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Drip Irrigation System Designed for Drought Areas

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Abstract: This paper presents an innovative prototype that harnesses Thermo-Electric devices (TEDs) to condense water vapor from the atmosphere in drought-stricken regions. Powered by solar energy and main supply sources, TEDs cool the air to generate water droplets for irrigation. Paired with a drip irrigation system, controlled by an Arduino Uno microcontroller and soil moisture sensors, the setup ensures efficient plant hydration while conserving water. Rigorous testing across diverse soil types validates the system's efficacy in responding to varying moisture levels. This integrated approach offers a promising solution to address water scarcity in drought-affected areas.
Keywords: Temperature monitoring, Automatic water generation, Sensing soil moisture, Automated watering for plants.

I. INTRODUCTION

The Drip Irrigation System with integrated technology modules offers a promising solution for farmers in regions where water is scarce. With water availability limited, cultivating crops presents significant challenges. None the less, by merging traditional drip irrigation methods with modern innovations, this system optimizes water usage and enhances crop management. Features such as soil sensors and temperature control enable precise monitoring and adjustment of irrigation processes. Through this integration, farmers gain the ability to remotely monitor their fields, ensuring plants receive the right amount of water without wastage. Overall, this advancement represents a significant step toward sustainable agriculture, promising improved crop yields while conserving precious water resources.

II. WORKING PRINCIPLE

For the implementation of Drip Irrigation System Designed for Drought Areas, the hardware components used are

1) PIC16F676 Microcontroller chip
2) LM35 is a temperature sensor
3) TEC (Thermo Electric Cooler) module
4) Heat sink
5) Fans
6) LCD display
7) Soil moisture sensor
8) Water pump
9) Relay module

III. SOFTWARE

For the implementation of Drip irrigation system designed for drought areas, the software required are :

1) Arduino IDE, where the code is written and verified, after the code gets verified without any errors it should be dumped into circuit and the outputs are observed on the serial monitor.
2) Keil uVision is an integrated development environment (IDE) designed for embedded system development.

In our prototype model, a thermal management system using four Thermoelectric Cooling (TEC) modules has been implemented. These modules operate on the Peltier effect, transferring heat from a cold body to a hot body when an electric current is applied. The cold body of each TEC module is exposed to the atmosphere, while the hot body is connected to a large aluminium heat sink for efficient heat dissipation. The firm connection between the TEC modules' hot bodies and the heat sink ensures maximum thermal contact, crucial for effective heat dissipation. The system is designed for testing and optimization, with considerations for factors such as thermal interface materials to enhance heat conduction, aiming to create an effective and efficient thermal management system tailored for specific applications.
The TEC modules play a crucial role in actively transferring heat, resulting in a notable temperature differential between the cold and hot bodies.

To optimize heat dissipation, a large aluminium heat sink is employed, augmented by the use of four fans to enhance convective heat transfer. Ongoing monitoring and potential adjustments underscore the adaptability of the system to varying thermal conditions. The integration of temperature control, humidity absorption, and individual power supply units showcases a comprehensive system designed to meet the specific demands of its intended environment or application, demonstrating a holistic approach to thermal management.

The drip irrigation system utilizes soil moisture sensors and a microcontroller to regulate watering cycles for different plant zones. When soil moisture falls below a predefined threshold, the microcontroller activates the water pump via a relay module, ensuring adequate hydration until the desired moisture level is reached. The system continuously monitors soil moisture levels, preventing both under and overwatering. Feedback is provided through an LCD display, indicating the status of each plant zone. Upon completing watering or reaching the desired moisture level, the system deactivates the water pumps. Experimental results validate its effectiveness across various soil types, showcasing its ability to conserve water and promote healthy plant growth. This integrated approach offers a sustainable solution for managing irrigation in drought-prone regions, optimizing water usage while enhancing agricultural productivity.

