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Smart multi water harvesting system

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Abstract— *This paper aims to provide an integrated smart home functional solution for every household to mitigate one of humanity's biggest challenges which is 'Water scarcity. This has been achieved by approaching a classical water collecting and reusable system which is based on Rain Water Harvesting (RWH) phenomena in association with advanced automated technologies like sensors, Arduino processors etc. These accessories have been taken here because these components consume low power and it is also environmental friendly. In this project rain water has been collected from roof top to a tank by smart water sensible movement of a valve. The water is not only being stored but it is also gets purified automatically after reaching to a certain level through the process of basic filtration and UV treatment. Therefore, the water within it becomes suitable for drinking. This system also deals with storing and purification of grey water through chemical treatment, which can be later used for various household applications like cleaning toilet, irrigation etc. The proposed model is effective, budget friendly and easily installable. The use of this smart home automation system will eventually help in saving the water for household. Additionally, other environmental advantages can be acquired through this process like recharging of the ground water, reducing soil erosion etc.*

Keywords— *Rain water harvesting (RWH), UV treatment, Basic filtration, Grey water, Sensors.*

I. INTRODUCTION

Times are changing and the planet slowly seems to be turning hostile. Due to increasing nature of the earth's temperature and greenhouse gas effect, climate changes and as results different natural disaster can be seen now days such as droughts, floods, famines etc. However there is still hope that this damage can be repaired and there could be conservation of resources for the mankind. With increasing population the pressure on natural resources like land, water has increased exponentially. With the increase in urbanization all the free surfaces have been cemented and this prevents the ground water table from recharging [1]. India receives some of the highest amounts of rainfall in the world but still some parts of our country experience dry spell conditions. The optimal solution to this problem is water harvesting. Currently there is a loss of approximately 72.5% water that can be used in various domestic activities. This paper talks about an efficient water harvesting and reusing device and its developments, made specifically for the domestic environment. Rainwater harvesting for smart water management helps to manage the rainwater collected on our terrace or rooftops [2]. If someone observes carefully, it can be noticed that, in most houses the rainwater from the terrace and rooftops are drained down to the storm drains with the help of pipes. This water can be utilized for various household activities after an efficient treatment i.e. for domestic work areas as well as for drinking purposes [3]. In Southern India , few

systems exists for rainwater harvesting, but nevertheless water conversations still remains an issue due to poor maintenance and utilization of these systems. In this manuscript a smart model has been developed with a better solution which is very convenient and cost effective and it will be able to handle the above stated issues. Reusing domestic waste water can contribute a lot in water conservation sectors. In this work, especially the problem has been figured out with kitchen waste water and additionally there is also a plan to provide a solution for managing the domestic Grey water for its reusable in near future [4, 5].

II. METHODOLOGY

In recent years due to the growing water scarcity the development of water management systems have come into focus .In many states like Tamil Nadu ,Bihar ,UP etc. , it has been made mandatory to install the water management and harvesting systems. A RWHS has generally two parts water catchment and storage tank. There are various methods of RWH among which the most common is using roof top as water catchment and then storing it in tanks but all the existing methods only deals with collecting and storing rain water which sometimes gets over flowed , the collected water is then manually operated for purification. So on analyzing these RWHS systems has been upgraded using IOT [6]. Here, the system collects the rain water in a smarter way ensuring zero over flow of rain water. Afterwards, it will be able to purify the water automatically through basic filtration and UV treatment thus making it fit for drinking .In order to enhance the collecting capacity, a proper tank size along with a suitable roof material is required .Each roof material has different run off coefficient indicating the efficiency of roof material to harvest rain water. Runoff coefficient takes in to account losses due to spillage, leakage, surface wetting and evaporation. Material having high runoff coefficient will lead to proper channelling of rain water droplets. Materials have been selected accordingly on basis of the water requirement. So here are some of the materials with their respective run off coefficient [7]. The below stated table 1 shows the materials along with its various coefficient values [1].

