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Design and Modelling of Automated Moisture & Temperature Sensing Umbrella Mechanism

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Abstract: ***The significance of rainfall as a crucial natural resource for various crop cultivations cannot be overstated; however, its excessive occurrence or manifestation in unfavourable climatic conditions can prove fatal by causing crop decay. The principal aim of this research endeavour is to safeguard crops against such aberrant weather circumstances. The proposed solution addresses a major predicament in the realm of agriculture, offering protection against unwanted precipitation or extreme heat through the implementation of an umbrella-like structure. This model encompasses the designated area, employing a mechanism comprising nuts, bolts, motors, gears, and sensors to facilitate the opening and closing of the umbrella in response to rain and temperature variations. The automated functionality of this system holds the potential to deliver optimal crop protection.***

I. INTRODUCTION

In the realm of portable shelter, an umbrella emerges as a collapsible canopy, supported by metallic or wooden ribs, typically affixed to a wooden, metallic, or plastic pole. Its purpose revolves around shielding plants from the elements of sunlight and rain. Umbrellas predominantly serve as handheld, portable devices, tailored for personal use, with golf umbrellas representing the largest hand-portable variants. Two distinct categories define umbrellas: fully collapsible umbrellas, wherein the metal pole supporting the canopy retracts, rendering the umbrella compact enough to fit inside a handbag, and non-collapsible umbrellas, characterised by an immovable support pole, with only the canopy capable of collapsing.

The objective of this research is to develop an optimised and cost-effective structure that protects crops in open areas. This umbrella addresses these requirements through the integration of multiple sensors and a set of DC motors, enabling automated sun rain tracking to maximise shading in its deployed location. The selection of a suitable DC motor is contingent upon torque considerations. Whenever the sun rises or rainfall begins, the umbrella's sensors detect light or rain and activate the motor, propelling the shaft to open or close the umbrella instantaneously. Mild Steel is used for construction of Umbrella Mechanism.

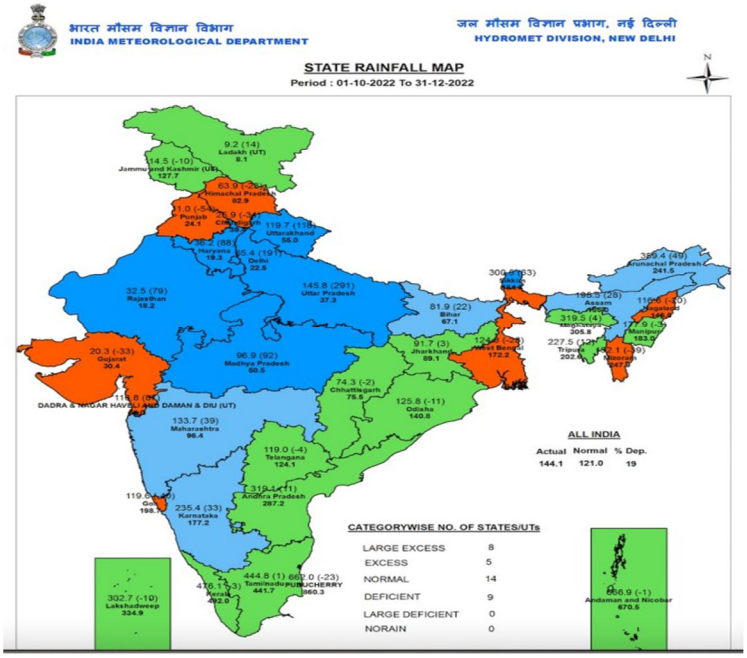

Figure - State-wise Rainfall Map of India

A. *Rainfall*

Monsoon rains in India occur during a specific season, typically from June to September, following a predictable pattern driven by the reversal of winds. They cover a wide geographical area and play a vital role in sustaining agriculture, providing water for crops and replenishing water bodies. On the other hand, non-monsoon rains are unpredictable and irregular, occurring outside the monsoon season at any time throughout the year. They have a more localised impact, affecting specific regions or areas, and their occurrence, intensity, and duration cannot be anticipated. While monsoon rains are generally beneficial, non-monsoon rains have a mixed impact on agriculture. While they may provide relief during dry spells, excessive or untimely non-monsoon rains can damage crops, cause soil erosion, and lead to floods. Non-monsoon rains are known for their destructive potential, often accompanied by strong winds, hailstorms, or heavy downpours. Understanding these differences is crucial for managing agricultural practices, water resources, and mitigating the risks associated with extreme weather events in India.