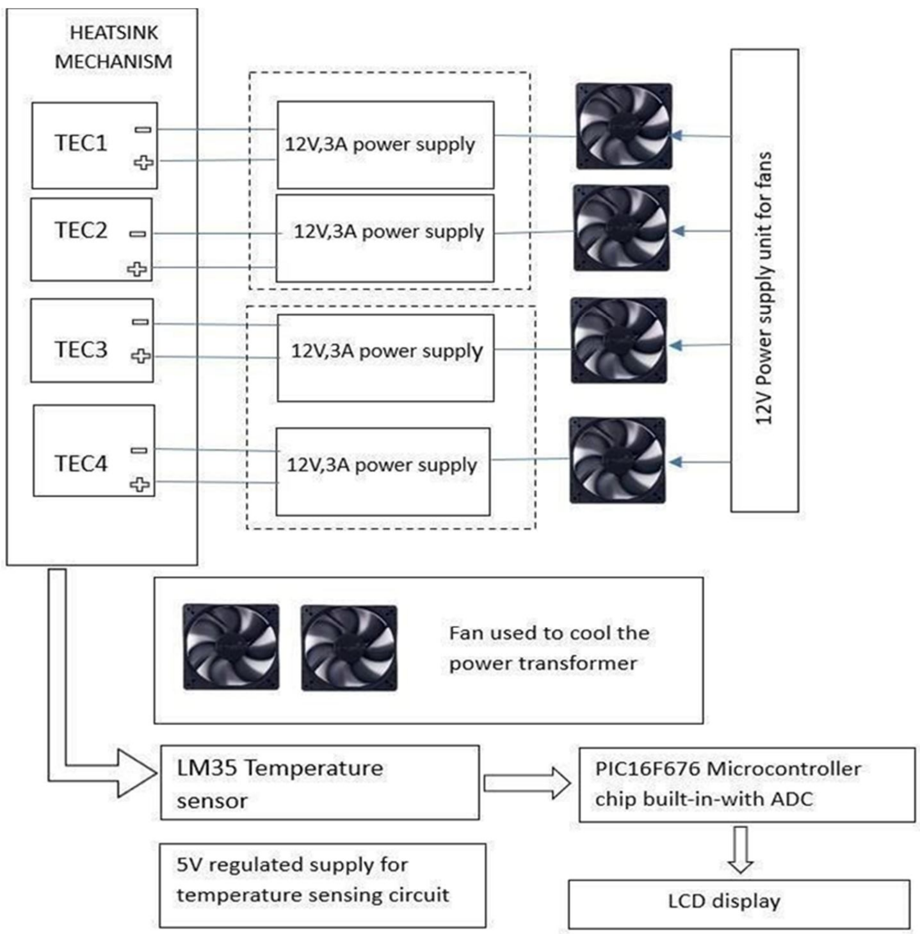

Fig.2.1 Block diagram of formation of water from TEC's

The cooling system integrates an LM35 temperature sensor positioned on the cold body of the Thermoelectric Cooler (TEC) module, interfaced with a PIC16F676 microcontroller featuring an Analog-to-Digital Converter (ADC) and 8-bit controller. This setup enables precise temperature measurement by converting analog signals from the LM35 into digital data, facilitating dynamic temperature control strategies. The microcontroller processes this data, executing actions based on the measured temperature. Through assembly language programming and Keil software, the system operates efficiently, displaying cold body temperatures on 2x16 LCD interfaces. This integration of sensor technology and microcontroller processing forms the foundation for intelligent thermal management within the cooling system design.

