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SMART APPROACH FOR GROUND WATER RECHARGING BY RAIN-WATER HARVESTING

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ABSTRACT
In today's modern world water scarcity is emerging as a new problem due to various issues be it increasing population, industrialization, increase in various forms of pollution. All these issues collectively are becoming a major source for water scarcity or water pollution. Water scarcity is majorly faced in Urban areas and in few parts of Rural areas as well. As we all know water is very precious, we must take important steps and precautions to save water and increase water availability. The goal of the present study is to utilize rain-water and to take steps for the concept of nature conservation, in this study rain-water harvesting system is analyzed to be as an, replacement for the source of water. Harvesting rain-water is one of the best, simple and cost-effective way for the conservation of water. This study of model enables us to save rain-water for future usage as well as keeping an eye on its quality. This developed model satisfies all the requirement for the common usage of water in all the areas fulfilling basic needs.

Keywords: Water, water pollution, Harvesting rain-water and Ground Water

I. INTRODUCTION
We live in an era where technology is improving at a very fast pace but contrarily, we are missing on our basic needs such as water and its protection from pollution. Due to the continuous growth of industrialization which in-turn has resulted in the growth of Urban population and usage(wastage) of water at a very large scale and become a major reason for decline in underground water which is considered as source of clean water from the time of our ancestors.

Although India receives higher rainfall when compared to other nations of similar size it still faces issues when it comes to water usage and water conservation. When it comes to the point of water conservation, rain-water harvesting is believed to be one of the best solutions as rain-water is considered to one of the purest forms of water on the Planet. Rain-water harvesting system can be used to provide sources for high-quality, soft water and reduces our dependency on rivers, ponds, and supplementary sources of water. It is cheaper economically in implementing when compared to other sources of implementing conservation of water. It is easy to implement in industrial areas, residential areas or any other vicinity.

Quantum of water collected through rain-water harvesting is intangible form which it is not possible to measure the quantity of water harvested in the rainy season, if we could measure the quantum of water collected during rainy season through rain-water harvesting this data will be helpful for the government authorities on creating a roadmap to deal with the issue of water conservation.

This paper proposes a model to deal with the issues mentioned above including from the collection of water to measuring its quality and quantity. It can be done by the help of various electronic components which includes various sensors, pump, microcontroller along with IoT to keep the user updated on the quality and quantity of water stored in the storage element.

The main objective of the rain-water harvesting system is to fulfil the rising needs of water necessity, to decrease the groundwater contamination, to increase the underground water table, to use the water for usages other than drinking, it can also help us in reducing the water bills in urban areas, along with reducing flooding and soil erosion and using it for irrigation purpose in Rural areas.

II. RELATED WORKS
In recent years many approaches on rain-water harvesting system has been introduced in different views. Rain-water harvesting system has an accumulation area and storage system. The main concept of rain-water harvesting system involves collecting water and to store it in storage tanks and later used for various forms/purposes.

There were different ideas for RWH. One of those examples include method such as the device using sun energy for RWH. It contains ultrasonic sensor, cellular modem, low power draw processing unit. By using solar energy, it monitors the water level and uses rain-water harvesting approach in various places especially rural areas. The rain-water collection contributes to a large portion of water that is utilized by the people living isolated from municipal water supplies.

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Another method was quite different model which is statistical model. It is model practiced in area in Amman, Al Jubayah, which has the highest amount of rainfall. This is completely a statistical model which deals with the quantity of rainfall, storage of rain-water dependant on the area of rooftop and etc. It doesn't deal with handling the amount of handling all that water and its usage for future.

In another approach the user gets the information of all the necessary information on Desktop or Mobile and need not to worry about water quality. As a result of this paper the quality of rain-water and to establish a direct connect between RWH system and the user. This model deals mainly with establishing the connection between user and the RWHS through the means of IoT and doesn't deal with how to collect the data which is to be shown to the user.

An intelligent centralised rain-water harvesting project was utilised to conserve the rain-water process and additional sensors (rain water sensor, ultra-sonic sensor), and Arduino were used in one of the methods. The microcontroller is Arduino. The primary goal of this project is to save rain-water.

III. System Requirements

A. Software Requirements

1. ARDUINO IDE
2. BLINK APP
3. EMBEDDED C PROGRAMMING

1. ARDUINO IDE

The Arduino is an IDE. We have made use of Arduino sketch for Node MCU, the same is used to establish connection between the user and technical expert to achieve IoT environment. It is also used for designing the widgets in the Blink app. The replacement of binary data into percentage is also done by using Arduino IDE.

2. BLINK APP

The Blink app aims to allow users to swiftly construct interfaces for supervising and observing all of user hardware projects from their iOS or Android device. After installing the Blink app, we construct a project on dashboard along with arranging buttons, graphs, and other widgets on the display. The widgets may be used to turn images on and off, as well as many other apps that display infrared data.

3. EMBEDDED C PROGRAM

Embedded C is a popular and widely used programming language in the creation of a wide range of embedded devices. It is a well-known programming language that is widely utilised in all fields for developing various programming embedded models. Embedded systems are commonly developed using a variety of programming languages such as assembly, BASIC, C++, Python, and others.