B. *Sunlight*

Sunlight plays a crucial role in crop growth and photosynthesis, but excessive or inadequate exposure to sunlight can have adverse effects on crops.During the monsoon season, heavy cloud cover and frequent rainfall reduce sunlight availability. This leads to elongated stems, delayed flowering, and decreased photosynthetic activity in crops. The humid conditions during the monsoon create favourable environments for plant diseases. Flooding and water-logging caused by heavy rainfall restrict sunlight access, suffocate roots, and hinder nutrient uptake, resulting in crop damage and potential loss.In non-monsoon seasons, high temperatures and intense sunlight expose crops to heat stress and sunburn. Plants experience wilting, leaf scorching, and reduced photosynthetic efficiency. Water stress and dehydration are also prevalent due to limited rainfall, leading to stunted growth, and crop failure. Dry and warm conditions during non-monsoon seasons provide favourable conditions for pest infestation, with pests attacking weakened crops and causing further damage.

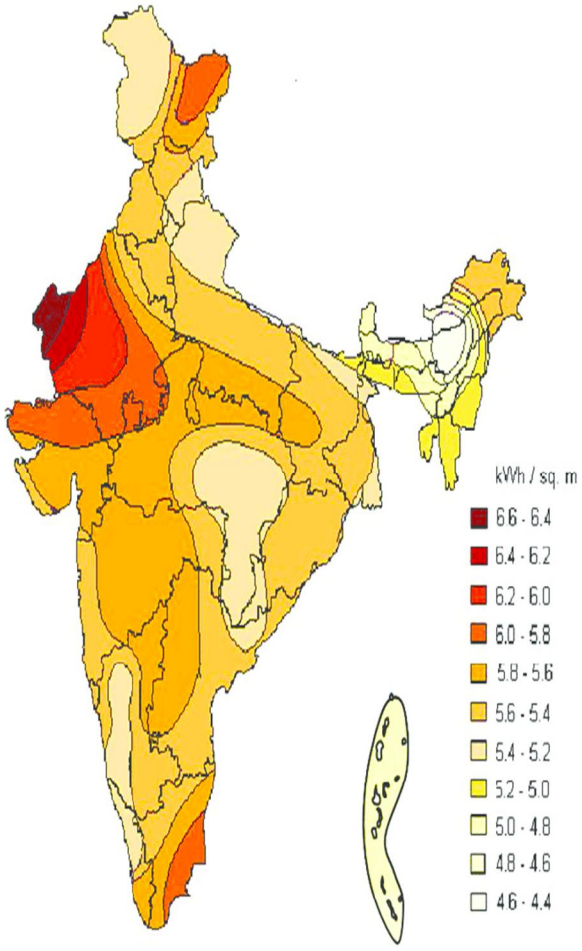

Figure - Sunlight distribution map of India

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II. METHODOLOGY

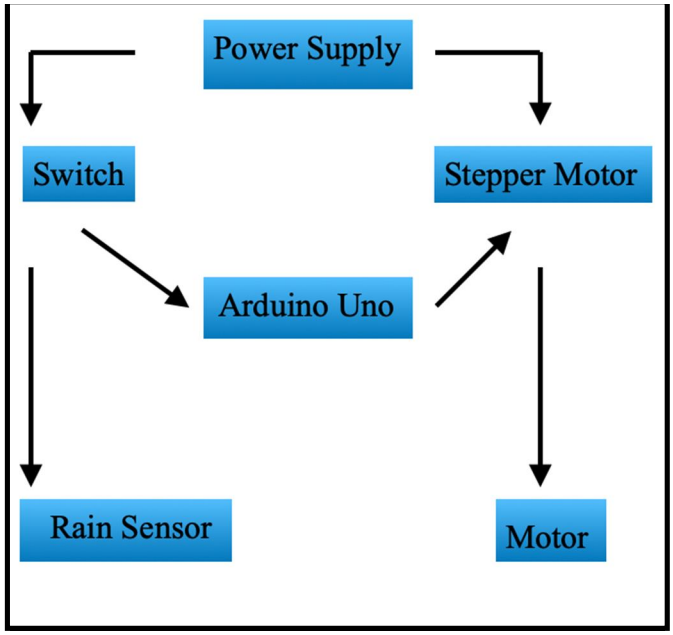

Figure - Block Diagram of Umbrella Mechanism

A. Working Principle

Upon the onset of rain on crop plantations or farmland, the moisture levels are monitored by a dedicated rain sensor to achieve the desired threshold. The sensor subsequently relays this data to an Arduino UNO, which triggers the activation of an umbrella mechanism powered by a Nut and Bolt Mechanism. This mechanism derives its energy from a 12V 1.2aH Lead Acid Battery. The crops are sheltered from adverse weather conditions by a waterproof polyester fabric, providing both crop protection and structural stability as it is securely attached to the umbrella ribs. The Robotic Gripper is affixed to one end of the umbrella rib, facilitating interlocking with other umbrella models