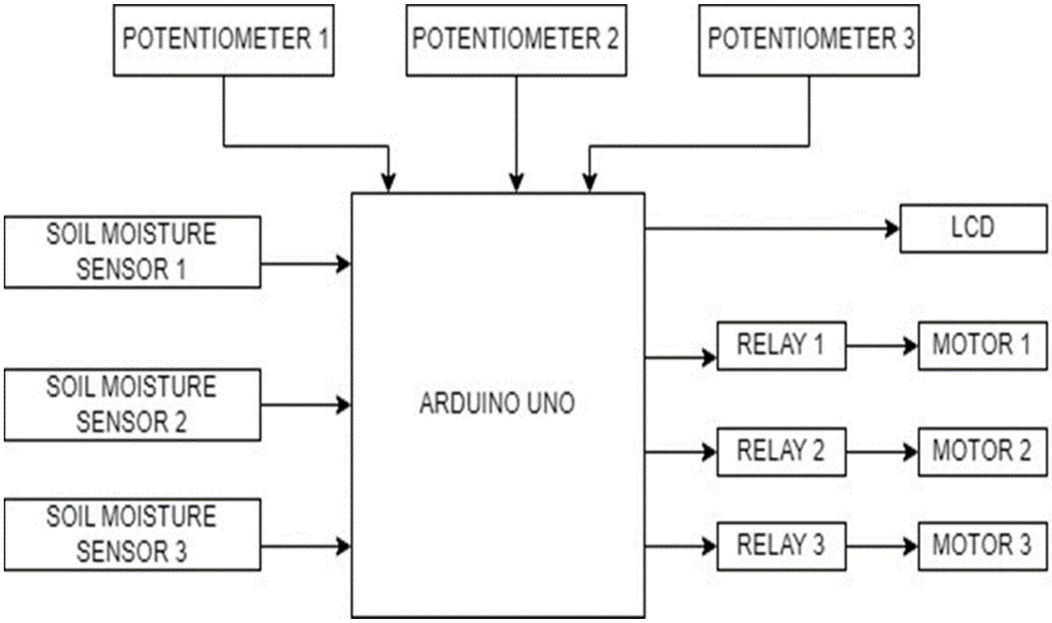

Fig 2.2Block Diagram of Soil Moisture Detection

IV. RESULTS

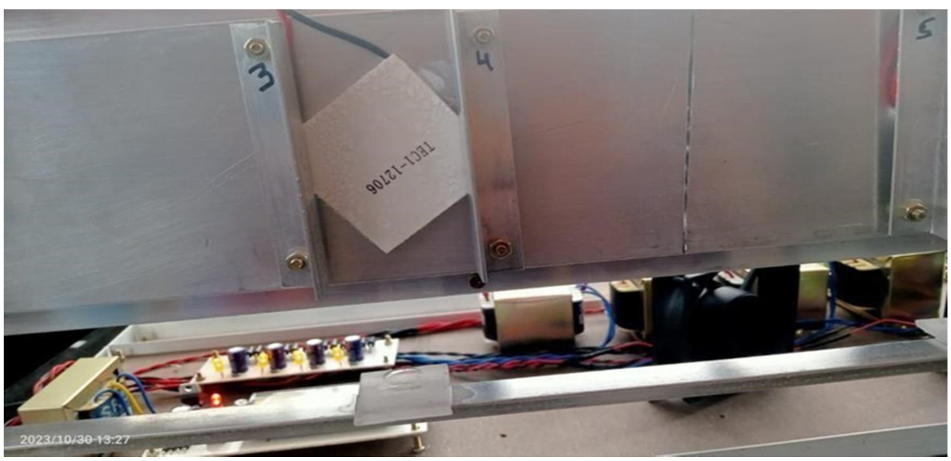

Fig 3.1 shows how the water is collected from the Thermo Electric Coolers (TEC).

Fig 3.2 Delivering of water to the plants

Fig 3.3 Three different Plants with soil moisture sensors

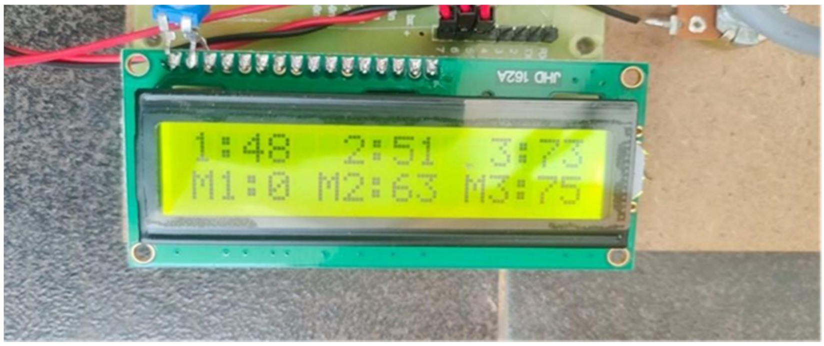

Fig 3.4 output of each plant displayed in LED

V. CONCLUSIONS

In conclusion, we have successfully developed the Prototype Model for Drip Irrigation. System for Drought Areas. The model underwent a thorough day-long testing process, during which we collected water from the Four Thermo Electric Coolers. By the end of the day, these coolers had produced a total of 1 liter of water, showcasing the practical effectiveness of the system in addressing water scarcity challenges in such regions. The system also automatically responded to varying soil moisture levels, promptly watering plants when moisture was insufficient and remaining inactive when levels were adequate. The proposed system offers additional benefits by delivering precise amounts of water to the crops, thereby preventing water wastage often caused by waterlogging. And this system operates autonomously, eliminating the need for manual intervention and saving time and labor.

