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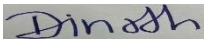
Group work: please list all names of all participants formally associated with this work and state whether the work was undertaken alone or as part of a team. Please note you may be required to identify individual responsibility for component parts. 10952523 - Jayawardena Kavinda - Introduction 10952463 - Dulaj Hewage - Objective 10952470 - Unagollage Wijesinghe - Objective 10952545 - Witharamalage Sirimewan – Background Study 10952565 - Pathiranage Didula Theekshana - Conclusion 10953075 - Duwage Perera – Outcome 10952645 - Chamathka Abeykoon – Conclusion 10953214 - Suwanda Akarsha – Outcome 10952629 - Rathnayaka Rathnayaka – Mapping Six Parameters 10952566 – Yaddehige Himasha - Mapping Six Parameters ***We confirm that we have read and understood the Plymouth University regulations relating to Assessment Offences and that we are aware of the possible penalties for any breach of these regulations. We confirm that this is the independent work of the group.*** Signed on behalf of the group: 	
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PUSL2021 IoT Group Project

Project Proposal 2024/25

Plant Optimizing System Using IoT

Group Name: Group - H

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1. Introduction

This is an automated solution based on the Internet of things (IoT) used to effectively grow and be productive with no human intervention. Through the process of using different types of sensors to check in with factors like soil moisture temperature, humidity and light levels, this system guarantees that the exact conditions is provided to grow healthy plants. This project, first and foremost, aims to increase productivity through continued, real time monitoring, and data lead adjustments for plants to thrive in optimal conditions. The aspect of a reduced manual labour, high in efficiency, very important for contemporary agriculture and urban farming is very essential this.

2. Objectives

The primary objective of the Plant Monitoring System is to design an IoT-based solution wherein parameters related to the environment and plants are monitored constantly to enhance the process of plant caring. This system will integrate all these components through using of advanced sensor technologies, automation, and real-time data analytics to ensure plants receive the adequate attention they need for uniform growth. The following are the main objectives the project aims to accomplish:

1. Complete Environmental and Plant Health Monitoring:

   Install a network of high accuracy sensors in order to monitor the condition of numerous environmental factors that are crucial to plants' vitality, such as light intensity, humidity, air temperature, and moisture of the ground. In addition, for the more specific activity in certain environments like these greenhouses or indoor gardens, essential plant indices like pH of the soil and concentration of nutrients may be incorporated.

2. Cloud-based analytics and real-time data acquisition:

   Individuals should employ IoT devices to gather consecutive, real-time information from the concerned environment. Once relocated to a more stringent cloud environment, this data will be analyzed quantitatively by more efficient software applications to generate valuable conclusions about the overall environmental climate and wellness of plants. This technology will enable the users to understand which decisions are most appropriate for plant care in terms of both short-term trends and overall trends of plant growth.

3. Intelligent Automation for Plant Care Optimization:

   Tie into climate control systems, which also control a network of lights and irrigation systems to ensure plants are cared for dynamically based on live sensor input. The technology utilized in the operation of these systems will regulate light exposure to promote the growth of plants, as well as control the temperature to prevent stressing the plants and watering them when soil moisture content is not optimal for production.

4. Customized Alerts and Notifications:

   Develop and install a personal alarm system that will notify the users whenever environmental conditions are either too high or too low for the type of plants, they have. With notifications that are given in advance, concerning possible issues like underwatering, overwatering, excessive temperatures, inadequate lighting, etc., consumers will be able to minimize plant stress by taking the necessary precautions in time, through a mobile application, an e-mail or, in the simplest way, an SMS.

5. User-Centric Data Visualization and Control Interface:

   Design a very easy and immediately understandable interface that allows users to easily monitor the condition of plants from any location. Real-time data visualization will be provided on the interface by way of graphs and charts showing the tendencies of the temperature, moisture, and other parameters over some time. Users will be able to control plant care decisions since they can remotely change automated parameters and set up specific levels for different factors.

6. Remote Access and Control:

   Ensure the users can oversee their plants from any part of the world by ensuring the system has an interface that will operate on computers, smartphones, and tablets. Users will indeed be able to track real-time data, receive alerts, and control lighting and watering systems whether they are at home or away, thus ensuring the plants are well taken care of.

