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LabVIEW based Rainwater Harvesting System

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Abstract: Today, there is a lack of water resources to meet water demands. Rainwater is a natural source of water to human beings and living things, which is not being used productively. The productive use of rainwater is called Rainwater Harvesting. The collected water may be used for drinking, gardening, household purposes etc. Our proposed solution is to monitor and control the quality and quantity of water using LabVIEW programming software and accordingly take further steps. The collected water goes through the threshold values of quality measurement i.e., pH value, Turbidity & Conductivity, while measuring the level of harvested water in the sump. If the harvested water is qualified, it can be used for household purposes and if it is not qualified, the harvested water sinks into the ground to increase the groundwater level. The aim of this project is to increase the groundwater level, productive usage of rainwater, reduce the water bill and it has less maintenance and is cost efficient as well. The future scope is to purify the water using filters and convert it into drinking water and irrigation purposes.

Index Terms: LabVIEW, Harvesting, pH Sensor, Arduino

I. Introduction

Rain-water harvesting is a method that is used to preserve rainy water for different uses and in future needs as well. Rainwater Harvesting is a technique of collecting and storing rainwater and to be used for various purposes while it can be used in future as well.

Rainwater harvesting systems were used long back to at least 4,000 years ago [1], the ability to estimate rainfall based on historical data continues to be the topic of much discussion [5]. The difficulty in estimating rainfall is increased when attempting to derive an optimal design of RWH, a system which is largely dependent upon the ability to model supply, demand, and storage effectively. We modify the non-parametric, stochastic rainfall generator of [2] increasing the daily data collection time frame from 50 years to 64 years while retaining the assumption that daily rainfall probabilities and distributions are contingent upon knowledge of a 30 days centered moving average around the previous day's information. We gather daily rainfall data from the United States National Oceanic and Atmospheric Administration.

As an additional extension over previously submitted work, we also evaluate the possibility of non-stationarity, the idea that water variability is non-constant over time, which recent studies indicate to be a serious problem [7]. In this study, we were concerned only with the stationarity or non-stationarity of supply rather than the larger analysis of regional water availability of primary interest is the required roof surface area and cistern volume to design a system capable of supporting all of a small family's water needs with 100% reliability in a semi-urban region of American countries and based on analyses of supply, demand, efficiency, occupancy, and other distributions. The results of the analyses are summarized in a response chart and a fitted multiple regression equation, another useful extension, which is also potentially useful for water planners in this region of American countries. The significance of this study is important. First, the study extends previous non-parametric rainfall generators longitudinally. Second, the study evaluates non-stationarity of rainfall as part of a potential rainfall estimator.

Third, it provides a mechanism for determining the optimal roof surface area and cistern size for the construction of an RWH that is 100% reliable. Fourth, the conclusions from the study informed the real-world construction of an author's RWH. This study also expands and improves a paper currently under journal consideration in several major ways. First, we extend the analysis of rainfall generators to explore for non-stationarity of rainfall in the geographic region, a unique contribution. Second, we provide separate surface response plots for given family sizes, which are more useful to RWH system planners. Third, we provide curve fitting models via regression that allow planners to have estimates of what building requirements are likely to be needed. Fourth, we evaluate the portability of models across family sizes. None of this work has been published or presented previously by the authors. Rainwater harvesting in urban and rural houses is shown in figure 1.