Figure - Umbrella Mechanism

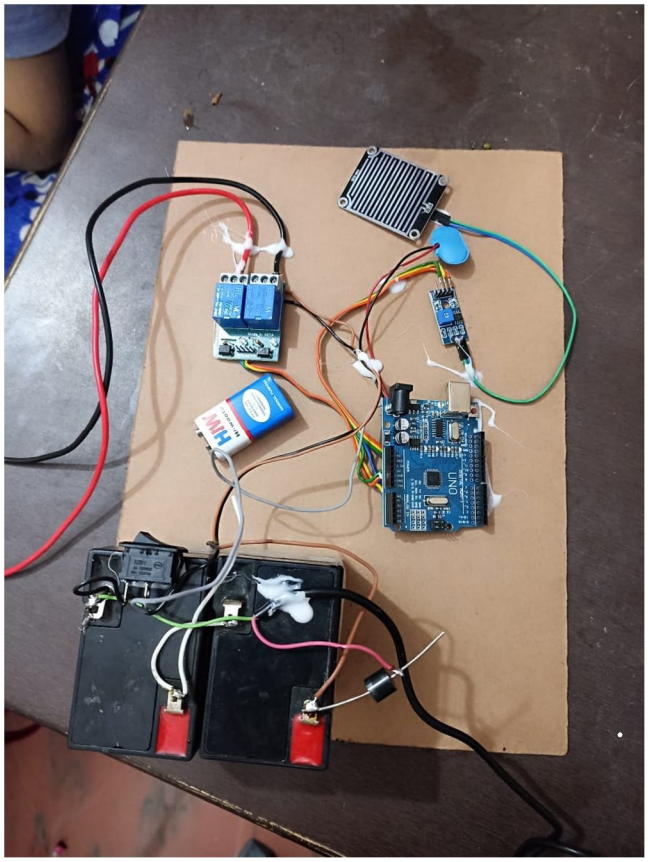

Figure - Power Supply for Umbrella Mechanism

B. Calculations for DC Motor

Power = torque*angular velocity
torque = 1 arm
Mass of structure = 10 KG
Weight of Structure = 10*9.8(take g = 9.8 m/s^2)
= 98.1N(consider it as 100 Newton)
Clearance between Middle rod and bolt = 12mm
Torque = 100*12 = 1200 N-mm
We know that,
required speed of water to open structure lies between 80 to 85 RPM,
So, $\boldsymbol{\omega} = 2\pi\boldsymbol{\omega}/60$
$= (2\pi*85)/60$
= 8.377
Power = 2*8.377 = 16.755 Watt.

III. FUTURE ADVANCEMENTS IN DESIGN

Taking into consideration various factors such as the expansion of farmland, larger crop sizes, and a persistent hot or humid climate, potential modifications and advancements can be implemented in the Umbrella model. However, it is important to acknowledge that design modifications would result in an increased project cost.

Within the context of this research paper, two enhancements can be proposed for the Umbrella model:

1) *Introduction of a Hollow Cylinder:* The purpose of this hollow cylinder is to serve as a shelter for the Umbrella mechanism, effectively safeguarding it from wind debris and potential theft. The cylinder acts as a protective enclosure, ensuring the security of the mechanism.

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2) *Integration of an Iris Mechanism:* This mechanism would be installed atop the hollow cylinder, which encloses the Umbrella mechanism. Its primary function is to shield the umbrella mechanism from rain-induced damage, such as the corrosion of components. Additionally, the Iris Mechanism provides comprehensive protection to the sensor housings. When the Umbrella mechanism is in the closed position, it is completely covered from all sides and the top. When the Iris Mechanism is activated, it unveils the hollow cylinder and exposes the Umbrella mechanism to the open air. The Umbrella mechanism can then be raised using either a nut and bolt mechanism or a rack and pinion mechanism.

