IJARETY

International Journal of Advanced Research in Education and TechnologY (IJARETY)

Volume 11, Issue 5, September-October 2024

Impact Factor: 7.394

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 5, September-October 2024 ||

DOI:10.15680/IJARETY.2024.1105038

Green Technology -Building a Solar Energy Based Moisture Sensor for Water and Soil Conservation

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ABSTRACT: The main aim of this Multidisciplinary Facet project is to build equilibrium and stability between the harmonious coexistence of organisms and their environment by adopting Conservation practices, to maintain ecological balance and ensuring the availability of natural resources for future generations.

Earth, tree and water are linked to each other and due to vast urbanization, industrialization and Irrigation we are breaking nature's rules, and now the time has come to give back or restore our natural resources. In India, almost two-thirds i.e 63 percent of India's districts are threatened by falling groundwater levels, which can further affect food and water security in India under climate change.A national database on land degradation prepared by the ISRO 2016 shows that 120.7 million hectares (MHA), or 36.7 percent of India's total arable and non-arable land, suffer from various forms of degradation with water erosion being its chief contributor in 83 MHA (68.4 percent).

Due to the Nomadic Pattern and under- construction Process of the B.J.R. Government Degree College, the land has become barren land. Which was not suitable for Plantation. Hence, we created, established, and are maintaining Greenary through the novel Miyawaki Technique and other Innovative Techniques which were adopted by the college. After Developing this Miyawaki garden in our Space Constraint BJR Government Degree College, we have observed that a lot of Run-off water and Topsoil erosion while watering the Plants.Hence we came up with this Green Technology – Solar energy based Soil Moisture Sensor.

I. INTRODUCTION

What is a Ecosystem

Definition: An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic or living, parts, as well as abiotic factors, or non-living parts. Biotic factors include plants, animals, and other organisms. Abiotic factors include Water, Soil, temperature, and humidity.

In the ecosystem all the organisms and the physical environment interact with each other. These biotic and abiotic components are linked together through nutrient cycles and energy flows. Energy enters the system through photosynthesis and is incorporated into plant tissue.

What Maintains Balance in an Ecosystem?

Maintaining balance in an ecosystem involves hierarchical organizations, biogeochemical cycles, and other stabilizing factors. What keeps an ecosystem in balance includes factors like Water,Soil,energy cycling, feedback loops, species diversity, keystone species, and food webs. Additionally, disturbances to an ecosystem can have different impacts based on whether organisms are affected on an individual, population, or communitywide scale.

Water Resources in India

Water is essential for sustenance of life. India accounts for about 2.45 per cent of world's surface area, 4 per cent of the world's water resources, there are four significant surface water resources. They are rivers, lakes, ponds, and tanks.It is a limited resource. Water resources of the country are required to be harnessed judiciously to meet the growing requirement of our developing economy. Therefore, development, conservation and management of water resources are crucial.

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Soil Resources in India

Soil is one of the most precious resources, it is an abiotic resource that is scarce, it defines the quality of the land, Soil is as important as water as a resource. It provides nutrients and an anchor to the roots of plants and is therefore essential to their healthy growth and yield of food. it supports and manages plants and plants offer food for animals, and people. Soil is essential for the survival of life on the planet. India is a huge nation with diverse geology, terrain, temperature, and vegetation. As a result, India has a wide range of soil types distinct from one another. Soils also provide a substrate for attenuating pollutants and surplus water, groundwater recharging, nutrient cycling, and habitat for microbes and biota, among other services.

Soil is a renewable resource. It is constantly being formed and destroyed, mainly by erosion processes. Although erosion can spread rich soils by wearing down mountains, it can also lead to removal of top soils from agricultural areas. When erosion removes too much soil, the farmer will need to apply more fertilizer, which can cause pollution problems through runoff.

II. THE WATER AND SOIL DEPLETION LEVELS IN INDIA AS PER CGWB

According to the CGWB, (Central Ground Water Board) The total estimated groundwater depletion in India is in the range of 122–199 billion metre cubes i.e 61 per cent of the available ground water.

The primary cause is mainly irrigation which uses atmost 230 billion metre cubes of groundwater drawn out each year for irrigating agriculture lands in India.