B. Hardware Requirements

1.pH Sensor

2.TDS Sensor

3.Flow Sensor

4.LCD Display

5.Electromagnetic Relay

6.Power Supply

7.Pump

8.ESP32 Module

1. PH SENSOR

PH meter is an instrument that quantifies the hydrogen ion activity in water-based solutions. It is used to measure the acidic or basic nature in various solutions. If solution has a value lesser than 7 on scale then it is considered as solution is acidic and if it is greater than 7 on scale then it is considered as solution is basic and 7 is a neutral value. The values of various solutions changes based on its parameter.

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2. TDS SENSOR
TDS Sensor is hardware component is used to detects quality of water by measuring the order of opaqueness. It's a deice which is used to detect the total dissolved solids in solution. The dissolved solids like salts, minerals and so on. TDS values below 300 mm per litre is considered for drinking purposes.

3. FLOW SENSOR
Flow Sensor is a hardware component which is used for measuring the speed or flow rate of moving water. The working principle of Flow Sensor is Hall effect.

4. LCD DISPLAY
A liquid-crystal display (LCD) is a flat display panel or electronically tuned device that makes use of polarizers to modify the light modulated characteristics of liquid. Each and every running model uses an LCD to display output on a screen.

5. Electromagnetic Relay
Electromagnetic relay works where low power signal can be used to control circuit and use for various purposes. It is used to control the operation of DC motor. It consists of various parts like Electro-magnet, moving armature, Switching point contacts and spring.

6. POWER SUPPLY
Power supply is used to power the various hardware components used for accurate working of devices and displaying accurate results. It comprises of step-down transformer, diodes, capacitor, voltage regulator which provides output of 12V DC.

7. PUMP
Pump is a gadget that displaces fluids like various liquids, gases by various mechanical actions like converting electrical energy to mechanical energy.

8. ESP32 Module
ESP32 Module is a low cost efficient which is on chip microcontroller with integrated Wi-fi module and Bluetooth. It is manufactured on 40nm process.

IV. METHODOLOGY

The block diagram consists of various software and the hardware components discussed in the previous chapter.

Here microcontroller is considered as a target, which acts as a mother board where it is connected to other devices/components (hardware and software components).

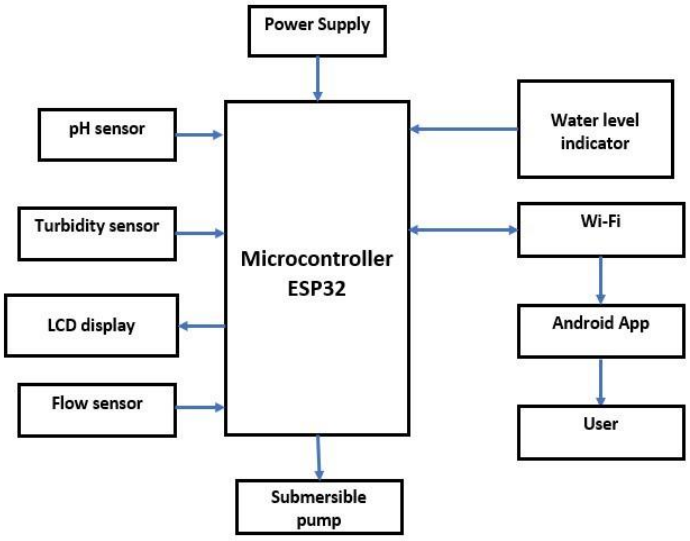

Figure1: Block Diagram

The information from various sensors reach microcontroller which is powered by power supply. Ph sensor which is used to check whether water is fit for drinking or not, TDS sensor which is used to check any dissolved salts present in water and make fit for drinking by purifying it, Flow sensor is used to measure the

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volume of water flowing through pipe to storage tanks which is used to measure quantity of water, Water level indicator which is used to know the water level in tank, LCD display is used to display the contents of all parameters on lcd board. Pump which is used to pump the excess water from tanks which is used in case of emergency (power loss). All information from various sensors which is in microcontroller perform various operation and later send to wi-fi module which is in turn reach to user via mobile application (blink app).

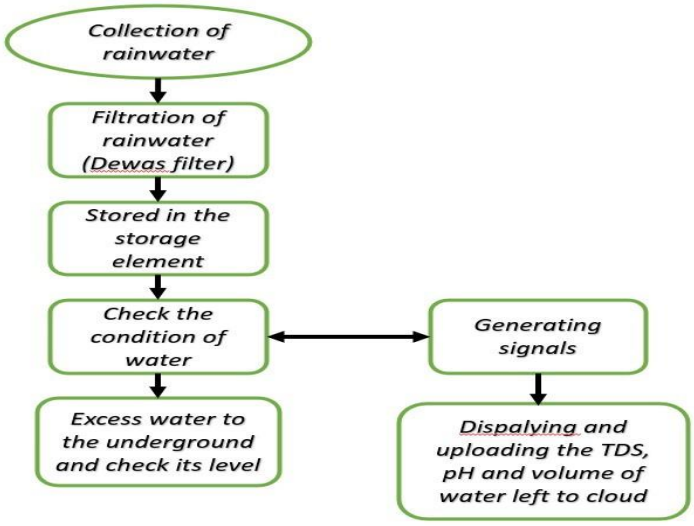

Figure2: Flow chart explaining RWH

Here we gather rain-water from the roof tops and store it in reservoirs. The main intention is to make provide water for future usage. Gathering and collecting rain-water for use is mainly important in dryland, hilly, urban and coastal areas and also in many other places.

