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Fog Water Harvesting And Smart Irrigation

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Abstract: *Water scarcity is one of the most significant challenges faced in arid and semiarid regions. Traditional fog nets have been used for centuries to capture moisture from fog, but they remain highly inefficient, with only 2–10% collection rates. This project explores an innovative approach to fog water harvesting by using high-voltage electrostatics to charge fog droplets and direct them toward a grounded collector mesh. Laboratory tests demonstrated that this method could collect up to 20 times more water than passive systems, with 40–45 mL of water generated in 5 minutes using minimal energy input. The proposed system is compact, scalable, and energy-efficient — up to eight times more efficient than commercial dehumidifiers — and holds strong potential for applications in sustainable agriculture and drinking water generation in fog-rich but water-scarce regions.*

Keywords: *Water scarcity*

I. INTRODUCTION

Water scarcity is one of the most significant challenges faced in arid and semiarid regions worldwide, posing a serious threat to agriculture, livelihoods, and human survival. Traditional fog nets have been used for centuries to capture moisture from fog, but they remain highly inefficient, typically achieving only 2– 10% water collection rates. This inefficiency limits their ability to serve as a practical solution for large-scale water generation.

This project explores an innovative approach to fog water harvesting by using high-voltage electrostatics to charge fog droplets and direct them toward a grounded collector mesh. By introducing a high-voltage potential difference between a charged emitter and a grounded metal screen, fog droplets are ionized and rapidly accelerated toward the collector surface, where they coalesce into liquid water.

Laboratory tests demonstrated that this electrostatic method can collect up to 20 times more water than passive systems, with 40–45 mL of water generated in just 5 minutes under controlled conditions, using minimal energy input. The prototype system operates on low power (≈39 W) and was found to be eight times more efficient than a conventional dehumidifier of similar power rating.

II. RELATED WORK

• Electrostatic Fog Harvesting Systems – Recent research shows that electrostatic methods improve efficiency by charging fog droplets using high voltage and attracting them to a grounded collector. These systems significantly increase water collection compared to passive methods.

• IoT-Based Water Management Systems – IoT systems using microcontrollers like NodeMCU (ESP8266) and applications like Blynk enable smart irrigation by controlling pumps and valves remotely, reducing water wastage and improving efficiency.

• Proposed System Approach – The proposed system combines electrostatic fog harvesting with IoT-based irrigation. It uses components such as metal rods, wires, AC-DC converter,

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III. METHODOLOGY

1. Without Power:

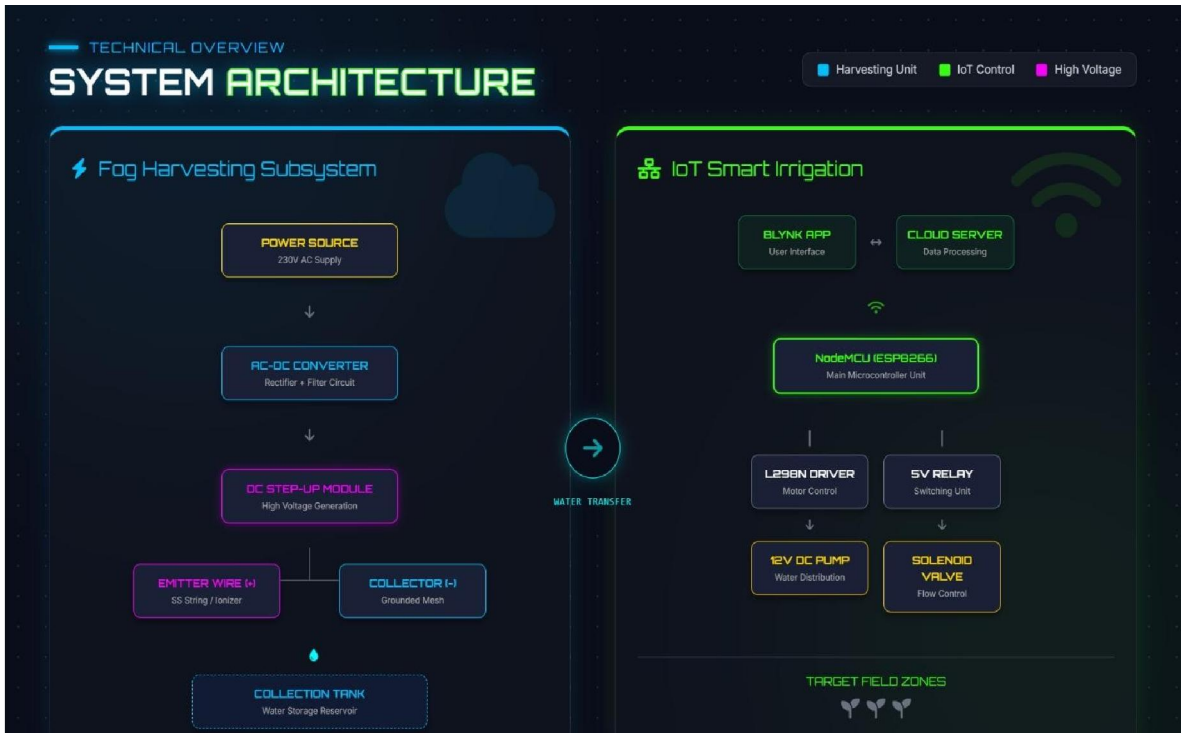
o Fog was allowed to pass through the mesh naturally, simulating a traditional passive fog net. o The goal of this test was to measure how much water, if any, would condense on the collector grid without any external influence.

