INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 08 ISSUE: 09 | SEPT - 2024 SJIF RATING: 8.448 ISSN: 2582-3930

Botanic Monitoring of Plant Using Raspberry Pi

Advika Kirkole
Electronics & Telecommunications
Marathwada Mitra Mandal's College of Engineering
Pune, India
advikakirkole2020.etc@mmcoe.edu.in

Dr. Jitendra M Bakliwal, Asst.professor
Electronics & Telecommunications
Marathwada Mitra Mandal's College of Engineering
Pune, India
jitendrabakliwal@mmcoe.edu.in

***Abstract*— The project leverages the Raspberry Pi, a cost-effective board computer, to cultivate an all-encompassing botanic monitoring and control system. By amalgamating sensors, cameras, and actuators with the Raspberry Pi's computing power, real-time environmental data can be gleaned, refined, and tapped remotely via web or cell phone interface. This metaphysical marks the Raspberry Pi's purpose in establishing a diverse, cost-effective panacea for botanic monitoring and control, with benefits including precision, mechanization, and accessibility over agriculture and environmental research.**

Keywords*— *Nutrition Detection, Sensor Network, Wireless Communication, Precision agriculture, Design, Plant monitoring.

I. INTRODUCTION

Botanic monitoring and control using Raspberry Pi is a money saving advancement for coordinating plant growth conditions in heterogeneous habitat. Harnessing the Raspberry Pi's capabilities, this Tech puts together true-time environmental data to fabricate peak rise environments for plants.

Raspberry Pi puts forward multiple benefits for botanic monitoring and control. Its zeal effectiveness & scalability make it right for different modes, from home gardens to farm fields. Additionally, its easy changeable features allow growers to alter the system to explicit crop standards which enrich its effectiveness.

Technology that enhances herb enthusiasts and farmers. A common issue in plant regulation is nutrient deficiency. Which can cover up rapidly if not taken care of promptly. Old school surveillance ways: labor-intensive, notably for massive areas. Nevertheless, advancements in tech such as mobile operating systems, offer a more efficient way to detect nutrient deficiencies in flora.

Plant ailment poses another substantial risk to agricultural output. Commonly triggered via pests, insects, or pathogens, these diseases can show the way to considerable shortfall if not regulated in time. To deal with this particular issue, automated crop disease detection systems source a solution for routinely monitoring cultivated zones & detecting capable threats.

As we move forward through the powerful and attainable technology that gives authority to the plant enthusiasts, farmers, and researchers, with the help of harnessing the skills of this minicomputer, folks can better understand and improve plant environments, foremost to healthier and more effective plants.

II. BOTANIC MONITERING AND CONTROL DESIGN

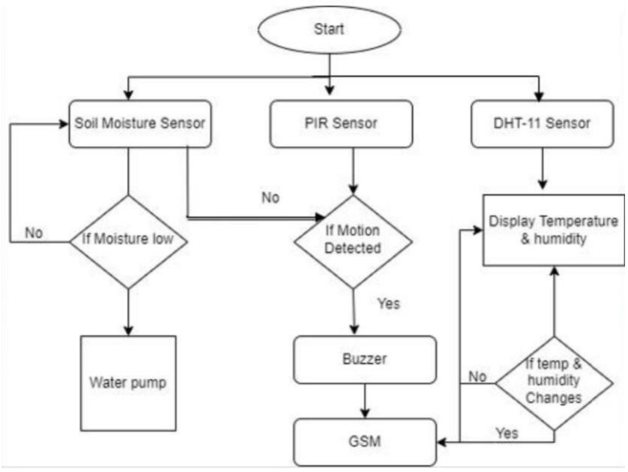

Fig 2.1: Flow chart

The flowchart illustrates a system where sensors monitor soil moisture, temperature, humidity, and motion. Based on sensor readings, it activates a water pump, buzzer, or GSM alert to maintain optimal conditions.

III. METHEDOLOGY

Architechture

The botanic monitoring system using Raspberry Pi is structured into three key layers: Sensor, Processing, and Communication/Action. The Sensor Layer collects real-time data using a Soil Moisture Sensor, DHT-11 for temperature and humidity, a PIR sensor for motion detection, and a camera for capturing plant images.

The Processing Layer, powered by Raspberry Pi, analyses the data. It runs a Convolutional Neural Network (CNN) to process plant images and detect issues like nutrient deficiencies. The Raspberry Pi also stores and manages the data, either locally or on the cloud.