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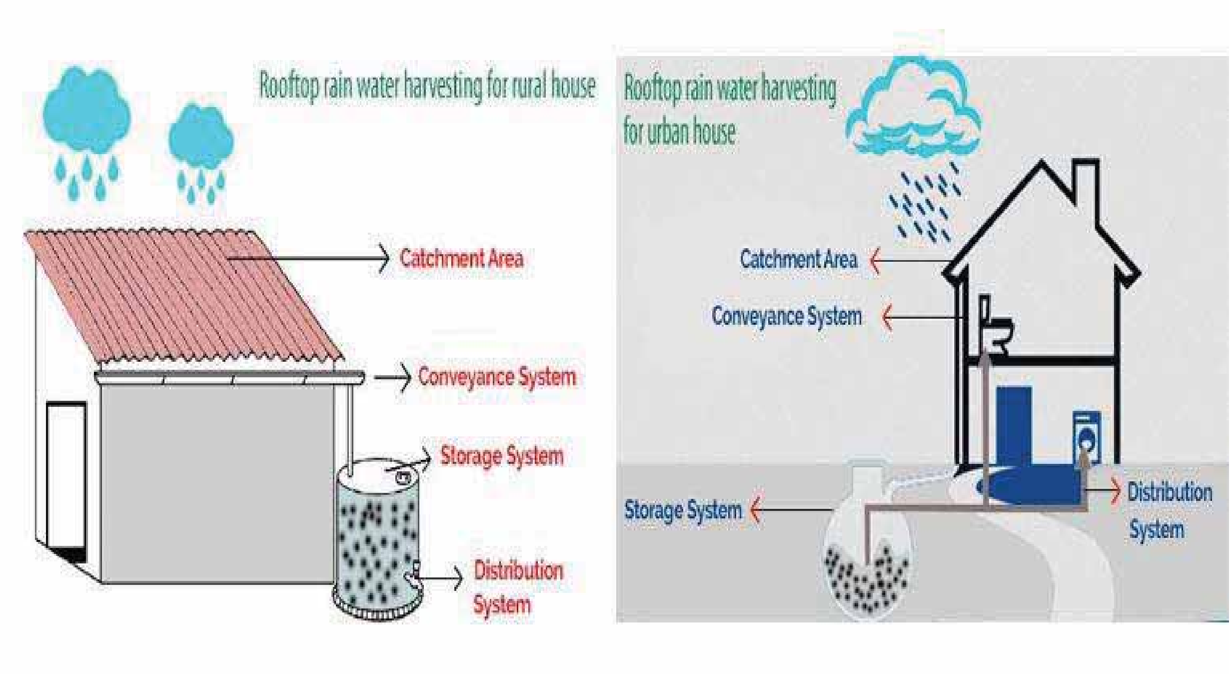

Figure 1. Rainwater Harvesting in Urban and Rural House

II. Literature Review

[12] Rain-water harvesting is a technique of collecting and storing rainwater from rooftops, the earth surface or rock and earth catchment area using normal techniques such as jars and pots as well as more complex techniques such as underground check dams and sumps. The techniques usually found in Asian and European countries arise from practices employed by ancient civilizations within these regions and still serve as a major source of drinking water supply in rural areas and urban areas. Commonly used systems are constructed of three principal components: catchment area, collecting device, and transport system.

[10] Issues are dedicated to rainwater harvesting, available through ITDG Publishing, Photo-manuals by Eric Nissen-Petersen. A range of manuals on how to build several tank types including cylindrical water tanks with dome, an under-ground tank, smaller water tanks and jars, installation gutters and splashguards.

Domestic Water Supply Using Rainwater Harvesting, by [11], Director of the Development Technology Unit, University of Warwick. Rain-water harvesting is a technique of collecting and storing water drops during the rainy season and for use in times when there is small rain to no rain availability. In certain regions of the world rain-water harvesting can be the difference between having a plentiful crop and dried up vines. There are several objectives behind rainwater harvesting.

Increase the availability of water during drought season. Many eco-systems have wet and dry seasons. Because the dry seasons can consist of weeks or months of little to no rainfall, it is important to collect the water during the rainy season and have it available for use during the dry season. Rainwater harvesting enables you to store rain when it is prevalent to be used when there is no rain.

III. Implementation

RWH is a method of capturing and storing water during rainy periods for use in times when there is little to no rain available. In certain regions of the world, rainwater harvesting can be the difference between having a plentiful crop and dried up vines. There are several objectives behind rainwater harvesting.

Increase the available water level during hot Seasons. Many eco-systems have wet and dry seasons. The hot season is a period of weeks or months and little to no rain, it is important to collect it during the rainy season and have it available for use during the hot season. RWH enables storage of water when it is prevalent to be used when there is no rain.

Prevent overuse of Aquifers. As cities and towns grow the need for water increases. Many municipalities rely upon aquifers deep below the ground for this water supply. The problem is it takes a long time to replenish an aquifer if it is quickly drained. By harvesting rainwater for later use, the demand on aquifers is reduced, which enables them to remain full.

