energy, improve living conditions in remote areas, and provide a sustainable power solution for various applications.**

***Keywords*—Electrical conductivity; Microcontroller Node MCU ESP8266; Reverse Osmosis; TDS; Monitoring and Control.**

I. INTRODUCTION

In recent years, the intersection of renewable energy and water purification has gained significant attention as global concerns about energy sustainability and access to clean water escalate. This introduction outlines the pressing need for innovative solutions by presenting the challenges associated with traditional water treatment methods and the environmental impact of conventional energy sources.

Emphasizing the potential of harnessing solar energy, the introduction sets the stage for exploring how solar technologies can be integrated into water purification systems to create a more sustainable and efficient approach. It outlines the goals of designing a solar-powered water purification system that not only addresses environmental concerns but also enhances the overall efficiency and accessibility of clean water.

II. MAIN OBJECTIVE

Harnessing solar energy for water purification systems serves a dual purpose of addressing water scarcity while promoting sustainable energy usage. The unique objective lies in leveraging the sun's abundant and renewable energyto provide clean drinking water in an environmentally friendly and economically viable manner. By combining solar power with advanced purification technologies, the aim is not only to ensure access to safe water but also to reduce dependence on non-renewable energy sources, mitigating climate change impacts in the process. This inventive strategy not only meets immediate water demands but also fosters long-term environmental sustainability. and resilience, making it a transformative solution for communities worldwide.

III. LITERATURE SURVEY

Waste is improperly managed in a highly populated nation like India, where it is dumped into rivers, lakes, and ponds,poisoning the water supply. One of the main sources of water is underground water, however it is becoming contaminated due to seepage of tainted water. After being cleaned at water treatment facilities, water from bodies of water is transferred for additional usage. Pollutant-free chemically treated water is contaminated when it is carried for a variety of reasons, such as decaying pipes or broken pipelines, which contaminate the water before it reaches its destination. People are starting to use water purifiers at home in order to ensure that the water they use for cooking and drinking is free of bacteria, viruses, and other microorganisms due to the rising levels of toxins. Water purifiers utilize ultrafiltration, reverse osmosis, ultraviolet light, and various other techniques to eliminate all foreign particles from the water. Reverse osmosis is a purification technique that lowers the total dissolved solids (TDS) count significantly.

However, in regions where the Total Dissolved Solids (TDS) value is relatively low, employing this technique can potentially decrease the TDS to a level that renders the water unsafe for consumption. In such scenarios, a PID fuzzy logic system, in conjunction with a TDS meter, is utilized to autonomously regulate the TDS of the water without necessitating user intervention. Furthermore, current methodologies rely on microcontrollers for monitoring water quality, a subject extensively discussed in the relevant literature, particularly concerning smart water purification methods. In recent studies, real-time water quality monitoring is achieved through sensor deployment. This includes utilizing a pH sensor for acidity measurement, a flow meter to gauge water flow, a thermistor temperature sensor for temperature assessment, and a conductivity sensor to detect free-flowing ions in water, indicating impurities. Communication between hardware and software is facilitated wirelessly through ZigBee technology. Further advancements involve real- time water quality assessment through a combination of pH, temperature, and TDS metering. Data collection is facilitated by an 8-bit microcontroller, with subsequent transfer to mobile devices via Bluetooth. Artificial neural network modeling is employed for data processing, consolidating multiple datasets into a unified system that provides instant water quality alerts. In another study, sensors are deployed to monitor water within the purifier tank, with data displayed on an LCD screen and transmitted to mobile devices through a Wi-Fi module. These sensors monitor various quality parameters such as conductivity, pH, temperature, turbidity, and total dissolved solids. Yet another approach involves utilizing sensors like temperature, turbidity, pH, and ultrasonic sensors for water quality monitoring and management. Users can access collected data via a dedicated mobile application. While current literature primarily focuses on water quality monitoring, forthcoming research aims to control water quality based on acquired data values, ensuring consistently high-quality water output from purifiers without human intervention.

IV. PROPOSED METHOD

Design and implement a sustainable water purification system that utilizes solar energy for power, ensuring access toclean water in off-grid or remoteareas.