o This served as a baseline measurement to compare the improvement offered by the powered system.

2. With Power:

o High voltage was applied to the emitter wire, charging the fog droplets and creating an electrostatic field that directed them toward the grounded collector mesh. o The fog droplets were observed as they accelerated toward the mesh, condensed, and dripped down into the collection tray. o The total volume of water collected was measured after a fixed time interval.

IV. SYSTEM CIRCUIT DIAGRAM



V. HARDWARE COMPONENTS

- USB DC to DC Booster
- DC to DC Step-Up (ZVS) Module
- Esp-01 Wifi Relay
- Stainless Steel Collector Mesh
- Stainless Steel Emitter Wire
- Dc Motor Pump
- Solenoid Valve

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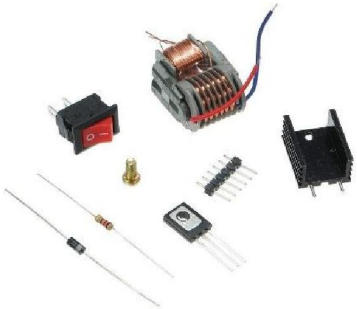
• **DC Motor Pump**

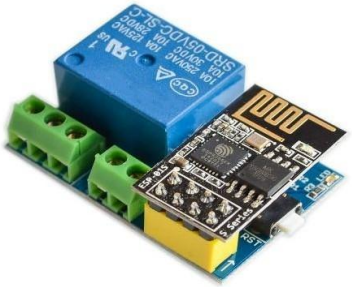
Type: Mini DC Submersible Water Pump
Operating Voltage: 3V – 12V DC (commonly 5V or 12V)
Rated Voltage: 6V / 12V (depends on model)

• **DC TO DC Step-Up Module**



Module Type: High Voltage DC–DC Boost Converter (ZVS Based)
Input Voltage: 12V DC
Input Current: 2A – 5A
Output Voltage: 10kV – 30kV DC

• **Esp Wifi Relay**



Module Type: WiFi Relay Module (ESP8266 Based) Microcontroller: ESP8266 (ESP-01 / NodeMCU compatible)
Operating Voltage: 5V DC
Logic Voltage: 3.3V (ESP8266)

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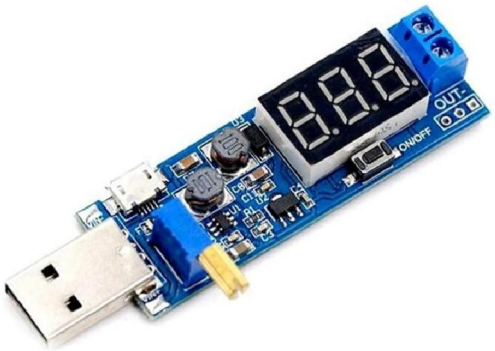
• **Solenoid Valve**

• Type: Normally Closed (NC) Solenoid Valve
• Operating Voltage: 12V DC
• Operating Current: 300 mA – 800 mA
• Power Consumption: ~5W – 10W
• **USB DC TO DC Booster**



Module Type: DC–DC Boost Converter with Voltmeter
Input Voltage: 5V DC (via USB / micro USB) Output Voltage: 5V – 28V DC (adjustable) Output Current: Up to 2A (max)
Output Power: ~10W – 15W

V. CONCLUSION

The project "Fog Water Harvesting Using Electrostatic Condensation" has successfully demonstrated the design, fabrication, and experimental validation of a novel, high-efficiency system for harvesting atmospheric fog water using corona discharge and electrostatic precipitation principles. The project addresses a critical and growing challenge — agricultural water scarcity in fog-prone regions of India — through an innovative, interdisciplinary approach that combines high-voltage electrical engineering, fluid dynamics, materials science, and Internet of Things technology.

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