Save Money and Pumping water up from underground can be a cost effective method. It is estimated that for every one-meter pumping of water level, there is a consumption of 0.4 Kilo watt. Hour of electric power consumption. So, by having water nearer to the surface, or at the surface in reservoirs, less electric power is required to collect the water so less money is spent.

The block diagram of the harvesting system is shown in figure 2. Block diagram of LabVIEW based rainwater harvesting system shown in figure 3.

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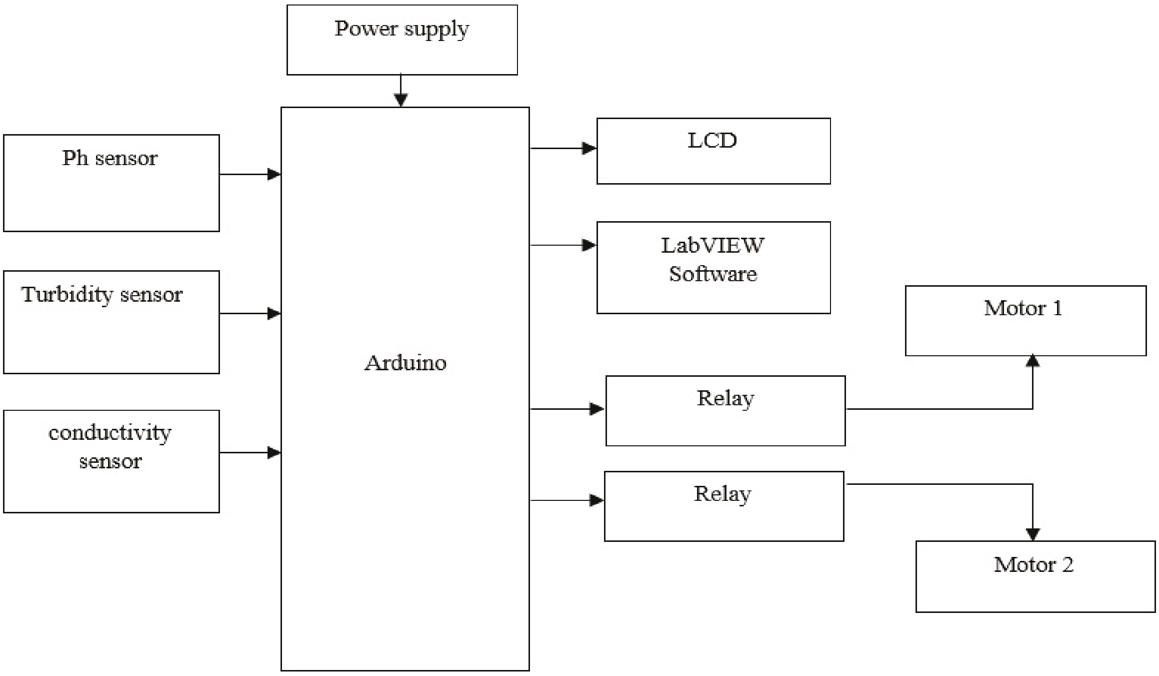