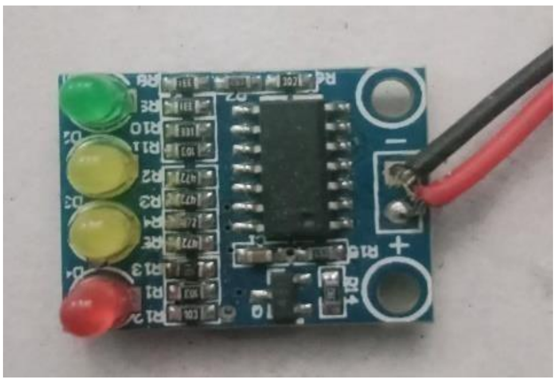

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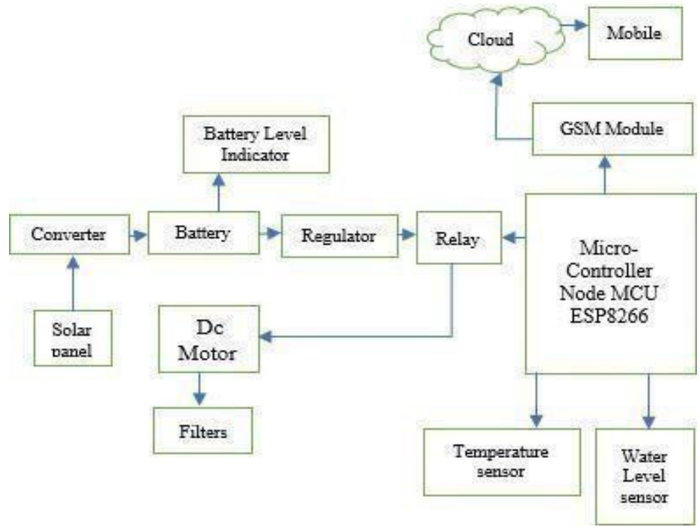
Fig-1 Battery Level Indicator

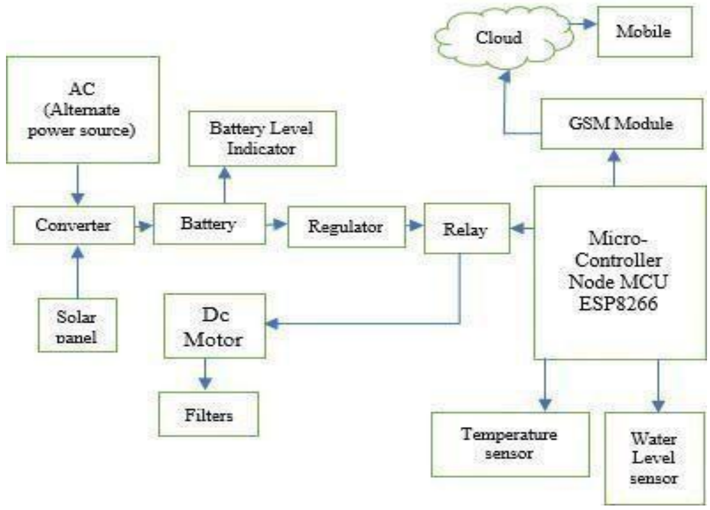
The system will include a battery level indicator for efficient monitoring and maintenance. This integrated solar-powered water purification system with a battery level indicator aims to provide a sustainable solution for clean water access, addressing both energy efficiency and water quality concernsin off-grid areas.

Block Diagrams

Main Block Diagram



Alternate power source Block Diagram



V. HARDWARE COMPONENTS

Fig-2 Solar Panel

A solar cell, commonly referred to as a photovoltaic cell (PV cell), is an electronic device that generates electricity directly from light radiation via the photovoltaic process. It falls under the category of photoelectric cells, which are devices that alter their electrical characteristics (such as voltage, current, or resistance) in reaction to light.

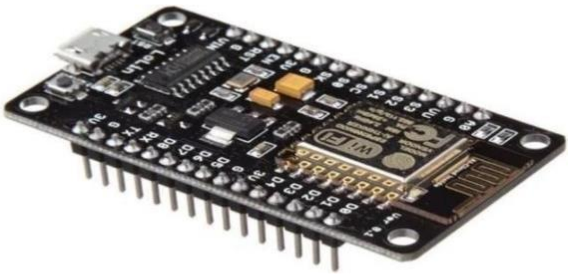


Fig-3 Micro-Controller Node MCU ESP8266

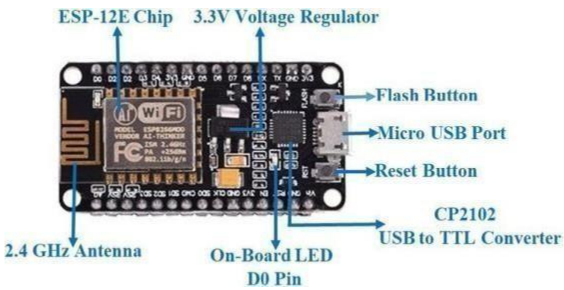


Fig-4 Components of Micro-controller MCU ESP8266

The Nodemcu (Node Micro Controller Unit) is a cost-effective System-on-a-Chip (SoC) based open-source software and hardware development platform centered around the ESP8266. With its ESP8266 development board boasting 30 pins, each designated for specific functions, it offers essential features such as integrated Wi-Fi connectivity, 17 GPIO pins, analog input capabilities, a USB-to-Serial converter, and seamless compatibility with the Arduino Integrated Development Environment (IDE) through a type B USB cable.

