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Automatic Plant Water System

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***Abstract*— Automatic Plant Watering Systems (APWS) represent a technological solution to one of the fundamental challenges in gardening: ensuring consistent and optimal hydration for plants. This paper presents a compact yet robust APWS designed to revolutionize water management in agriculture. The system utilizes strategically placed soil moisture sensors and a centralized control unit to continuously monitor and regulate soil moisture levels. Noteworthy features include adaptability to diverse soil types, customizable moisture thresholds for various plant species, and integration with real-time weather forecasting for intelligent irrigation decisions. The APWS addresses the challenges associated with conventional irrigation methods, mitigating issues such as overwatering or underwatering. Its autonomous operation and user-friendly interface provide ease of use, while the ability to operate remotely enhances flexibility. By optimizing water use efficiency, this system contributes to sustainable farming practices, leading to improved crop yield and resource conservation.**

Keywords: Plant, Agriculture, Soil, Moisture Sensors, Intelligent Irrigation, Crop, Water.

I. INTRODUCTION

The practice of gardening, whether as a leisurely hobby or a commercial endeavor, has long relied on the fundamental understanding that water is essential for plant growth and vitality. However, ensuring plants receive adequate hydration while avoiding overwatering can be a delicate balance, particularly in environments prone to fluctuations in soil moisture levels. This challenge has spurred the development of Automatic Plant Watering Systems (APWS), which aim to automate the process of watering plants, thereby alleviating the burden of manual intervention while promoting efficient water usage and optimal plant health.

The concept of APWS encompasses a diverse array of technologies and methodologies, all united by the common goal of delivering water to plants in a controlled and automated manner. Central to the functionality of these systems are sensors designed to measure soil moisture levels. These sensors, often utilizing conductivity or capacitance principles, provide real-time data on the hydration status of the soil surrounding the plant roots. This data serves as the basis for triggering automated watering events, ensuring that plants receive moisture precisely when needed, thus minimizing the risk of both drought stress and waterlogging.

One of the most prevalent types of APWS is drip irrigation, a method wherein water is delivered directly to the base of each plant through a network of tubing and emitters. This targeted approach not only conserves water by minimizing evaporation and runoff but also reduces the likelihood of weed growth and fungal diseases by avoiding wetting the foliage. Another approach gaining traction is the use of capillary action systems, wherein water is drawn up from a reservoir into soil via porous materials, mimicking the natural process by which plants absorb water through their roots. These systems are particularly well-suited for indoor gardening or applications where a constant water supply is desired.

Recent advancements in technology have further expanded the capabilities of APWS, with the advent of "smart" watering devices that leverage connectivity and automation to offer unprecedented levels of control and customization. These devices, often interfaced with mobile applications or microcontroller platforms such as Arduino or Raspberry Pi, allow users to remotely monitor soil moisture levels, adjust watering schedules, and receive alerts or notifications regarding system status. By harnessing the power of data analytics and machine learning, these smart systems can even adapt their watering routines based on factors such as weather forecasts, plant species, and seasonal variations, thereby optimizing water usage and promoting healthier plant growth.

The benefits of APWS extend beyond mere convenience, encompassing broader environmental and economic advantages. By ensuring plants receive the right amount of water at the right time, these systems contribute to water conservation efforts, particularly in regions facing water scarcity or drought conditions. Moreover, by minimizing

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water waste and reducing the risk of overwatering, APWS can lead to significant cost savings for both home gardeners and commercial growers alike. Additionally, by maintaining optimal soil moisture levels, APWS can enhance plant health and vitality, resulting in increased yield, improved crop quality, and reduced susceptibility to pests and diseases.

However, despite their numerous advantages, APWS are not without challenges and limitations. Calibration and maintenance of sensors and actuators require periodic attention to ensure accurate and reliable operation. Power supply considerations, particularly for outdoor installations, necessitate careful planning to ensure uninterrupted functionality. Environmental factors such as temperature, humidity, and soil composition can also influence the performance of APWS, requiring adaptation and customization to suit specific growing conditions.