Figure 2. Block diagram of the system

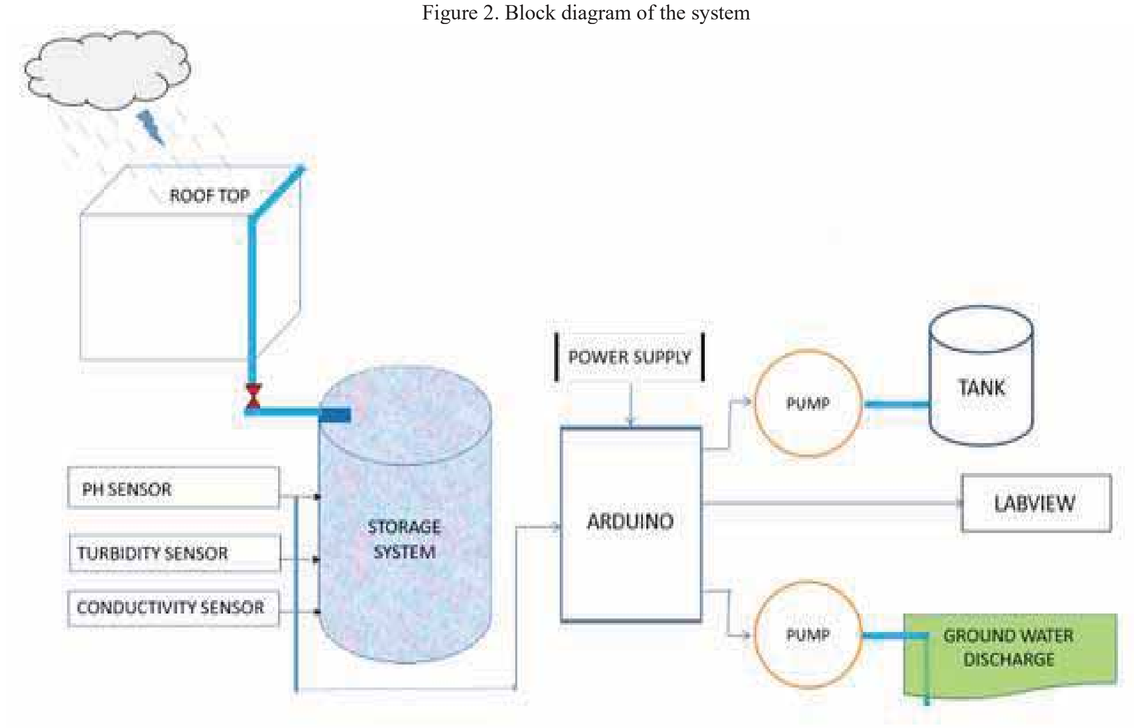

Figure 3. Block Diagram of Rainwater Harvesting Using LabVIEW

IV. Results

Harvesting and collection of rainwater is used to solve the problem of water crisis globally. The use of a rainwater harvesting system provides more advantages for any water crisis and domestic applications like drinking purpose, irrigation etc. This technique can be a boost to an incredible solution in areas where there is enough rainfall but not enough supply of ground-water. It will not only provide the most sustainable and efficient means of water management.

For this, the Government agencies should come out with an appropriate incentive structure and logistic assistance to make it a real success. Rain-water harvesting is something that hundreds of families across the world should participate in rather than pinning hopes on the administration to fight the water crisis. This water conservation technique is a simple and cost-effective process with numerous benefits that can be easily practiced in homes, apartments, parks and across the world. As we all know, charity begins at home, likewise, a contribution to society's welfare must be initiated from one's home. The hardware implementation of the system is shown

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in figure 4 and figure 5 shows the graphical user interface of the system using LabVIEW software.

Below are the results of the system:

1. Rainwater harvesting system is monitored and controlled using LabVIEW software.
2. Water level control and monitoring is done through wireless technology.
3. Water quality analysis includes pH, turbidity, and conductivity of water is monitored.
4. With the above analysis, water is sent either to the tank or it is discharged to the ground for drinking and gardening purposes.