Table 1: Materials along with its coefficient values

Roof material	Run off Coefficient
Metal	0.95
Slate Tiles	0.90
Concrete blocks	0.60
Green roof	0.50
Gravel	0.25

Along with rain water harvesting the modified system stores and purifies the grey water from kitchen through basic filtration, oil filtration and chemical treatment .The treated water can be used for cleaning, irrigation, toilet etc. All this treatment process occurs automatically and hence no human interference is required [8] .
The block diagram of the overall methodology has been demonstrated in the below Fig. 1.

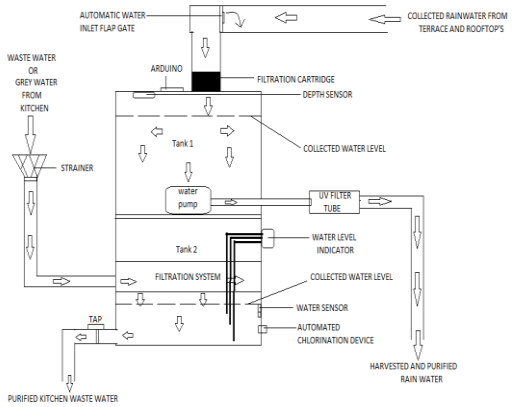

Fig 1: Block diagram of the overall developed system.

System flow chart of the overall model has been shown in the below Fig. 2.

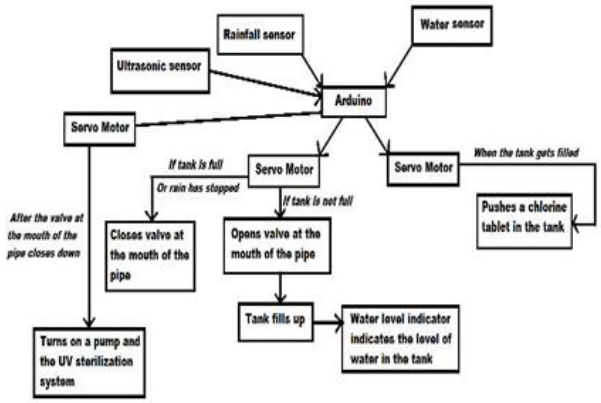

Fig 2: Flow chart of the overall developed system.

The overall circuit diagram of the developed model has been represented in the next Fig. 3.

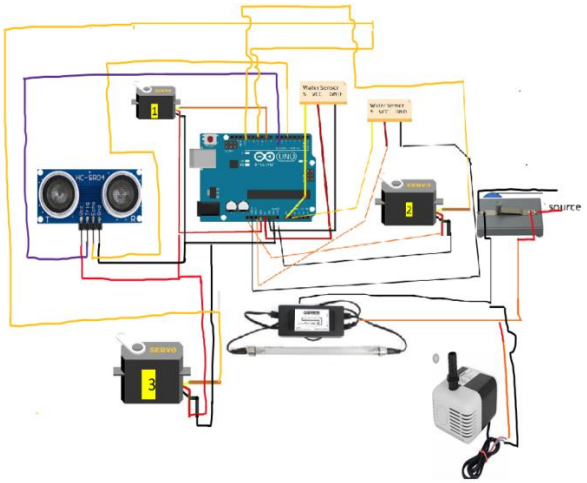

Fig 3: Overall circuit diagram of the developed model.

The components and materials which are being used here to develop the system have been depicted accordingly.

A. Arduino Uno Board

An arduino is used to control the whole system. It is programmed and used to control the servo motors, water sensors, the ultrasonic depth sensor used in the device.

B. Servo Motors

The servo motors are used in three sections of the system. In tank 1 it is used in the closing and opening of the water inlet / valve for rainwater, it is also used in the diy switch that turns on the AC operated water pump, and it is also used in the chlorination system of tank 2 where it acts as a mechanical hand to push chlorine tablets in the kitchen grey water.