7. Sustainable and Resource-Efficient Plant Care:

   Increase efficiency of energy and water and all other resources incorporated into the system with sustainability as a value. Flood irrigation will be avoided and used only when needed while energy is to be conserved through proper scheduling and setting of light and climate through automation and real-time data acquisition. This will result in more appropriate methods of gardening that are energy and naturally resource-conserving.

8. Modular customization and scalability:

   Design a structure that will suit whole home gardens and even large-scale commercial or farming models. In case sensors can be attached or removed based on specific needs, people will be able to monitor several plants or entire sectors of a garden at the same time. Moreover, the system will be flexibly designed with different settings and parameters corresponding to different plant species at the plant.

9. Support for Education and Predictive Suggestions:

   Display suggestions about different plants and articles and resources to the users based on information obtained from their plants. Depending on the environmental conditions, the system will also be informative in determining when to fertilize or water plants, risks and invasion of pests or shortcomings of nutrients in the soil. This will be useful for novices as well as experienced gardeners because it forms better plant-care practices for them.

10. Contribution to Smart Gardening and Data-Driven Agriculture:

    The system aims to contribute to the growth of the related areas of data-enabled farming and intelligent gardening by integrating IoT platforms with data analysis tools and models. The knowledge gained by the system extends beyond improving specific plant care working procedures on the overall scale, which will lead to the improvement of farming methods, better yields on agricultural land, and proper horticultural practices.

This edition goes a good deal further, especially as to resource utilization, scalability, and the utilization of advanced analytics. Moreover, it expands how our system could impact data-driven agriculture and or sustainable gardening, increasing the scope and value of a project.

3. Background Study

- Recognize the target market,
    - Gardening Enthusiasts: Gardening enthusiasts appreciate cultivating plants for fun, food, or environmental purposes.
    - Beginners: Those who want guidance and assistance since they have never gardened.
    - Experienced Gardeners: Skilled experts looking for cutting-edge methods and information.
    - Plant Collectors: Plant collectors gather rare or unique plant species.
    - Proponents of Sustainable Living: These are people dedicated to using eco-friendly methods and minimizing their environmental impact.

- Discover the most important trends and difficulties,
    - Urban Gardening: Urban gardening is gaining popularity in cities due to limited space and the growing demand for fresh produce.
    - Indoor Gardening: Cultivating plants inside, particularly during winter or in harsh climates, is a rising trend called indoor gardening.
    - Sustainable Practices: Sustainable practices involve reducing pesticide use, conserving water, and emphasizing organic farming.
    - Accessibility: Platforms that cater to users with varying backgrounds and skill levels are essential.

- Analysis of Competition,
    - Determine Current Platforms: Examine well-known gardening websites and applications, like Dave's Garden, Gardenia, and PlantNet.
    - Examine Features: Consider their advantages, disadvantages, and special features.
    - Find Gaps: Determine how current platforms fail to satisfy user requirements.

- Technical Points to Remember,
    - Platform Selection: Depending on the intended features and target audience, choose an appropriate platform (web, mobile app, or both).
    - Technology Stack: Select the right frameworks, development tools, and programming languages.
    - Database Design: Build a reliable database to store user data, plant information, and other relevant information.
    - User Experience (UX): Ensure that the interface has straightforward navigation and clear layouts for ease of use.
    - Scalability: Build the system to handle expansion and rising user counts.

- Strategies for Monetization,
    - Freemium Model: Freemium models offer basic capabilities for free but charge for additional services or premium memberships.
    - In-app transactions: Through in-app transactions, users may buy plants, seeds, or gardening materials directly from the platform.
    - Advertising: Show users relevant advertisements.
    - Affiliate marketing: Work together with businesses that provide gardening products to promote them.

- A focus on sustainability,
    - Eco-Friendly Features: Include elements that promote sustainable activities, such as tips for organic gardening, water conservation, and plant selection.
    - Partnerships: Collaborate with organizations dedicated to environmental conservation and sustainability.
    - Educational Content: Offer materials about eco-friendly gardening methods and their advantages.

4. Key Parameters

To connect the six main factors to your plant optimization project (which uses sensors to monitor temperature, humidity, a solar panel, and an automated system), here's how each factor is handled:

1. Sustainability:

   Your project helps with sustainability by using solar panels as a clean energy source, lowering the need for non-renewable resources and reducing the carbon impact. The automated watering system uses water wisely, avoiding waste.

