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SustAIn: An AI integrated system designed to evaluate the health of house plants

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Abstract

The research delves into creating an advanced Artificial Intelligence application designed to improve the well-being of indoor plants using cutting-edge technology. Responding to the increasing demand for sustainable indoor gardening options, the system evaluates important aspects of plant maintenance, including soil quality, water levels, sunlight exposure, and overall health, and provides tailored care suggestions. By utilizing user feedback and visual data analysis, the app offers helpful advice to avoid typical problems such as watering too much or too little. Following an agile development method, the project focuses on functionality and user experience, assessing system performance with ISO 25010 standards. Findings show that there is a high level of user satisfaction in terms of usability, security, and functional stability, with room for improvement in performance efficiency. The research highlights how AI and IoT can promote environmentally-conscious plant care in home gardening, emphasizing the importance of these tools in raising awareness and accountability.

Keywords: Artificial Intelligence; App; House Plants; Integrated System; Predictive Algorithm

1. Introduction

Environmental issues have become widespread due to advances in technology and the spread of modernization across the globe. The apparent priorities among people pose a significant burden that will affect everyone from these habits of genuine carelessness attitudes about our nature. With global warming and extreme weather conditions, there is an increasingly urgent demand for change and growth. Despite efforts to mitigate the effects of our actions, it remains insufficient to reverse the conditions that damage inflicted upon our planet.

Advancements in agricultural technology go hand in hand with home gardening in providing inter-related solutions toward enhancing personal well-being, agricultural productivity, and overcoming the environmental challenges. Gardening supports physical health and has a significant contribution toward emotional well-being, especially for low-income households, in that it gives them a reason to feel a sense of belonging and community [1]. In the face of hazards to biodiversity, given the process of urbanization and shrinkage of green spaces, home garden agroforestry systems emerge as a resort of many households to conserve plant diversity along the routes of sustainable development goals [2].

More effort is needed to utilize our resources, capabilities, and knowledge to care for our environment effectively in today's fast-paced technology era. The rising alarm over environmental concerns highlights the urgency for action. The strike of the pandemic could be the spark plug that catalyzes our efforts to contribute to healing and protecting nature.

The adoption of smart technology in agriculture as championed by the initiative in the Philippines suggests that there is an enormous potential for utilizing such an application of accessible, low-cost tech means that could give small

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farmers a more productive and synergistic capability [3]. Incidents such as the 2023 Technoforum and successful experiments with smart greenhouses point toward a “smarter” agricultural future [4, 5]. While in the midst of pandemic crises and global conflicts causing food insecurity, acts like plant parenting and partnerships to raise fruit-bearing plants demonstrate the proactive approach of people toward food sustainability and economic resilience [6]. Examples include SARAI and a household plant health-tracking app, both demonstrating how mobile can benefit farmers and home gardeners in developing and developed countries, offering critical information from optimal times to plant to accurate weather forecasts that facilitate data-informed decisions that promote sustainable practices [7, 8]. Combined, these initiatives highlight an exciting common interest in marrying environmental stewardship with technology, which contributes to both ecological and human health in an increasingly dynamic planet.

Setting aside the technological, environmental and beneficial aspects of house plants, Architectural Digest also highlighted its addition to the aesthetic value of indoor places that started a botanical trend reshaping modern spaces with environmental touches [9]. The modernization of the digital world also allowed plant care to parallel with the evolving trends that meets the need of plants, leveraging modern technology in sustaining plant needs [10]. However, despite these technological solutions, the unending progression of urbanization will be the cause of scarce to outdoor spaces leading to environmental degradation and reduced green spaces. The popularization of indoor gardening is expected to rise and combat these problems through further studies and technological improvements [11, 12].

This study aims to develop an application that tracks the health of house plants through user input. It represents a crucial effort to integrate technology with environmental concerns; thus, an analysis will assess and measure the impact of this application on plant health and home gardeners’ practices.

2. Synthesis

Objective

The goal of this study is to create a comprehensive system designed to assess and monitor the living conditions of plants, taking into account a variety of factors that influence their health and growth. This system will evaluate the impact of environmental variables, including weather patterns; water availability, sunlight exposure, soil quality, and additional external elements that may affect plant vitality. By integrating these variables, the system aims to provide a more accurate understanding of the factors that contribute to optimal plant health and identify potential stressors that could hinder growth, enabling better plant care and management.

