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REUSING WASTE WATER FROM RO SYSTEMS AND MANAGING WATER RESOURCES IN SOCIETY USING IOT AUTOMATION

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ABSTRACT

Reverse osmosis (RO) systems require a lot of water to produce less drinking water, which is a problem that an increasing number of water purifier consumers are now encountering. 25% water gets rid of the other 75%. Additionally, instead of wasting that 75%, it will use it for other things. India wastes over 2430 Cr. litres of water every day. Making the water drinkable through reverse osmosis is how IOT will transform everything. Here, a system that collects RO wastewater from residences in a single common tank and uses it to water grass in public facilities and wash cars is being designed utilizing 10T and Sensor. Every design relies heavily on ESP32. The ESP32 is intelligent. This design includes sensors like a soil moisture sensor, a water level indicator, and a turbidity sensor. With the help of the Thingspeak application, this research study has developed a user interface (UI) that allows users to see the current condition of the complete system. Clean water will be saved thanks to the proposed design.

Keywords—IoT (Internet of Things), Reverse Osmosis (RO) muddy Water, Esp32, Thingspeak, wi-fi (Wide Fidelity), IOT Cloud, GSM Module, Sensor.

I. INTRODUCTION

As more people use water purifiers nowadays, more water is being used and wasted. As you probably already know, reverse osmosis only produces 25% of the water that is drinkable and uses 75% of the water produced. Therefore, the average water purifier wastes 4 glasses of water to produce just 1 glass of drinkable water. Those sewage lines receive the 75% of water that is squandered. An answer has been found to the previously mentioned issue.

The solution includes hardware that is completely automated by IOT and user-friendly because we used the Thingspeak application to allow the user to view a live status of the entire hardware and system's functioning. ESP 32 serving as the hardware's brain. Espressif Systems (ESP 32) will be used to operate the entire system and will be linked to the Thingspeak app, which will be downloaded and installed on the user's smartphone through wifi, in order to provide notification of each action made.

The system will gather waste RO water from every household and store it in a single communal tank. Following that, we will use ESP32-based automatic pumps to pump the water into the garden and grass. The water that was conserved can be used to wash cars. By utilising ESP32 and the Thingspeak Application, the entire process is automated. With this specific technique, fresh water that was previously utilized for washing and gardening would be conserved. There will be less water contamination.

History of Reverse Osmosis

Abbe Nolet, a physicist from France, invented reverse osmosis in 1748. In that same year, he noticed a solvent moving from a lower concentration solution to a higher concentration solution over a semipermeable membrane. As a result, the scientific community began to understand the theory of osmosis. Then, in 1877, Pfeffer studied the osmotic pressures of solutions with different compositions, made note that osmotic pressure rises with temperature, and found that the relationship between osmotic pressure and temperature remained constant in his tests.

The next step was taken by the Dutch scientist Van't Hoff, who combined these results into the well-known equation that bears his name and indicates that osmotic pressure is equal to the sum of solute concentration, temperature, and the universal gas constant, $\Pi = cRT$. This relationship's discovery, which held true for diluted solutions, contributed to van't Hoff's winning the 1901 Nobel Prize in Chemistry. Reverse osmosis as a water treatment technique wasn't really studied in depth until the 1950s.

Reverse osmosis study money was first made available by the Office of Saline Water in 1953. At the University of Florida, researchers Reid and Breton started looking into cellulose acetate as a viable membrane material. Then, in 1960, Loeb and Souririjan made a significant advancement in the creation of cellulose acetate membranes by developing a film with a permeability that was almost 500 times larger than the original. In 1966, Westmoreland and Bray of General Atomic invented the spiral-wound membrane structure, which has since been the standard for R.O membranes. In the late 1960s and early 1970s, applications for the technology emerged in the military, local government, and commercial sectors as it continued to advance and become more affordable . As a popular material for the production of reverse osmosis membranes, polyamide emerged in the 1980s and 1990s. Reverse osmosis is now the most widely used technique for desalinating water, surpassing thermal alternatives (such as distillation).