In conclusion, Automatic Plant Watering Systems represent a promising convergence of traditional gardening practices with modern technological innovation. By automating the process of watering plants, these systems offer convenience, efficiency, and sustainability, empowering growers to cultivate healthy and thriving gardens with minimal intervention. As technology continues to evolve and adoption rates increase, APWS are poised to play an increasingly integral role in the future of agriculture and horticulture, enabling us to nourish both plants and planet alike.

II. LITERATURE SURVEY

W. Y. Tan et al.,[1] The existing water irrigation system relies on manual or time-based control, which can result in water wastage and overwatering of plants. Besides, Malaysia is expected to experience long-term drought caused by climate change by 2030, which will impact the plants tremendously. A prototype of the system has been developed to address these challenges. The water irrigation system targets public gardens with Wi-Fi coverage and utilizes rainwater to irrigate plants. It aims to mitigate the long-term drought impact by introducing distributed water tank systems and making better irrigation decisions using raindrop sensors. The system utilizes microcontrollers, sensors, and actuators powered by rechargeable batteries for better portability to users. Users only need to ensure water supply availability at the installation area, without relying on alternating current supply. The irrigation system enables automatic mode and manual mode through Thinger.io software. The prototype demonstrates better water conservation compared to traditional irrigation methods. Precise water irrigation and real-time data monitoring effectively minimizes water wastage while optimizing plant growth. Furthermore, integrating of automatic controls and remote manual control features greatly improves cost efficiency by minimizing labour expenses and operational costs. The system supports the Sustainable Development Goals, Goal 11 (Sustainable Cities and Communities).

C. B. Thangammal et al.,[2] Farmers frequently encounter issues such as irregular weather patterns and ineffective resource management, particularly in irrigation practices. Offering them a centralized information platform equipped with vital data for monitoring and managing their fields has the potential to be a game changer. This paper describes an advanced smart agricultural system that combines both cutting-edge software and hardware modules to transform current farming practices. The hardware components, which include data collecting and soil quality assessment sensors, work together with machine learning models to provide accurate weather forecasts and crop recommendations. Our technology offers a high degree of precision in predicting and advising suitable crop choices based on real-time soil conditions by utilizing closely trained models. The user-friendly online interface offers safe authentication mechanisms, complete irrigation status updates, and crop-specific information. The system's distinctive strength comes in its ability to handle soil data, allowing it to provide individualized crop suggestions and exact planting directions. This research not only provides farmers with actionable knowledge but also represents a big step toward more sustainable and efficient farming practices. The study finishes with suggestions for potential future refinement avenues, highlighting the ongoing commitment to enhancing precision farming technologies.

T. Patil et al.,[3] The passion for gardening is a seed that once sown always reaps benefits and provides a peaceful place to live around. To have plants around us is a soulful experience in itself. It gives a healthy and fresh dimension to the house. Indoor plants is one way to utilize the smallest of the available space to plant varieties of plants. Along with the benefits comes the efforts behind a home garden. The proposed scheme is to have every house a beautiful garden by providing them with automatic watering system. The people face a lot of problem when they plant indoor plants in their houses. It is important that water requirements of plants are timely fulfilled, so one has to be responsible consistently. The scheme offers an automated power efficient, water efficient and most convenient scheme for indoor plants. Wastewater management and plant maintenance both can be processed hand in hand in the designed system. Whenever kitchen wastewater which is less contaminated is collected and recycled then it is supplied to indoor plants by providing solar powered electronic system which will regulate all these process and work without human intervention.

N. H. Damia et al.,[4] In the age of technology, automation has permeated our lives, and the demand for remote control systems continues to grow. This study introduces an IoT-powered Automatic Plant Watering System, driven by the NodeMCU ESP8266 microcontroller and a soil moisture sensor. Users can monitor soil moisture levels through a mobile application, remotely activating the watering process. This system addresses the challenges of manual plant care and the need for efficient solutions, especially in light of the COVID-19 pandemic. The project aims to deliver cost-effective and accessible intelligent farming tools, promoting sustainability and water conservation aligned with the United Nations' Sustainable Development Goals 2 (SDG-2). By offering precise soil moisture control, customization, and remote capabilities, this innovation empowers users to maintain healthy crops, fostering a recent trend in plant care. The research discusses system design, implementation, and implications, aligning with the demands of modern agriculture.