Fig-5 RO Membrane

Fig- 6 Carbon Filter

A semi-permeable membrane is used in the water purification process known as reverse osmosis (RO) to separate water molecules from other contaminants. In order to overcome the osmotic pressure that promotes even dispersion, RO exerts pressure. Precision of Filtration: 0.0001 microns. Gallons per day, or 75GPD, of water flow.

Sediment, chlorine, volatile organic compounds (VOCs), smells, and bad tastes are all eliminated from water via carbon filters. Because of the activated carbon in them, the link is strengthened when water moves through them. When heavy metals come into touch with the filter's active coal, which is made of a specific substance, they are eliminated together with pollutants including volatile organic compounds (VOCs). Compared to when it entered the filter, the water that emerges is far cleaner. Filters made of carbon are excellent at eliminating contaminants that adhere to carbon. Commercial Filtration Supply offers premium carbon filters since some pollutants, like sodium, might evade the filter and remain in the system, making your health the top priority at all times. Thus, out of the 129 dangerous bacteria detected in tap water, each carbon filter eliminates 100 of them!

VI. HARDWARE IMPLEMENTATION

Fig-7 Solar Panel

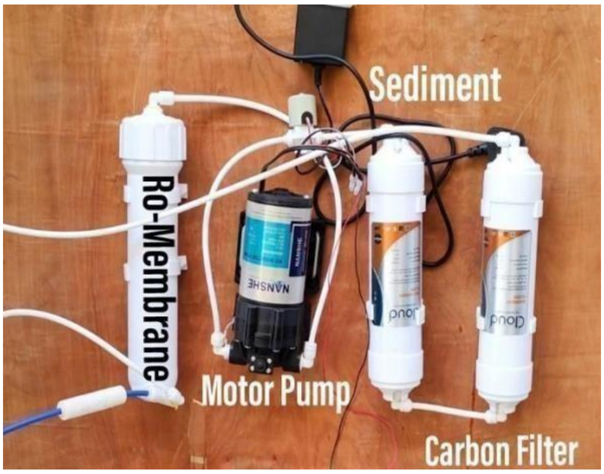


Fig-8 Filter Setup

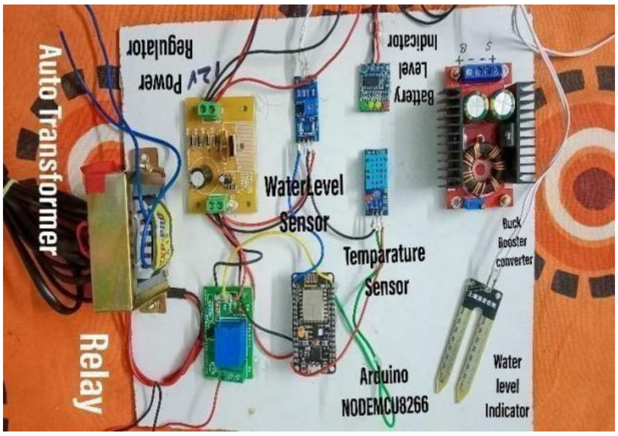


Fig-9 IOT Setup

The battery level indicator project utilizes both LED and LCD displays to provide real-time status updates on battery levels, allowing users to monitor remaining battery capacity. Similarly, the water level indicator alerts users when the tank reaches maximum capacity. Additionally, a temperature sensor is employed to monitor the solar panel's temperature. In the system, a buck-boost converter is employed as a DC-DC converter capable of adjusting output voltage levels either higher or lower than the input voltage. Meanwhile, a power regulator is utilized to establish and sustain a consistent output voltage, regardless of input voltage fluctuations or load changes. The Arduino unit receives input data from various sensors, facilitating seamless integration and data processing. Operating within a frequency range of 8 to 160MHz and voltage range of 3 to 3.6V, the NODEMCU ensures reliable performance. Furthermore, the Wi-Fi module boasts an operational range spanning from 46 to 96 meters, enhancing connectivity options for the system.