In the Communication and Action Layer, the system automatically activates the water pump when moisture is low, triggers a buzzer if motion is detected, and sends alerts via a GSM module for any critical environmental changes. Optionally, users can monitor and control the system remotely through a web or mobile interface.

This streamlined architecture allows for efficient real-time monitoring, analysis, and automated actions, ensuring optimal plant health.

Hardware

The botanic monitoring system using Raspberry Pi involves a well-integrated hardware setup designed to monitor various environmental conditions affecting plant health. At the core of this system is the Raspberry Pi, which serves as the main processing unit, controlling and coordinating the entire operation. The system is powered by a stable power supply, ensuring uninterrupted functionality. Key sensors are connected to the Raspberry Pi, including a Soil Moisture Sensor, which measures the water content in the soil, and a DHT-11 sensor, which monitors temperature and humidity levels. The PIR (Passive Infrared) sensor is another critical component, detecting any motion around the plants, which can trigger a security response if necessary.

Additional hardware components include a water pump, which is activated automatically by the Raspberry Pi when the soil moisture level drops below a specified threshold. This ensures that the plants receive adequate water without manual intervention. The system is also equipped with a GSM module, allowing it to send alert messages to the user's mobile device in case of critical conditions, such as extreme temperature fluctuations or unauthorized access detected by the PIR sensor. Lastly, a buzzer is integrated into the system to provide audible alerts, drawing immediate attention to any significant environmental changes or threats.

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 08 ISSUE: 09 | SEPT - 2024 SJIF RATING: 8.448 ISSN: 2582-3930

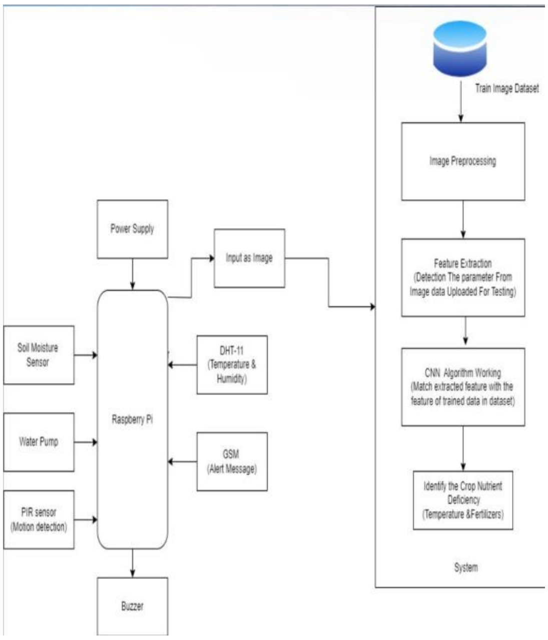

Fig 3.1: Block Diagram

Software

The software component of the botanic monitoring system is crucial for processing the data collected by the sensors and implementing intelligent responses. The Raspberry Pi is programmed using Python, leveraging its extensive libraries for hardware interaction and data processing. The system begins with initializing the sensors and setting up the GPIO (General Purpose Input/Output) pins to collect data from the connected sensors. The software continuously monitors the inputs from the Soil Moisture Sensor, DHT-11 sensor, and PIR sensor, making decisions based on the data received.

One of the software's significant functions is image processing, where images of the plants are captured and analysed. These images are processed using a Convolutional Neural Network (CNN) algorithm, which has been trained on a dataset of images depicting various plant conditions. The software first preprocesses the images, extracting relevant features that might indicate issues such as nutrient deficiencies. The CNN algorithm then compares these features against the trained dataset to identify any potential problems. If an issue is detected, the system can provide specific recommendations, such as adjusting the temperature or applying fertilizers.

Furthermore, the software manages the automation of the water pump based on soil moisture readings and sends alerts via the GSM module when certain thresholds are crossed. These alerts ensure that the user is kept informed about the plant's health and can take timely action when necessary. The overall software design emphasizes real-time monitoring, automated responses, and remote communication, creating an efficient and responsive botanic monitoring system.

IV. RESULTS

The results of the botanic monitoring system using Raspberry Pi demonstrated significant improvements in plant health management through automated monitoring and response mechanisms. By continuously collecting and analyzing real-time data from various sensors, the system ensured that plants were maintained in optimal conditions with minimal human intervention.

Fig 4.1: Home page

The Soil Moisture Sensor effectively monitored soil hydration levels, triggering the water pump only when necessary. This automation reduced water wastage and ensured consistent soil moisture, leading to healthier plant growth. The DHT-11 sensor provided accurate temperature and humidity readings, allowing the system to alert the user whenever environmental conditions strayed from the ideal range. These timely alerts enabled quick corrective actions, preventing potential stress on the plants.