S. Nandyal et al.,[5] Lawn management technology automatically irrigates the plantings as needed thereby reducing one's labor. The concept of automated watering is accomplished by measuring water content of soil and avoiding human interference in the yard. The inlet pressure supplies water via the pipeline by evaluating sensor readings. A fire sensing device detects flames or smoke in the yard. GSM is utilized to notify the user of the precise filed status. The data to be sent is structured as messages and transmitted to specified location. A wireless camera is attached to the robotic device to take images and shoot video of the garden area. With minimum human participation, an integrated smart gardening machine entirely controls the duties of keeping plants alive. Our research proposes a surveillance robot that will monitor the water supply to the plants without much user involvement. Whenever the soil becomes dry and moisture level falls below the threshold value the robot will alert the owner through a text message and immediately supplies water to the plants. The technique also makes sure that no excess of water is supplied to the plants. The robotic setup is also capable of monitoring the other parameters such as temperature, humidity and fire around the garden area.

A. Arun et al.,[6] Agriculture is one of the most precious sectors of our nation and it accounts for a good percentage of our nation's GDP. This sector has to be given more importance compared to others since it acts as the heart of our nation. Irrigation is one of the important and primary processes for plant growth. Due to water scarcity and unseasonal rain farmers fail to achieve better crop productivity. It is possible that the water pipeline will get damaged, resulting in leaks and increased water consumption for agriculture. To resolve this, this research work aims to design a smart irrigation system to help farmers in their agricultural activities and effectively utilize water sources using the Internet of Things components and sensors. With advanced technologies, the proposed system automates the irrigation process and effectively identifies water leakage in water pipelines installed in the agricultural fields that facilitate effective usage of the water sources in agricultural activities. Leakage in the pipeline can be identified by monitoring the water level in the water tank and considering the nature of the soil and the planted crops and their water absorption level.

III. CIRCUIT DETAILS AND WORKING

The circuit diagram of the automatic plant watering system is shown in Fig. 1. The circuit comprises an Arduino UNO board, a soil moisture sensor, a servo motor, a 12V water pump and an L293D (IC1) motor driver IC to run the water pump. You can power the Arduino board using a 7V to 12V wall wart or plug-in adaptor or solar panel. You need a separate 12V battery or power supply or solar panel for the pump motor.

Two types of soil moisture sensors are available in the market—contact and non-contact sensors. A contact soil sensor is used in this project because it has to check soil moisture to measure the electrical conductivity. The moisture sensor provides an analogue output, which can easily be interfaced with Arduino. In this project, two sensors can be connected to analogue pins, A0 and A1, of the Arduino board. Each sensor has four pins (Vcc, Gnd, Ao and Do) available for interfacing with the Arduino board. Here, digital output pin (Do) is not used. The water pump and servo motor are controlled by Arduino connected to digital pins 3 and 9, respectively. That is, the servo motor signal control pin is connected to pin 9 of the Arduino board.

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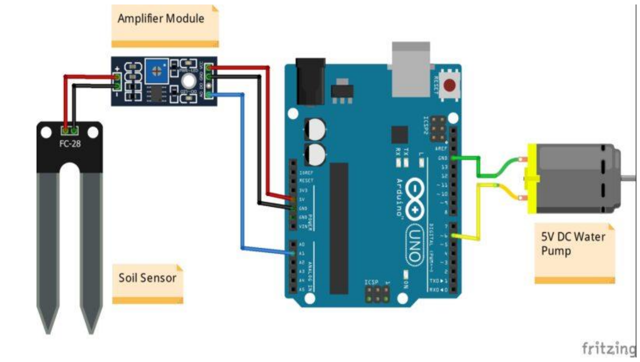

Figure 1: Block diagram

In the case of a soil moisture sensor, we get two modules – a sensor and an amplifier module. First, we need to connect the sensor with the amplifier module using two female to female jumper wire. Next, we need to connect the VCC and GND of the amplifier module to the 5V and GND of the Arduino. Then we connect the AO pin of the amplifier module to the A1 pin of Arduino. Here we have chosen the A1 pin but you can choose any analog pin. But remember, you have to change the following code accordingly.