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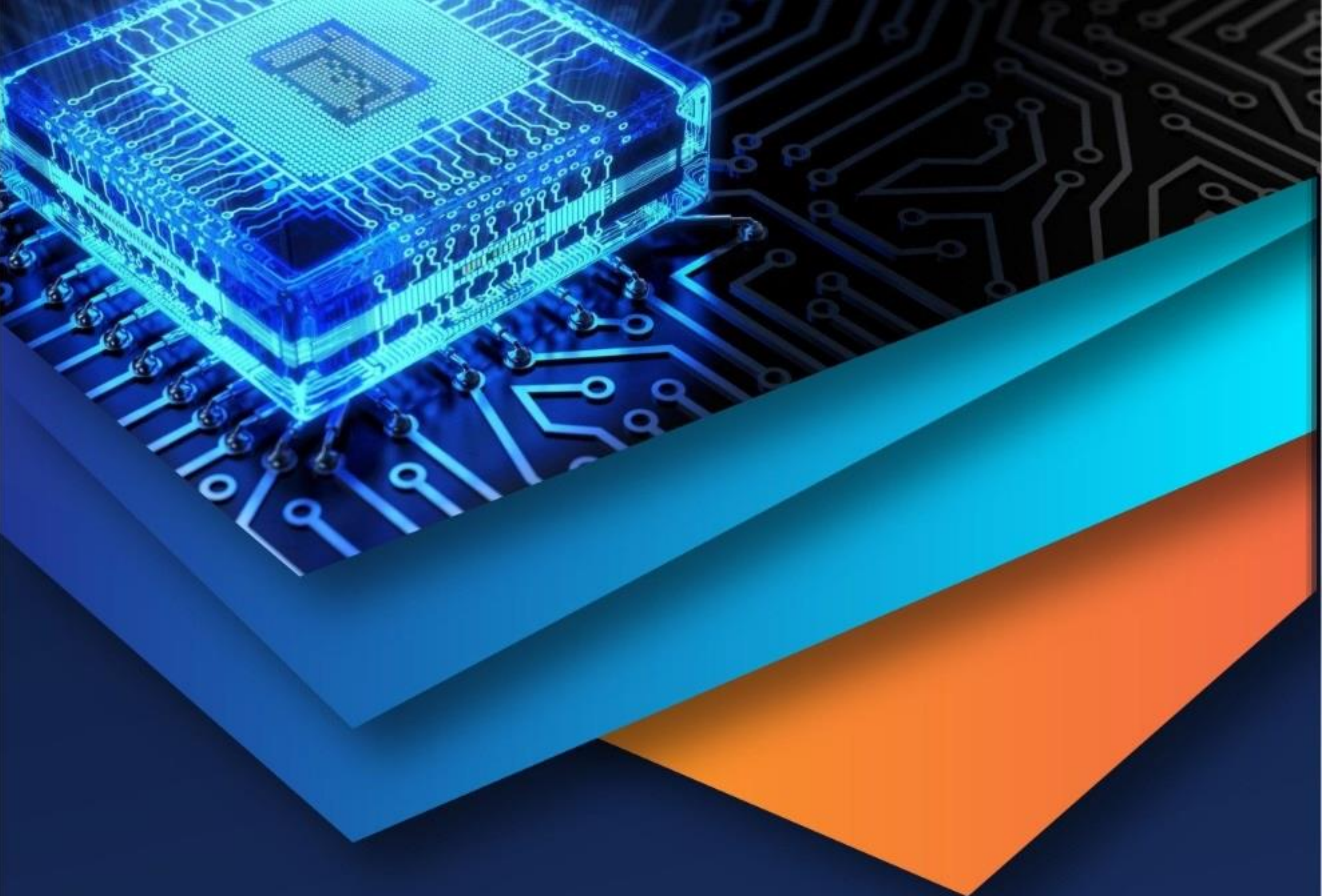

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