II. LITERATURE SURVEY

[1]Water is a unique resource that is plentiful in nature. Waterbodies cover more than 70% of the Earth's crust. Out of the entire supply of water present in the crust of the Earth, 97% of it is salty and 27% of it is still polluted but drinkable. Icebergs and glaciers make up the remaining 0.3%. The utility of water increases rapidly as the industrial revolution and technical development progress. The concept of "water reusability" was being proposed at the time by environmental campaigners. Reusability refers to using water that is already a waste product or a consequence of an industrial or residential process. "Desalination" is one of the extensively used techniques for water reuse. It addresses the method of getting rid of the salt content that is present in the body of water. Large plants with membranes of porous permeability are necessary. Desalination is a process that requires care and interest, but it's equally important to concentrate on reusing water in home and industrial settings. Reusing water on an industrial scale involves many different techniques, but household-scale reuse is only partially countable. Thus, a system that addresses the issue is proposed here, allowing for the reuse of waste water on a domestic scale, particularly at the household level, and controlling the process flow when determining the purpose of reuse in relation to factors like pH values and waste water turbidity levels.

[2]The basis of all life on earth is water. Clean One of our basic necessities consists of having access to clean water to drink. An urgent problem of water scarcity has emerged with the growth of urbanisation. Reusing and recycling waste water is inspired by this. In addition to outlining the necessity of waste water treatment, this essay provides a quick overview of the process' many steps. Only under specific conditions does the waste water treatment plan function at its best. Consequently, sensors can be utilised for automation at many phases of the

water treatment process. In addition to outlining the value and necessity of recycling waste water, this article offers a plan for automating the waste water treatment facility.

[3]The basic necessities of people, such as a clean, safe environment free of hazards, are frequently addressed by humanitarian responses. Polluted household waste water produces living conditions that have a direct impact on the wellbeing of people everywhere, including distant settlements and war-torn nations. We describe a transportable, semi-industrial, IoT enabled waste water treatment solution designed for distant sub-Arctic villages lacking centralised sewage systems or waste water treatment facilities. In order to run a home water reuse system, open-source hardware and software platforms were installed on an Arduino Mega and Raspberry Pi. The water recycling system was created as a component of the Alaska Water and Sewer Challenge to meet the need for a financially viable replacement for piped water and sewer service in undeveloped remote Alaskan Communities. The internet-enabled Arduino Mega and Raspberry Pi COTS, which allowed for both local and remote control, were used to operate the semi-industrial wastewater treatment system. The production model can fully benefit from internet of things concepts that would allow for proactive care scheduling, optimised time for treatment to meet available community electrical loads, and remote assistance and operation, to name a few. The treatment system was implemented as a proof-of-concept to evaluate existing waste water technology.

[4]The availability of potable, clean water is currently a serious worry for people all around the world. Sewage and industrial wastes have contaminated all of the water resources, including rivers, lakes, ponds, and others. There is growing public awareness about how wastewater contamination affects the environment. The water is cleaned utilising Physicochemical treatment and Biological treatment processes, among other wastewater treatment methods. To get rid of the contaminants, methods like coagulation, flocculation, and activated sludge have been used. The principal pollutants in wastewater—halogenated hydrocarbon compounds, heavy metals, dyes, pesticides, and herbicides—are to be eliminated by the wastewater treatment technique suggested in this research. In order to make wastewater reuse a reality and to improve water quality, we suggest this concept that every home have a water treatment plant.

[5]To further the national motto of "reduce, reuse, and recycle," the goal of this endeavour is to construct a reasonably priced robot to clean the trash out of the lake. With the aid of a conveyor belt, the robot gathers trash from the lake and deposits it in the trash container. An Internet of Things application is used to control the robot. The robot can navigate bodies of water by controlling the direction of its propellers by connecting to the Node-MCU board via the Wi-Fi protocol. The goal of this project is to reduce the amount of work required from humans to restore the blue colour of the planet's water bodies. The robot more effectively supports the labor force in protecting and restoring the lake's ecosystem.