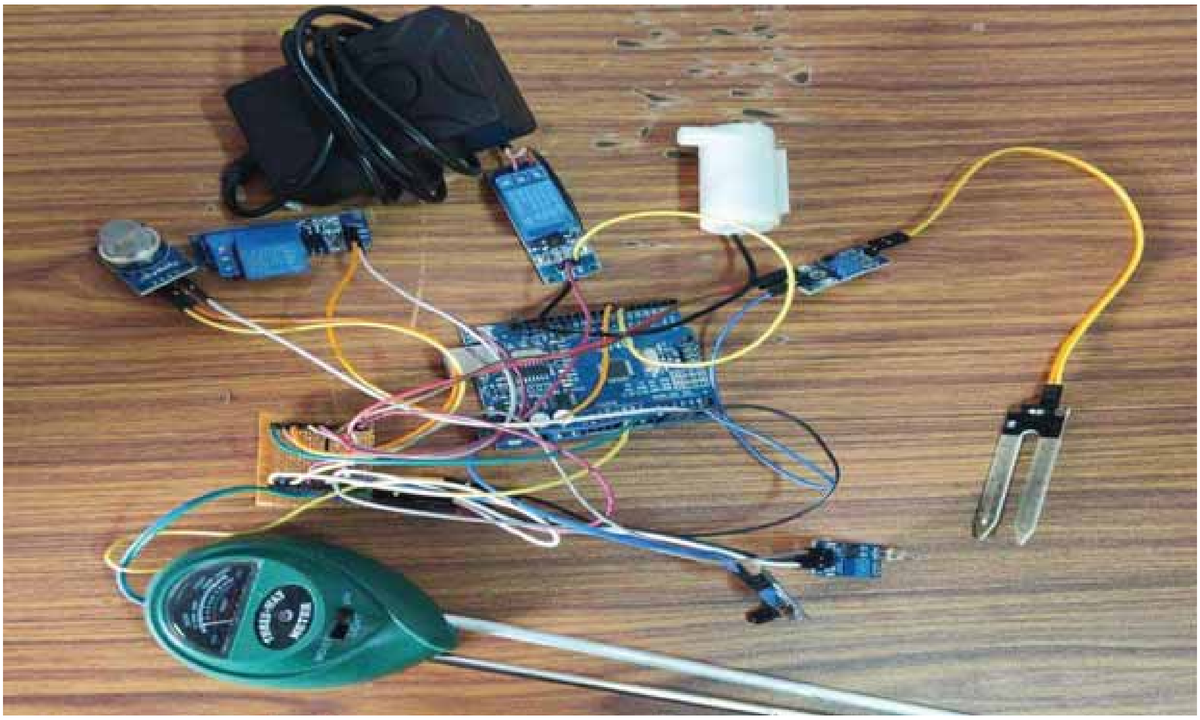

Figure 4. Hardware Setup of the system

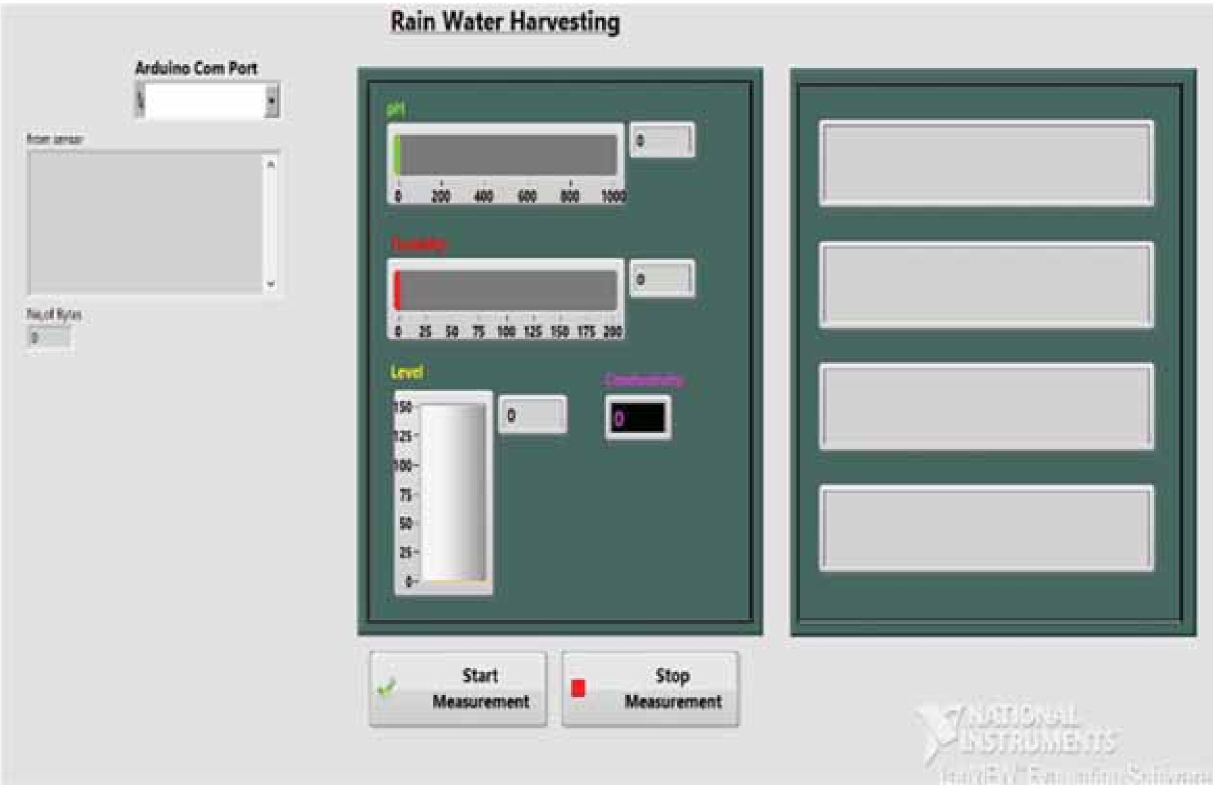

Figure 5. LabVIEW display of the system.

V. Conclusions

The Rainwater Harvesting System Using LabVIEW mainly aims to improve the quality of ground water resources and to meet the increasing demand for water during dry seasons.

Nowadays, rainwater is being used as the primary source of drinking water in several rural areas and semi urban areas. Because rainwater is free from pollutants and contains salts, minerals, and other natural contaminants. In areas where there is excess rainfall, the surplus rainwater can be used to increase ground water level through artificial recharge techniques.

In urban areas, water harvesting is usually done with the help of some infrastructure or the simplest method for a rainwater harvesting system is storage tanks. In this, a catchment area for the water is directly linked with cisterns, tanks and reservoirs. Water can be stored here until needed or used daily. The roofs of homes or apartments are the best catchment areas provided, they are large enough to store daily water needs. Other than that, large bowls and tarps can also fulfill the function.

References

[1] Abdulla, F.A., & A. W. Al-Shareef. 2019. “Roof Rainwater Harvesting Systems for Household Water Supply in Jordan.” Desalinization 243:195-207.

[2] Basinger, M., F. Montalto, and U. Lall. 2018. “A Rainwater Harvesting System Reliability Model based on Nonparametric Stochastic Rainfall Generator.” Journal of Hydrology 392:105- 118.