In India almost two-thirds - 63 percent - of India's districts are threatened by falling groundwater levels, which can further affect food and water security in India under climate change.

A national database on land degradation prepared by the ISRO 2016 shows that 120.7 million hectare (mha), or 36.7 per cent of India's total arable and non-arable land, suffers from various forms of degradation with water erosion being its chief contributor in 83 mha (68.4 per cent).

What is Green Technology?

Green tech–or green technology–is an umbrella term that describes the use of technology and science to reduce human impacts on the natural environment. Green technology encompasses a wide area of scientific research, including energy, atmospheric science, agriculture, material science, and hydrology.The goal of green tech is to protect the environment, repair damage done to the environment in the past, and conserve the Earth's natural resources. Green tech has also become a burgeoning industry.

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Solution to Solve this Problem

By Building Solar Energy Based Soil Moisture Sensor- A soil water sensor is an instrument which, when placed in a soil for period of time, provides information related to the soil water status of the soil (Cape 1997).

Why need to adopt innovative approach.

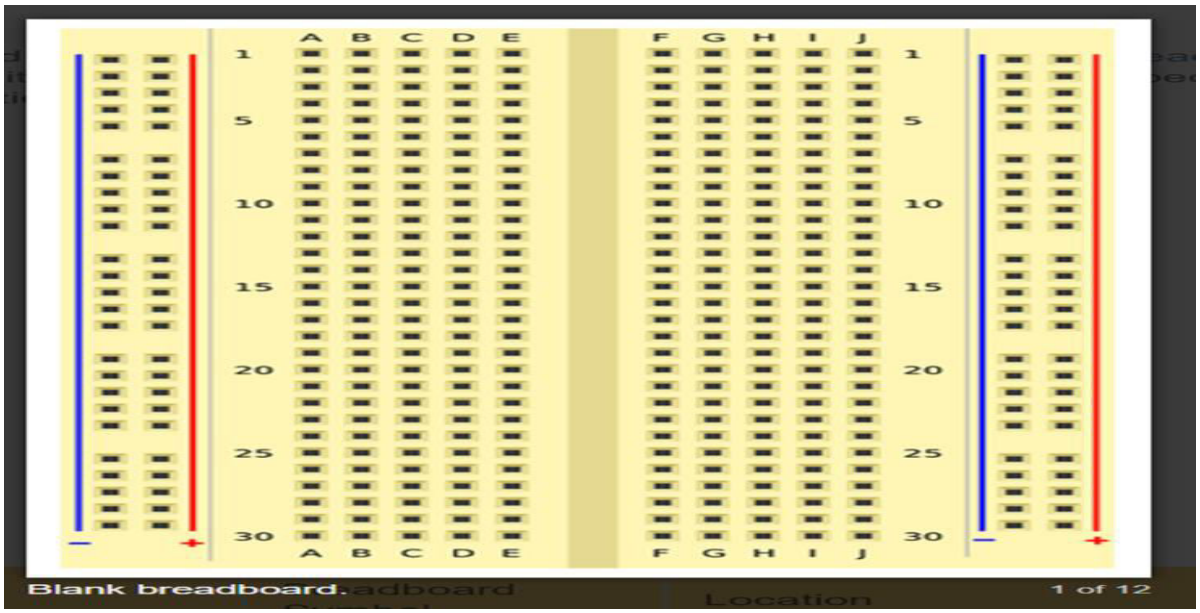
An innovation system is a network of organizations, enterprises, and individuals focused On bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance. Agricultural development demands and depends on innovation and innovation systems. Innovation is widely recognized as a major source of improved productivity, competitiveness, and economic growth throughout advanced and emerging economies. The development of agriculture food industry and integrated supply chains with globalization, technological and corporate advancements and environmental effects have all widened the scope of agriculture. Innovation is a major instrument in social and economic development; especially, Eco-friendly innovation stimulates not only production but an efficient use of natural resources as well. As a result of changing economic, political and ecological conditions in the world, Innovation now enable higher value in unprocessed raw material within a chain; processing, packaging, storage, delivery and distribution of food after production and food safety. Consequently, use of technology in agriculture accelerates growth and development with effective production through said processes. The ultimate impact of technology can be achieved in decreasing poverty throughrural development