Now we need to connect the 5V DC water pump to the Arduino. To do that we just need to connect the +ve wire of the pump to D6 of Arduino and -ve wire of the pump to the GND of Arduino. We have chosen D6 because it is a PWM pin as well so if you want to use analog input and control the water flow then you can use the same pin. If we use a pump with a higher power, we need a relay module to make the connections

Working

- In plant watering system, soil moisture sensor checks the moisture level in the soil and if moisture level is low then Arduino switches On a water pump to provide water to the plant.
- Water pump gets automatically off when system finds enough moisture in the soil.
- Working of this Automatic Plant Irrigation System is quite simple. First of all, it is a Completely Automated System and there is no need of manpower to control the system.
- Arduino is used for controlling the whole process.
- If moisture is present in soil then transistor Q2 remains in triggered/on state and Arduino Pin D7 remains Low.
- Now if there is no Moisture in soil then Transistor Q2 becomes Off and Pin D7 becomes High.
- Then Arduino reads the Pin D7 and turns On the water motor. Motor will automatically turn off when there is sufficient moisture in the soil.

IV. RESULTS AND DISCUSSION

Figure 2 presents is the PCB design of automatic plant watering system-

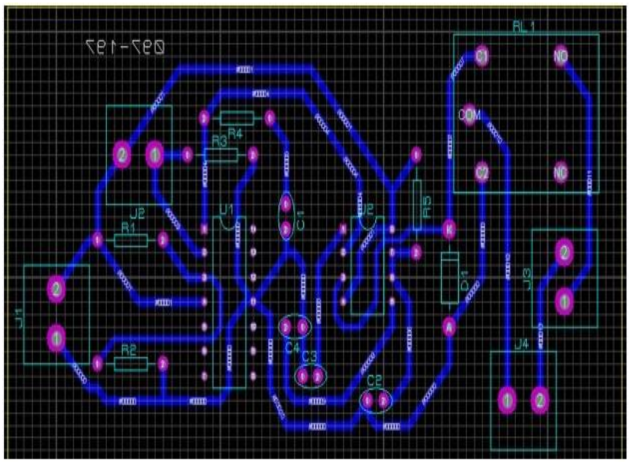

Figure 2: PCB Circuit

- We insert two probes in the soil in such a way that they will conduct when the soil is wet and they will not conduct when the soil is So, when the probes do not conduct, the system will automatically detect this condition with the help of comparator which will become high when the input is low than reference voltage which is 0 Volts.
- Comparator will trigger the NE555 Timer which will switch on the Electric valve and as a result, it will allow the water to flow.
- When the soil is wet, the probes will again conduct and make the output of the comparator low which will also make the NE555 output low, thus switching the relay which will turn the pump.

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Figure 3: Project Photograph

Place the flower pots where the pipe from the servo motor horn can easily reach them. When the moisture level dips below 600, servo horn rotates at an angle of 70 degrees. That is, after servo motor horn moves 70 degrees toward the first pot, the motor pump will be on for five seconds and then stop automatically. Then, the servo returns to its original position. Similarly, if you are using a second sensor, the servo motor horn will move to 145 degrees to the second biggest pot, motor pump will be on for eight seconds and then stop automatically. The servo returns to its original position.

From this work, we can control the moisture content of the soil of cultivated land. According to soil moisture, water pumping motor turned on or off via the relay automatically. This saves water, while the water level can be obtained in a preferred aspect of the plant, thereby increasing productivity of crops. Servo motor from vegetation water uniformly dispersed in water, in order to ensure the maximum utilization of absorption through. Thus, there is minimal waste of water. The system also allows the delivery to the plant when needed based on the type of plant, soil moisture, and observed temperature. The proposed work minimizes the efforts of major agricultural regions. Many aspects of the system can be customized and used software to fine-tune the requirements of the plant. The result is a scalable, supporting technology. Using this sensor, we can see that the soil is wet or dry. If it is dry, the motor will automatically start pumping water.

Automatic system using a microcontroller, moisture sensor and other electronic tools were been developed. It was observed that the proposed methodology controls the moisture content of the soil of cultivated land. The motor automatically start pumping water if the soil is dry and need water and stops when the moisture content of the soil is maintained as required.