III. METHODOLOGY

The following procedure and components are part of the designed system, as indicated in the below figure. The procedure will begin with waste water from residences' RO systems.

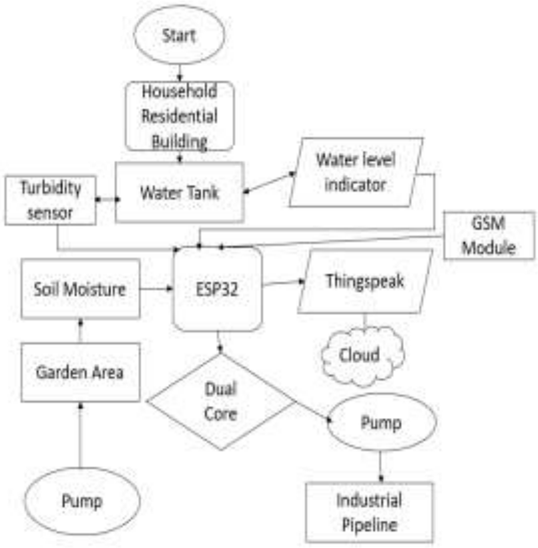

Fig. 1 System's Flow Chart

The waste water from household RO systems will be the first component of the above-mentioned system. It will be gathered in a shared tank that is located in the basement of the infrastructure. We will need fewer pumps and less electricity because the RO waste water would naturally flow through pipes due to gravity. Pumps will then be used to force the waste water into the garden area once the ESP 32 receives signals from the soil moisture sensor indicating that the soil's water content is declining.

A water detector is an electronic device that is intended to detect the presence of water for reasons such as to deliver an alarm in time to allow the prevention of water leakage. Building management systems can be integrated with water leak detection devices utilising a variety of protocols, including Modbus. Data centre and server room monitoring IT employees can be alerted using SNMP protocol leak detection solutions.

Like smoke in the air, turbidity is the cloudiness or haziness that results from a vast number of tiny particles that are often imperceptible to the unaided eye. Turbidity measurement is a crucial water quality test. Glass and plastic are examples of transparent solids to which turbidity (or haze) is also applied. The percentage of light that is refracted more than 2.5 degrees from the direction of incoming light is referred to as haze in the manufacture of plastic.

A Soil Moisture Sensor is one kind of low-cost electronic sensor that is used to detect the moisture of the soil. This sensor can measure the volumetric content of water inside the soil. This sensor is consists of mainly two parts, one is Sensing Probs and another one is the Sensor Module. The probes allow the current to pass through the soil and then it gets the resistance value according to moisture value in soil. The Sensor Module reads data from the sensor probes and processes the data and converts it into a digital/analog output.

In order for the user to observe the mechanism's real-time status, the ESP 32 has WI-FI connectivity, which is the project's primary requirement. Of all microcontrollers, ESP 32 is the easiest. From user to system or from system to user, data can be wirelessly sent and received. Bluetooth connectivity is included as well.It receives electrical signals wirelessly from the user's device and from the hardware via Wireless Fidelity (WI-FI) or Bluetooth communication.

Cloud computing is one element that makes the internet of things more accessible. Users can control hardware through cloud computing, which also makes it possible to multitask. When used, cloud compounding functions as a catalyst that allows users to instantly manipulate hardware. Cloud computing functions as a component of hardware that gathers information from sensors and transmits information and instructions to controllers via the user end interface. To store and distribute data in real-time for analysis and action, cloud computing requires cloud servers. Cloud servers are required for the system to function in order to transport data from hardware to the user interface.