Figure - Hollow Cylinder

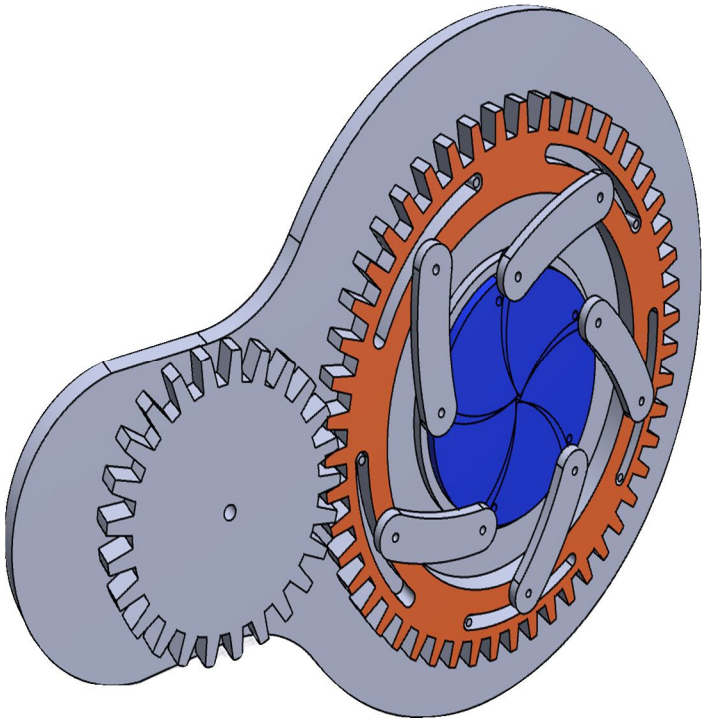


Figure - Iris Mechanism

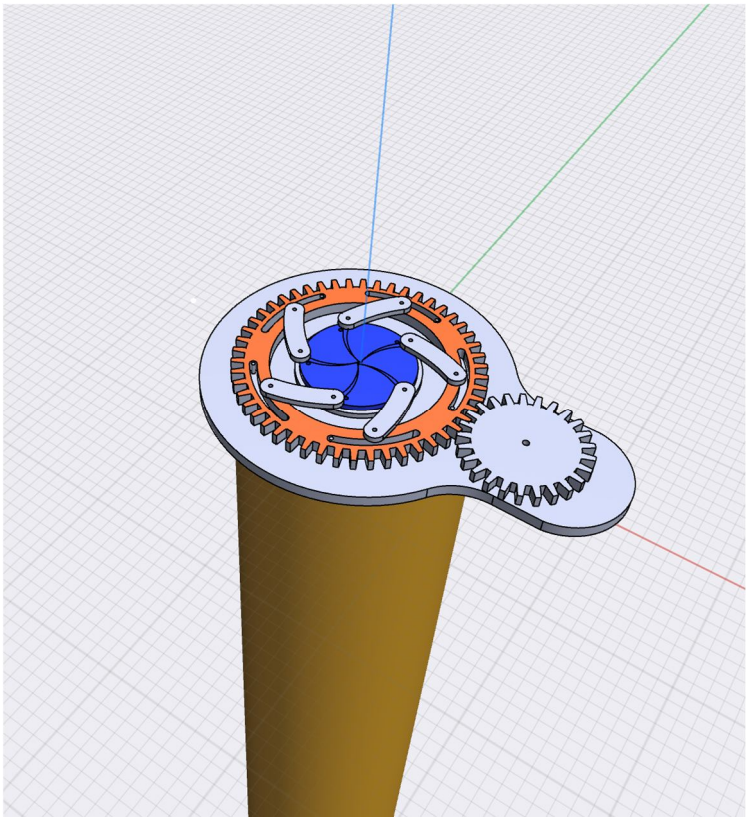


Figure - Installation of Hollow Cylinder and Iris Mechanism

IV. CONCLUSION

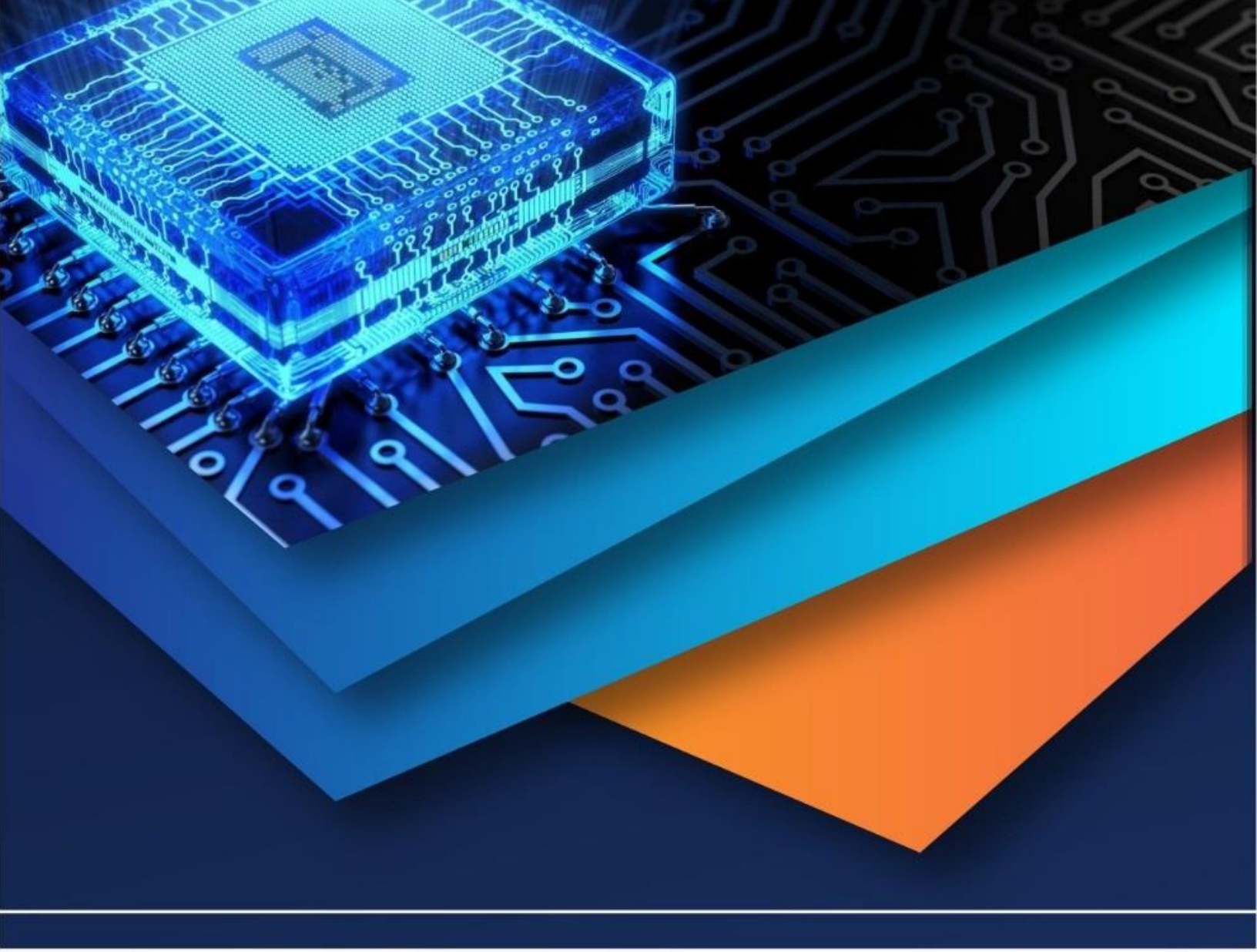
This Project being one of its kind, can be deployed to different agricultural settings, doesn't matter whether if It's a farmer or hobbyist.

With all the process involved, designing is done in such a manner that all mechanical components involved in this project suffers minimum damages when subjected to adverse weather conditions. This project module also features nut & bolt mechanism. Personalised algorithms are also developed to identify weather condition based on set value. This system prototype can also be used along with the renewable sources of energy, mainly solar energy. This system is controlled by Arduino Uno and motor which are used for folding the umbrella roof with two or more switches.

REFERENCES

[1] Post Monsoon 2022: District wise Rainfall in India (https://sandrp.in/2023/01/01/post-monsoon-2022-district-wise-rainfall-in-india/)

[2] Insolatiom map of India Average Daily Solar Radiation in units of kWh/m (https://www.researchgate.net/publication/3094745 13_On_ the_occurrence_ of_CommonBaronLepidoptera_Nymphalidae_Limenitidinae_Euthalia_aconthea_Cramer_1777_in_the_Delhi_area_and_analysis_of_abiotic_factors_affecting_ its_distribution_in_India)



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