WHY ADOPT THIS TECHNIQUE IN BJR GOVERNMENT DEGREE COLLEGE

Since rainfall in India is highly seasonal, Rain water Harvesting system alone can't contribute to the conservation of water . Water protects the ecosystem and wildlife. Moreover, conserving water also saves energy. By using Solar Energy based Soil Moisture Sensor which are water and energy-efficient, we can reduce water usage, Minimize Soil erosion and save energy too.After Developing the Miyawaki garden in our Space Constraint BJR Government Degree College, We have observed that lot of Run-off water and Top soil erosion while watering the Plants.Hence we came up with this Green Technology – Solar energy based Soil Moisture Sensor.

III. MATERIAL AND METHODS

The green technology solar energy based moisture sensor was adopted and developed in the space constraint environment of the new college campus, as we have observed that lot of Run-off water and Top soil erosion while watering the Plants, to maintain and combat the Depletion levels of Soil and Water as per the standards of Govt of India.



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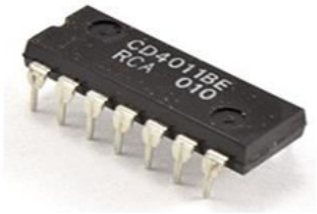
Empty Bread board

Part	Picture	Breadboard Symbol	Location
4011 NAND gate			Rows 1–7, straddling the middle of the breadboard, with semicircular notch facing up
10 MΩ resistor			B2 to (-) bus
470 Ω resistor			B3 to B11
Red LED			Long lead to A11 Short lead to (-) bus
100 kΩ resistor			C2, other lead free
100 kΩ resistor			D1, other lead free
9 V battery and snap connector			Red lead to (+) bus Black lead to (-) bus
Jumper wires (4)			B1 to (+) bus J1 to (+) bus A7 to (-) bus Left (+) bus to right (+) bus

In this project, we will design a simple soil moisture sensor circuit that can built on a breadboard. The circuit will have two probes that we insert into soil. It will turn on a small light (called a light-emitting diode (LED)) if the soil is too dry, and the light will stay off if the soil is wet Then, when the light is on, you will know it is time to water your plants or lawn.

The charge controller has one Input and Two Outputs.
The Input of the charge controller is connected to the Solar Panel.
One of the output is connected to the Bread board and the other is connected to Battery.
Now the sound buzzer is connected to the Bread Board

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The Positive terminal connected to D3 and the Negative Terminal to the Negative pole .
Now the Soil Moisture sensor Circuit is ready for testing

The breadboard is placed in a plastic container with a sealable lid to make it waterproof (the removable lid ensures that you can still change the battery). Two small holes are drilled in one side of the container to allow the 100 kΩ resistor leads to poke through. The resistor leads are connected with alligator clips to two popsicle sticks covered in aluminium foil. These popsicle sticks serve as sturdier probes that are easier to handle than the tiny resistor leads. Note that the outer surface of the probes must be an electrically conductive material, and most metals are conductors. The probes would not work if they were just wooden popsicle sticks.