C. Water Sensors

Two water sensors are used in the system, where one is used in tank 1 , that senses rainwater and is responsible for opening and closing of the water inlet valve's flap. The second sensor is connected in tank 2 that is responsible for working of the chlorination device.

D. Ultrasonic depth Sensors

It senses the water depth in tank 1 and sends a signal to the arduino which in turn sends a signal to the servo motor of the water inlet valve which closes or opens the flap depending on how much water is present in the tank . The arduino also sends a signal to the servo motor in the diy switch which helps in turning on the switch that actually turns on the A.C powered components like the water pump and UV filter present in the system.

E. Water Sensors

Two water sensors are used in the system, where one is used in tank 1 , that senses rainwater and is responsible for opening and closing of the water inlet valve's flap. The second sensor is connected in tank 2 that is responsible for working of the chlorination device.

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It senses the water depth in tank 1 and sends a signal to the arduino which in turn sends a signal to the servo motor of the water inlet valve which closes or opens the flap depending on how much water is present in the tank . The arduino also sends a signal to the servo motor in the diy switch which helps in turning on the switch, that actually turns on the A.C powered components like the water pump and UV filter present in the system.

G. Water pump

A water pump is used in tank 1 to pump out the water from tank 1 to the uv filtration system.

H. UV filtration tube

It filters the pumped out water, by killing any living bacteria that is less than 0.3 microns in the Water.

I. Water level indicator

A water level indicator made out of LED's, translators and resistors powered by an external D.C source indicates the water level in tank 2 , and states whether the water is at low level, good level or Full level depending on which the user will decide to put more water in tank 2.

J. Home made filtration system

It is a basic filtration system consisting of sand, activated charcoal, cotton swabs, pebbles and small stones that are layered in a compact manner that filters out the kitchen grey water and makes it somewhere reusable.

All the components which have been used here to design the model has been shown in the below Fig. 4.

		
(a) Arduino board	(b) Water sensor	(c) Ultrasonic sensor
		
(d) Servo motor	(e) Pump	(f) UV filter

Fig 4: Different components which have been used here to design the model.

III. RESULTS AND DISCUSSIONS

Here, in this work, two bottles of water have been utilized to test the physical working nature of the whole model. One of them contained soul and dust to simulate the dust that would be washed off the roofs when we collect it. The second bottle contained vegetable peels to simulate the kitchen sink water. The different stages of purification worked out as desired. The servo motors rotated in the correct direction and in order to first collect the rainwater and then purify it, also by taking care that the tank does not overflow. The second set of purification of kitchen waste water also met the expectations and the servo motor ensured that a chlorine

tablet has been added to the tank to finish the purification stage. The hardware model of the whole system has been shown in the below Fig. 5.

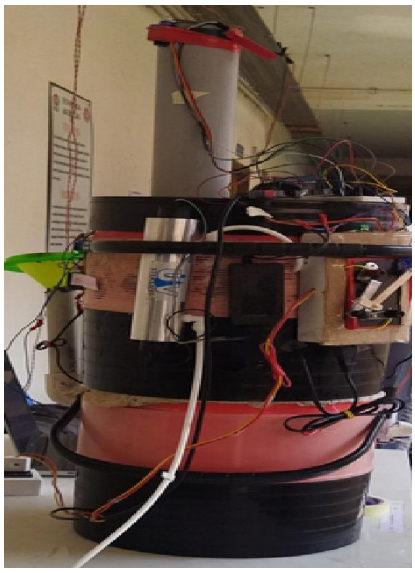

Fig 5: The hardware model of the developed system.

IV. CONCLUSIONS

There are many devices available in market for rain water harvesting. However in this model IoT working principle has been adopted which has been made the whole system much more convenient to use compared to other systems. The sterilization ensures that pure water for drinking can be available from the above stated system. Additionally, the kitchen waste water purification system will also be able to increase the overall efficiency of the system and will be able to provide more productive output in water management sectors. This model can easily be used in household purposes to fight with the greenhouse gas effect and ultimately make an easy and suitable climate to live for the human being.

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