Studies on RWH have till date have focused on harvesting of water only but poor quality of rain-water sometimes, makes it difficult to check the quality of water. Hence, quality of water becomes an important part of RWH.

In today's world, because of increased emission of gases that are toxic in the environment, has resulted in receiving acid rain. If pH of rain is greater than 5 it is suitable for drinking but if it is less than 5, it is unfit for drinking. Use of bad quality of water imposes bad effects on health. It can become a reason for illness and diseases such as: Vomiting or Diarrhoea, Sick stomach, skin rashes, Cancer (like leukaemia), Reproductive problems (like Infertility), Developmental problems (like Learning disabilities).

In 2001 Kerala received blood rain i.e., rain in red colour. This red coloured rain dyed the clothes pink in colour. Green, yellow and black coloured rains were also reported in Kerala, and eastern and north-central provinces of Sri Lanka. As a result, it becomes necessary to check the pH of rain-water before harvesting it. To take measures for water scarcity, quality and unequal distribution, new techniques are in demand to be explored.

V. RESULT DISCUSSION

The above model is Smart Approach to Groundwater Recharging by Rain-water Harvesting System deals smartly with the problem of decrease in underground water by various problems such as pollution, population, wastage of water.

Here we are using various sensors such as pH sensor, TDS sensor, water level indicator to measure the pH, turbidity, and level of water in the storage element respectively along with a flow sensor which is used to measure the rate of flow of water from temporary storage to permanent storage.

We are using two storage elements to store the water, one for the immediate usage which can come in handy during long power-cuts in rainy season and the another is a permanent tank which will be the underground unit of water storage.

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Figure 3: Rain-water harvesting prototype model

Dewas filtration system is used to filter the water from impurities which has various size of pebbles along with charcoal to ensure the purity of water.

User can stay up to date about the quality and quantity of water in the permanent tank as this model is equipped with IoT to update the user about all the information, all these data is sent to user's mobile phone through Blynk App also it displays all these values in an LCD display.

A pump is used to pump the water from permanent unit to using unit of storage when required. All these functions of the model are controlled by the ESP32 microcontroller which is the heart of this project.

The model can be powered by 12V DC supply, an adapter can be used when using AC supply to convert DC supply of 12V can be used to power the device. the incoming AC to DC for the model or directly a LM317 voltage regulator is used to regulate the voltage for pump and pH sensor whereas pH sensor is also equipped with its own pH board which converts analog data of pH meter to digital data.

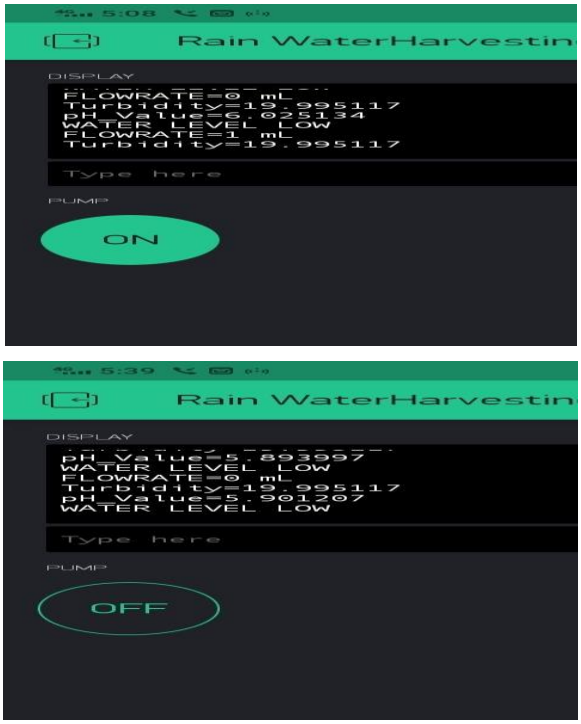

Figure 4: Snapshots of result obtained on Blink app

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The above figure explains the output displayed on blink app. Here various components output like ph value, TDS value, Water level value and flow rate. All the component readings displayed on blink app reach user via mobile phone.

VI. CONCLUSION

Rain-water harvesting system conventionally mean and deal only with storing and using the rain-water for future usage when there is drought or some other natural calamities where living beings face water shortage. Our model not just does this conventional function of rain-water harvesting but also keeps a track on the quality and quantity of water stored and keeps the user up to date on all the information with the assistance of IoT provided to this circuit with the help of Wi-Fi module in the ESP32 microcontroller. Our model uses two storage elements and provides facility to use the water stored either immediately or later based on the user requirement and monitors the amount the water used in the form of water flown to the permanent tank from storage tank with the flow meter connected in between temporary and permanent storage elements.

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