IV. RESULTS AND DISCUSSION

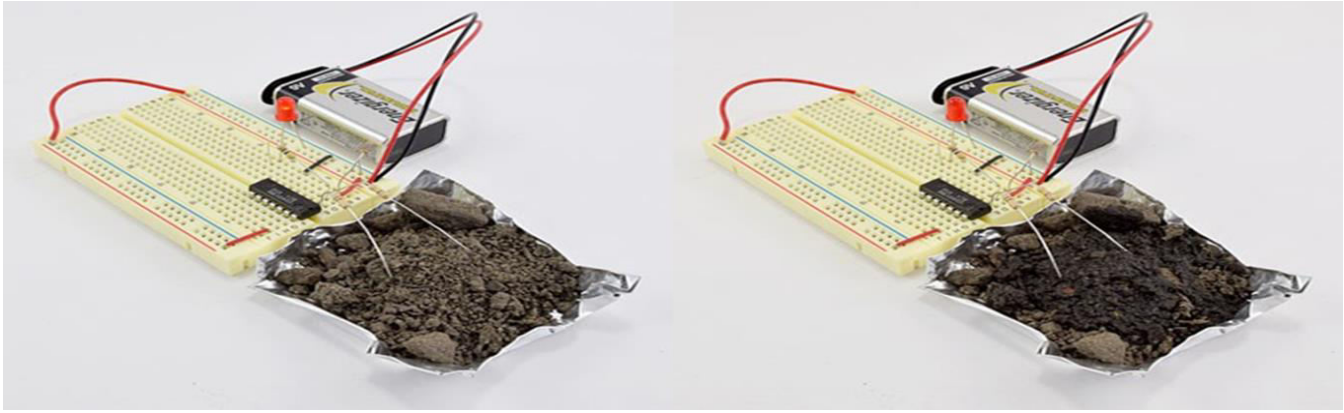
Testing the Circuit
Make sure the free 100 kΩ resistor leads are not touching each other. The LED should be on, because the resistance between the leads is very high (electricity would have to travel through air to get between them, and air is not a good conductor).

Touch the two free leads directly to each other. This should cause the LED to go out, because the resistance between the leads is zero. Electricity can flow easily from one lead to the other.

Put a small pile of dry soil on a plate. Touch both resistor leads to the soil at the same time. The LED will turn on, because the resistance of the dry soil is very high.

Slowly add drops of water to the soil and watch as the soil gets wet. Eventually the LED will turn off, because the wet soil has a low resistance.

we can also try testing the circuit with our hands. Try touching both resistor leads to our palm at the same time. If our hands are slightly damp or sweaty, the LED will turn off.



The LED stays on when the resistor leads touch dry soil (left) and turns off when the leads touch wet soil (right). So, if the LED is off, that indicates that the soil is already wet and you do not need to water your lawn or plants

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Assembling the circuit for testing the Soil Moisture

Placing the Resistors in the Dry soil the LED Bulb and the Sound Buzzer Gets ON

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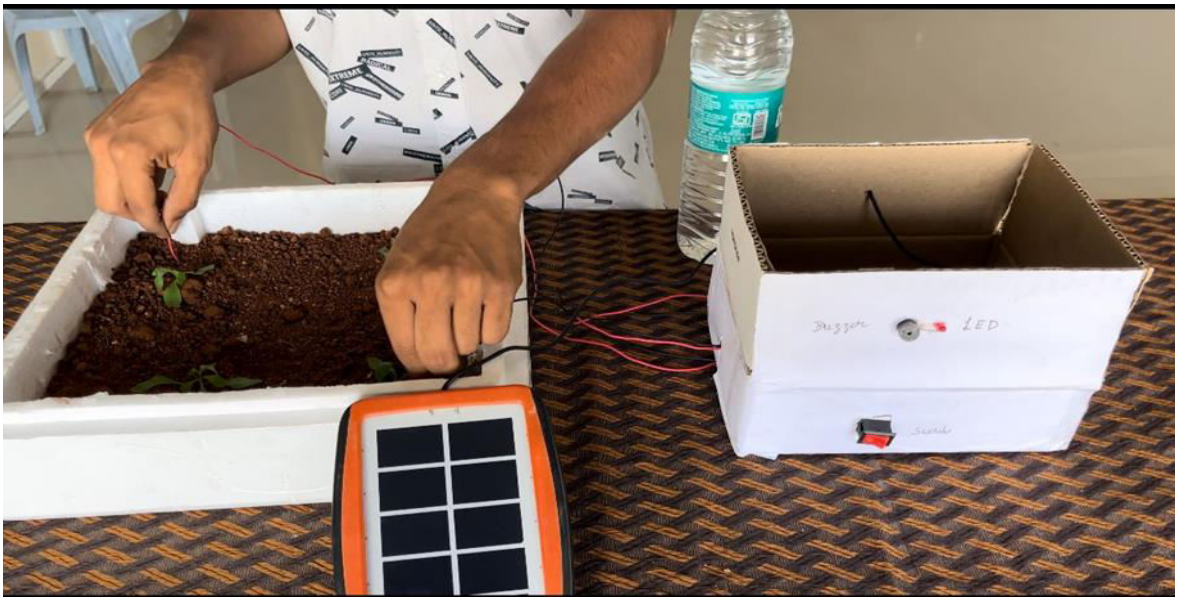
Initiating the water medium in the soil by pouring the Water , the water should be evenly distributed all through the soil ,so as to form the medium from one resistor to another ,till then the LED bulb keeps glowing.