The solar panel takes the sunlight and converts into electrical energy, that electrical energy stored in the battery to purify the water. The battery level indicator indicates the amount of energy stored in the battery which means the green led shows the 100 percent of energy stored in the battery and yellow indicates the 75 percent of energy, orangeled indicates the 50 percent of energy, and red led indicates the 25 percent of energy stored in the battery. After that the supply connected to buck booster to convert or maintain constant voltage and connected to motor to run. The sedimentation filter acts as a barrier against different types of sediments or suspended soils, after that Ro filter removes chlorine from water with a semipermeable membrane to remove dissolved salts after that, Carbon filter removes certain chemicals, from water and finally we get a purifier water. And also, when the water level indicator reaches themaximum point, it gives a notification through the Arduino NODEMCU8266 it indicates the level of water temperature of the water

VII. SOFTWARE REQUIREMENT

```
#define BLYNK_PRINT Serial
#defineBLYNK_TEMPLATE_ID "TMPL39veLUNxL"
#defineBLYNK_TEMPLATE_NAME"QuickstartTempla
te"
#define BLYNK_AUTH_TOKEN
"Y0ZwZe1MCPIGlnL6o2bVvGpKusRRvFtk"
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "DHT.h"
// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = " BLYNK_AUTH_TOKEN";
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "murali";
char pass[] = "Pavan@123";
const int motor = D3;
DHT dht(D2, DHT11);
void setup()
{
 // Debug console
 Serial.begin(9600);
 dht.begin(9600);
 pinMode(motor, OUTPUT);
 Blynk.begin(auth, ssid, pass);
}
void loop()
{
 Blynk.run();
 int moist = analogRead(A0);
int level = map(moist, 1024, 0, 0, 100);
 if(level >
  90){ digitalWrite(motor,
  LOW);
  Blynk.virtualWrite(V0, 1);
 }else if(level < 20)
 { digitalWrite(motor,
 HIGH);
 Blynk.virtualWrite(V0, 0);;
 }
 int temperature = dht.readTemperature();
 int humidity = dht.readHumidity();
 Blynk.virtualWrite(V1, level);
 Blynk.virtualWrite(V2, temperature);
 Blynk.virtualWrite(V1, humidity);
 delay(1000);
}
```

VIII. RESULTS AND DISCUSSION

The solar panel takes the sunlight and converts into electrical energy, that electrical energy stored in the battery to purify the water. The battery level indicator indicates the amount of energy stored in the battery which means the green led shows the 100 percent of energy stored in the battery and yellow indicates the 75 percent of energy, orangeled indicates the 50 percent of energy, and red led indicates the 25 percent of energy stored in the battery. After that the supply connected to buck booster to convert or maintain constant voltage and connected to motor to run. The sedimentation filter acts as a barrier against different types of sediments or suspended soils, after that Ro filter removeschlorine from water with a semipermeable membrane to remove dissolved salts after that, Carbon filter removes certain chemicals, from water and finally we get a purifier water. And also, when the water level indicator reaches the maximum point, it gives a notification through the Arduino NODEMCU8266 it indicates the level of water temperature of the water

Fig-10 Showing mobile notification about water overflow and there is an indicator which shows battery level.

IX. CONCLUSION

Harnessing solar energy for water purification systems offers a sustainable and efficient solution to address global water scarcity. Utilizing ample sunlight for purification processes, these systems diminish dependency on fossil fuels and mitigate environmental harm. Moreover, they offer clean drinking water access in distant or underprivileged regions, thus addressing critical needs sustainably, contributing to improved public health and socioeconomic development. Overall, integrating solar energy into water purification systems represents a crucial step towards achieving a more sustainable and equitable future for all.

FUTURE SCOPE

Looking ahead, the future scope for harnessing solar energy in water purification systems is promising. Advances in technology and research are likely to lead to more efficient and cost-effective solar-powered purification methods, making them more accessible to a wider range of communities. Additionally, the integration of smart technologies and data analytics could optimize system performance and enhance reliability. Furthermore, the scalability of solar- powered purification systems make them suitable for both small-scale household use and large-scale industrial applications, offering versatility in addressing diverse water purification needs. Overall, the continued development and adoption of solar-powered water purification systems hold significant potential for sustainable water management and environmental conservation in the years to come.

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The goal of the research project is to practically implement theoretical ideas I would like to extend my heartfelt gratitude to my mentor, Mr. D. Mahaboob Basha, an assistant professor in the Srinivasa Ramanujan Institute of Technology's EEE department, for her constant support and encouragement in submitting original ideas. We are grateful for the platformthat the Department of Electrical and Electronic Engineering at Srinivasa Ramanujan Institute of Technology provided for our research.

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