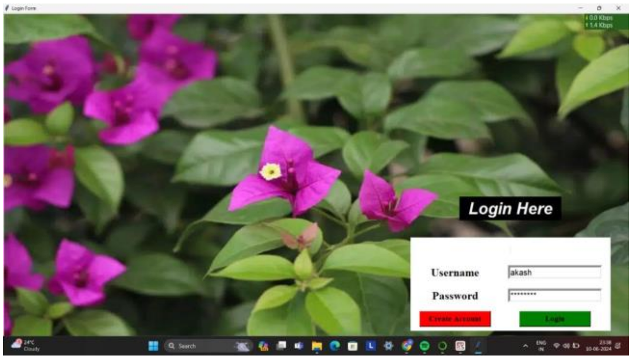

Fig 4.2: Login page

The integration of the Convolutional Neural Network (CNN) for image processing proved to be a valuable tool in detecting early signs of plant health issues, such as nutrient deficiencies. The system's ability to analyze plant images and compare them against a pre-trained dataset allowed for early diagnosis and treatment, which significantly reduced the risk of plant disease or poor growth.

Fig 4.3: Detection

The PIR sensor's motion detection added a layer of security to the system, alerting the user in case of unauthorized access or animal interference. This feature helped protect the plants from potential harm.

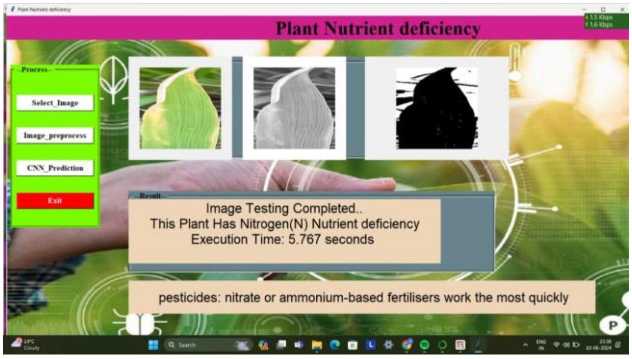

Fig 4.4: Detected

Overall, the project demonstrated that the botanic monitoring system was effective in maintaining optimal growing conditions, reducing manual labor, and enhancing plant health. The system's automated responses, combined with real-time alerts, provided a reliable and efficient method for monitoring and managing plant growth in various environments.

V. CONCLUSION

In conclusion, the integration of Raspberry Pi into botanic monitoring represents a significant advancement in how we observe and manage plant health. This project demonstrated the feasibility of using affordable and versatile technology to gather and analyze critical data on plant conditions. By employing sensors to monitor variables such as soil moisture, light levels, and temperature, the system offers a comprehensive solution for real-time plant care.

The data collected through the Raspberry Pi setup provides valuable insights into the environmental factors affecting plant growth. This not only enables more precise and timely interventions but also supports the development of predictive models for better plant management. The real-time monitoring capability ensures that any deviations from optimal conditions are promptly addressed, thereby enhancing plant health and yield.

Moreover, the project highlights the potential for Raspberry Pi to be used in a variety of botanic applications beyond basic monitoring. Future expansions could include integrating machine learning algorithms for predictive analysis or expanding the system to monitor a broader range of environmental factors. Such advancements could greatly benefit both amateur gardeners and professional horticulturists.

Overall, this project underscores the transformative impact that affordable technology can have on botanic monitoring. By leveraging Raspberry Pi, we can achieve a deeper understanding of plant needs and implement more effective management practices, ultimately fostering healthier and more resilient plant ecosystems.

VI. REFERENCES

[1] Chandankumar Sahu, Pramitee Behera, "A Low Cost Smart Irrigation Control System", IEEE Sponsored 2nd International Conference on Electronics and Communication System (ICECS 2015)

[2] Computation Joaqu´ınGuti´errez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel A´ngel Puerto-Gandara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module" ,IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT,0018-94562013

[3] G. Yuan, Y. Luo, X. Sun, and D. Tang, "Evaluation of a crop water stress index for detecting water stress in winter wheat in the North China Plain," Agriscience Water Regulation., vol. 64, no. 1, pp. 29–40, Jan. 2004.

[4] F. R. Miranda, R. Yoder, and J. B. Wilkerson, "A site-specific irrigation control system," presented at the ASAE yearly. Int. Meeting, Las Vegas, NV Jul. 27-30,2003, Paper No. 031129.