Applications: Automatic plant watering systems have diverse applications across various sectors:

1. **Residential Gardening:** These systems are ideal for homeowners or renters who want to maintain gardens or indoor plants without the hassle of manual watering. They can be especially beneficial for individuals with busy schedules or limited mobility.
2. **Commercial Agriculture:** In large-scale agriculture, automated watering systems can optimize water usage, improve crop yields, and reduce labor costs. They can be tailored to suit different types of crops, soil conditions, and climate requirements.
3. **Greenhouse Cultivation:** Greenhouses rely on precise control of environmental factors to nurture plants year-round. Automatic watering systems help greenhouse operators maintain consistent moisture levels, promoting healthy growth and minimizing the risk of disease.
4. **Urban Landscaping:** Municipalities and landscaping companies can use these systems to maintain public parks, gardens, and streetscapes efficiently. They contribute to the sustainability of urban environments by conserving water and reducing maintenance needs.
5. **Research and Education:** Automatic watering systems are valuable tools for scientific research, experimentation, and educational purposes. They allow researchers, students, and hobbyists to study plant behavior, irrigation techniques, and water management strategies in controlled settings.

V. CONCLUSION

Automatic plant watering system offers a convenient and efficient way to ensure your plants receive the right amount of water, even when you're not available to tend to them manually. By utilizing gravity-fed or sensor-controlled mechanisms, these systems can help maintain optimal soil moisture levels, promote plant health, and conserve water resources. While there may be initial setup and maintenance requirements, the long-term benefits of automation can greatly outweigh the investment of time and effort. This project is budget friendly and ensures that the project is working properly and we have been quite successful in achieving both the things. We also had the expectation to help the society by making such a project which can be useful to masses. We got to learn so much about the applied electronics from making this project. The future of automatic plant watering systems holds promising advancements in technology and sustainability. Integration with smart home systems and IoT (Internet of Things) devices could enable remote monitoring and control of watering schedules through smartphone apps or voice commands.

REFERENCES

1. W. Y. Tan, R. Khor, W. Fang Yeo, C. C. Kang, J. D. Tan and M. Ariannejad, "Smart Water Irrigation System with Real Time Data Collection and Wireless Communication," *2024 International Conference on Green Energy, Computing and Sustainable Technology (GECOST)*, Miri Sarawak, Malaysia, 2024, pp. 1-5, doi: 10.1109/GECOST60902.2024.10474709.
2. C. B. Thangammal, P. Saai M, M. T. Umar N, N. S S and M. K, "Agribot: An IoT and Deep Learning-Based System Empowering Precision Farming," *2024 Second International Conference on Emerging Trends in Information Technology and Engineering (ICETITE)*, Vellore, India, 2024, pp. 1-6, doi: 10.1109/ic-ETITE58242.2024.10493822.
3. T. Patil, J. D. Mallapur and D. G. Mallapur, "Self Monitored Indoor Plant Maintenance with Wastewater," *2023 International Conference on Network, Multimedia and Information Technology (NMITCON)*, Bengaluru, India, 2023, pp. 1-6, doi: 10.1109/NMITCON58196.2023.10275889.
4. N. H. Damia Mohamad Razam and S. Sara Rais, "IoT-Enabled Automatic Plant Watering System," *2023 IEEE 8th International Conference on Recent Advances and Innovations in Engineering (ICRAIE)*, Kuala Lumpur, Malaysia, 2023, pp. 1-6, doi: 10.1109/ICRAIE59459.2023.10468389.
5. S. Nandyal and K. Siddiqua, "Automated Home Garden System Using Robotics," *2022 IEEE North Karnataka Subsection Flagship International Conference (NKCon)*, Vijaypur, India, 2022, pp. 1-5, doi: 10.1109/NKCon56289.2022.10126697.
6. A. Arun R, V. V. Punitha, P. Kaladevi and D. Muthusankar, "An automatic Irrigation and Water Leakage Detection System in the Agricultural Field," *2022 3rd International Conference on Communication, Computing and Industry 4.0 (C2I4)*, Bangalore, India, 2022, pp. 1-6, doi: 10.1109/C2I456876.2022.10051225.