2. Efficiency:

   Using sensors to check temperature and humidity ensures that plants get the best growing conditions. The automated system adjusts the environment in real time, providing accurate and efficient plant care without needing constant human help.

3. Cost Efficiency:

   Using solar power and automation helps reduce expenses like electricity and labor. The sensors also stop plants from getting too much water or fertilizer, saving money on resources over time.

4. Flexibility:

   You can expand your system by adding more sensors and automated features as needed. This makes it suitable for different sizes of farming, from small gardens to large commercial farms.

5. Innovation:

   Combining Internet of Things (IoT) technology with sensors and automation creates a new way to farm. It brings smart, data-based decisions into agriculture, improving accuracy and productivity.

6. Environmental Benefits:

   Using solar panels and careful water management lowers the environmental impact of farming. Also, automating the system to water plants only when needed helps save natural resources, supporting eco-friendly practices.

This method supports sustainable farming and helps plants grow better while using resources wisely.

5. Outcomes

The objectives of the IoT project that seeks to increase plant growth using sensor data and control include the following.

1. Enhanced Growth and Crop Yields:

   Sensors to continually track temperature, humidity, and other environmental parameters will guarantee that plants grow in the best possible conditions. This will ensure that the plants are fully developed, growth cycles are shortened, and even the crop yield is higher than ordinarily possible, for instance, in the case of cinnamon trees.

2. Resource Utilization Maximization:

   The system provided which automatically controls moisture levels in the soil and atmospheric conditions ensures that water, electricity, and other inputs do not go to waste. Other than solar-powered automation, plant owners will also cut down their dependence on nonrenewable sources and therefore reduce their operational costs while saving precious resources such as water.

3. Reduction of Water Wastage and Pollution:

   The solar energy and other sources employed in the project will enable a reduction in water wastage and overapplication of chemicals, which ultimately detracts from sustainable farming practices. This would enhance soil health and balance the ecosystem over time.

4. Informed Decision on Building Farming Operations Around the Weather Interventions:

   IoT will enable farmers, through the steady flow of data information, to build models on when to plant their crops, and when and how much water their plants and crops need. This reduces uncertainty in people, especially those in the agricultural sector, and allows for good planning in the long term which helps to enhance productivity.

5. Less Requirements of Labor:

Farmers will no longer be involved in such tasks as watering and monitoring environmental conditions as these tasks will be automated. It makes monitoring and supervision unnecessary, which increases operational efficiency.

6. Ability for Broader Applications:

The system advancing towards more usage is a part of the broad-scale mechanization of all agricultural processes. It will enable more users from private consumers and amateurs to professional farmers.

7. Supports Sustainable Goals (SDG) and Commitment to Action:

Encouraging biodiversity, sustainable land use and resource use efficiency this project contributes to the advancement of Responsible Practices in Agriculture and the UN's SDG 15 (Life of Land). It enhances environmental health and promotes sustainable agricultural development.

8. Economic Advantage:

Cost of operations (fuel, machinery) will be significantly reduced because of such factors as automation and solar energy and income will significantly increase due to better quality and quantity of crops. It is assumed that this will be beneficial for the rural economy.

All these effects should serve to propagate environmentally friendly agricultural technologies aiming at achieving modern farming techniques that guarantee sustainability, profitability and increased productivity.

6. Conclusion

The Plant Monitoring System, which is the heart of this system, is a ground-breaking automation tool because it combines environmental monitoring and control automatically. It is a technology that increases the growth and productivity of plants using sensors, cloud analysis, and intelligent automation. Among the noteworthy features are:

Real-time monitoring: Regular and straightforward supervision of soil moisture, light levels, temperature, and humidity among other important variables.

Data acquisition analysis: The making of sound decisions based on the information as well as data already gathered.

Automated Control: Controlled climate, light, and irrigation, what more can a plant's health be?

Remote and Direct Access: Care for plants may be done from whichever point on earth – easily.

Control and Monitoring: Easy plant care management and observation from the comfort of a computer.

Graphic Visualisation and Interaction: Computer interfaces that are graphic in nature make it simple and easy to work with the visual data.

This technology allows its users to sustain plants while reducing efforts needed to support them thus allowing for sustainable practices which suit the modern needs of farming and urban gardening standards. The Plant Monitoring System is an effective resource for professional and amateur craftsmen and will be further developed as technology progresses.