The Thingspeak app will show the user how much water is in the tank when utilizing a second sensor, the water level indicator, which is placed within the tank. The Turbidity sensor gives the quality of the water. Additionally, it will communicate with the ESP 32 to activate the pump and transfer water to another tank or a commercial pipeline for use in upcoming smart city projects when the tank fills above a predetermined level. Thingspeak will be able to display the device's precise and current condition by connecting to the IOT cloud. When in use, cloud computing functions as a piece of hardware that gathers information from sensors and transmits information and commands from the user end interfaces to controllers. Real-time data delivery and archiving are done using cloud servers, which allows for the study and recording of all activities.

This project's process for saving data into the cloud storage is as follows:- The cloud storage saves the client's data into the servers as the client uploads or sends the data or file to the servers via any user interface; it saves a copy of that file so the client can retrieve the information in the file whenever they want from the servers. The live circuit data will be transferred by the ESP 32 to the servers of the Thingspeak app using WI-FI in this project. The extra water will be transferred to an industrial pipeline in accordance with the smart city programme of the Indian government. The GSM Module is used to send message to the mobile number to which the user mentioned in the code. There are several benefits to using RO for waterfiltration, but while cleaning, about 75% of the RO is lost.

The ESP 32, the circuit's brain, gathers data from every component, sends it into the cloud, and utilises relays to send user commands to each pump. A digital signal from the ESP 32 was used by the dual core relay to switch on and off the supply to the pumps. A single dual core relay device an individual may control is used to operate both pumps. Users can use the real-time data offered by soil sensors to control the on and off of pumps in order to conserve water.

IV. RESULT

The output is displayed on the LCD Screen

as shown in the above figure 4.1

Fig: 4.1 Output on LCD Screen

Different sensors were used in an experimental arrangement, and the IoT cloud received frequent updates with the sensor data for real-time monitoring.

The sensor readings gathered in the Internet of Things cloud. The sensor data is directly fed here through the Thing Speak cloud website. Temperature, turbidity, and readings were taken by the sensor. sss

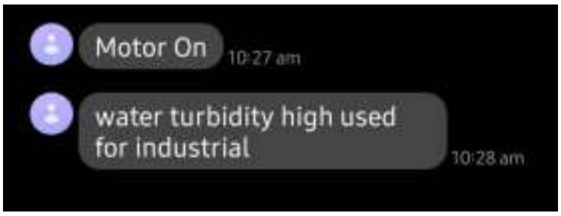

Fig: 4.2 Message received in the mobile.

From the results it is inferred that whenever the sensor readings go beyond the threshold, it will turn ON the motor for further recycling process and the valve is automatically closed. This will prevent using tainted water and allow for the elimination of atmospheric pollution. As a result, it will be possible to forgo using unreliable recycled water and to stop polluting the atmosphere. The GSM module is responsible for messaging. The first message is delivered to the user (when the sensor value is lower than the predetermined value). The water will be sent back to the filtering tank if the sensor value is not met when the user receives the message, it is assumed.

V. CONCLUSION

According to the study, it is possible to clean wastewater to produce water that is suitable for reuse. The outcomes demonstrated that three flows were amenable to collection, neutralisation, and additional treatment. The water could be reused following the amalgamation of several effluent kinds. 95% less sodium, 193 mg/L less chloride, and less nitrogen in the solution. Below detection thresholds, metals like iron and aluminium dropped. The TOC value was also less than 10 mg/L. By using the suggested wastewater treatment, the process diagram indicated that we could efficiently cut the water use by 85%. By successfully conserving fresh water, this module will not only reduce society's water use. There will be less maintenance required, and it will be more affordable. Gardening is also made simpler by it. This undrinkable water that was supposed to be utilised in place of our preserved water will now be used for a variety of other reasons by fresh water instead.

FUTURE SCOPE:

Future versions of the system will be capable of recycling water from various sources, including air conditioners.

And when the system is ready, the water gathered can be used for a variety of tasks, including building and mixing cement. As part of Atmanirbhar Bharat, the system would also supply that extra waste water to industries

In contrast to the 3.5% CAGR recorded between 2018 and 2022, the market for reverse osmosis pumps will increase at a 9% CAGR between 2023 and 2033. In industrial procedures, these pumps are used to remove impurities from water.

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