Once the soil gets wet uniformly then the Sound buzzer and the LED bulb will switch OFF

The circuit works by "detecting" the resistance between the two free 100 kΩ resistor leads. The resistance is very high in the dry soil, So the LED light and the Sound buzzer will turn on to indicate that the plants need to be watered. The resistance is very low in the wet soil, the LED light and the sound buzzer will turn off, and stay off until the soil dries out again.

Clay soil retains more water because of the LED light turns off for a longer duration, Loamy soils requires average of two days of watering in winter season and once a day in summer season. black soil tends to retain the moisture for a very long time, which increases the crops during summer times or dry season, Red soil has the least water moisture holding capacity in any season.

Average Soil Moisture

SOIL 1 (SANDY CLAY LOAM)

Table 1: Soil 1 average soil moisture

PARTICULARS	SOIL MOISTURE
Maximum	20 %
Minimum	14 %

SOIL 2 (CLAY LOAM)

Table 2: Soil 2 average soil moisture

PARTICULARS	SOIL MOISTURE
Maximum	25 %
Minimum	19 %

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SOIL 3 (CLAY)

Table 3: Soil 3 average soil moisture

PARTICULARS	SOIL MOISTURE
Maximum	32 %
Minimum	23 %

SOIL 4 (SANDY CLAY LOAM)

Table 4 : Soil 4 average soil moisture

PARTICULARS	SOIL MOISTURE
Maximum	26 %
Minimum	17 %

Soil Moisture Levels in soil with different Plants

NO	TYPES OFPLANT	OPTIMUM MOISTURE PERCENTAGE	ACTUAL(%)
1.	Papaya	60 – 85 %	80
2.	Mango	60 – 70 %	66
3.	Banana	50 % and above	82
4.	Aloe Vera	50 -70 %	66

V. CONCLUSION

Water is a valuable resource, and water shortages are a serious problem in many parts of the world. The problem can be made worse by people who waste water; for example, by watering a garden or using sprinklers on their lawn (or a farmer taking care of an entire field) when it has rained recently or the soil is already moist. Our solar based soil moisture sensor help to conserve water and prevent soil erosion and is cost effective as it is based on solar energy.This is a cheapest model which can be developed and can be installed in the college campus, lawns, parks, Green house etc.The main purpose of the experiment was to test the feasibility of using this “plug-and-play” soil moisture sensor with a long-term solar power supply in the farmland environment. By interpreting the acquired data, it is beneficial to better understand soil physical properties in the field and to manage the crop’s growing process for resource conservation.The experiment results indicate that when sunlight is sufficient, the battery requires two days to fully charge in summer and 3 to 4 days to fully charge in winter. When the battery is fully charged, it can operate for 30 to 40 days continuously even after dynamic power is no longer added. Thus, we believe that this design is successful and can realize a "wireless" mode of soil moisture sensors for farm environments.This sensor can be inserted into different soil depths and provide real-time information about moisture distribution of different soil layers, it can be applied to various farmland irrigation automation systems. Thus, this sensor can be further developed as a node of wireless network at a field scale or be utilized individually in greenhouse.The model does not require mobile phone, wifi connectivity as this may be a burden for low budget farmers or malli’s. IoT monitoring systems have a few key needs, but top of the list is connectivity. However, this is not just any connectivity.LPWAN solutions and cellular IoT connectivity are a great fit for IoT monitoring in the Energy sector, with the packet size and data rates to meet these unique needs.It reduces human interference and ensure proper irrigation.It minimizes water loss and to maximize the

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efficiency of water used.It prevents over labour of the pumping machine and prevent it from getting burned.In a nutshell, the water and soil are conserved and plants grow in better conditions.

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International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975 Impact Factor: 7.394

www.ijarety.in editor.ijarety@gmail.com