[3] Evans, C.A., P.J. Coombes, and R.H. Dunstan, RH. 2016. “Wind, Rain and Bacteria: The Effect of Weather on the Microbial Composition of Roof-Harvested Rainwater.” Water Research 40: 37-44.

[4] Guo, Y. and B.W. Baetz. 2017. “Sizing of Rainwater Storage Units for Green Building Applications.” Journal of Hydrologic Engineering 12(2): 197-205.

[5] Lall, U., and A. Sharma. 2014. “A Nearest Neighbor Bootstrap for Resampling Hydrologic Time Series.” Water Resources Research 32(3): 679-693.

[6] Magyar, M.I., V.G. Mitchell, A.R. Ladson, and C. Diaper. 2017. “An Investigation of Rainwater Quality and Sediment Dynamics. Water Science & Technology 56(9) 21-28.

[7] Milley, P.C.D., J. Betancourt, M. Falkenmark, R. Hirsch, Z.W. Kundzewicz, D.P. Lettenmaier, and R.J. Stouffer. 2008. “Stationarity is Dead: Whither Water Management?” Science Magazine, 319: 573- 574.

[8] National Geographic. 2020. “Water Footprint Calculator Methodology and Tips. Accessed 10 March.

[9] National Oceanic and Atmospheric Administration. 2012a. NNDC Climate Data Online. Accessed 7 March.

[10] John Gould “Rainwater catchment systems: reflections and prospects” pp: 2-5, volume 18, January 2010.

[11] Ibrahim, Gaylan Rasul Faqe; Rasul, Azad; Ali Hamid, Arieann; Ali, Zana Fattah; Dewana, Amanj Ahmad "Suitable Site Selection for Rainwater Harvesting and Storage Case Study Using Dohuk Governorate". April 2019.

[12] Duke, Katie. "Ownership of Rainwater and the Legality of Rainwater Harvesting in British Columbia". Appeal. Retrieved 2016-03-29, 2014.