- To design an application that enhances plant care by offering comprehensive profiles on soil quality, water levels, sunlight exposure, and health indicators, integrating user feedback for accuracy, and using a predictive algorithm for personalized insights to address the lack of modern tools.
- To develop an application that analyzes diverse data points to provide houseplant owners with precise health insights and guidance for consistent care schedules, helping prevent overwatering and under-watering while offering advantages over traditional gardening methods.
- To implement a versatile system that leverages modern technology to manage various houseplants with tailored guidance and comprehensive profiles, actively mitigating environmental challenges and promoting sustainable practices.

3. Methodology

3.1. Theoretical Framework

Figure 1 showcase how the adaptation of technology in agriculture can contribute to the sustainability of house plants. Predictive algorithm will play pivotal role in this process through data analyzation of plant caring steps – assessing and optimizing plant’s health through the application. Artificial Intelligence further provides input on the tailoring of customized plant care instructions for each plant, thereby promoting healthier and sustainable growth

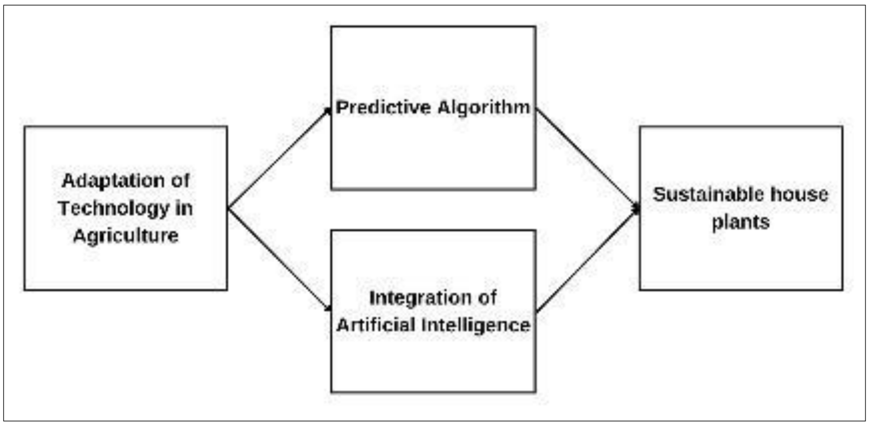

Figure 1 Theoretical Framework

3.2. Conceptual Framework

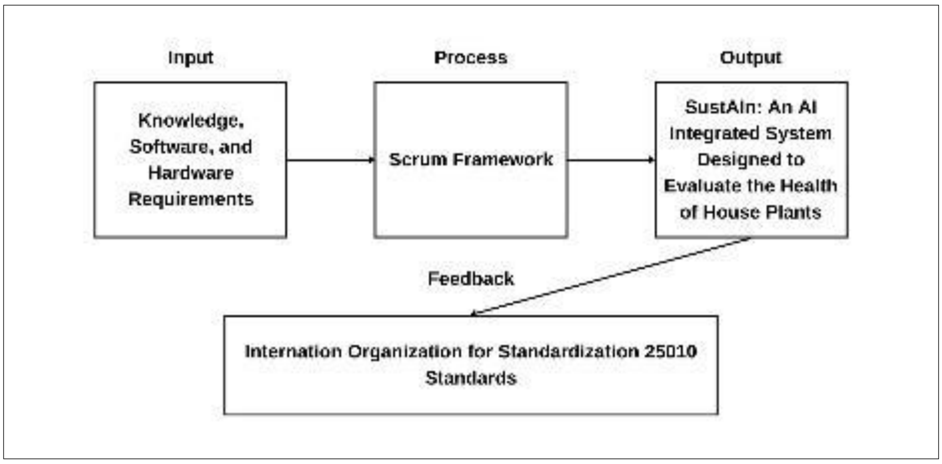

Figure 2 Input-Process-Output Framework Model

IPO model is devised to illustrate the development of the study. Input phase involves the gathering process of all necessary knowledge, software, and hardware requirements to ensure a high quality system. The Process phase applies the scrum framework to guide the stages that the system will go through from planning to maintenance. Output is the completed study with all objectives satisfied. All of these should reflect on the feedback of ISO 25010 which will be evaluated with the help of respondents in light of their user experience.

3.3. System Architecture

Figure 3 illustrates the application’s detailed structure, emphasizing its various interconnected components that collaboratively support a smooth and efficient user experience. The design of this system architecture reflects a deliberate selection of essential elements integrated throughout the implementation process. Key components include the user interface, internet connectivity, and a well-structured database.

This system architecture captures the dynamic interaction between the user and the system. The interface serves as the main point of interaction, enabling users to input information. Once the user provides input, the data is transmitted to the backend—the processing core of the application. Here, an integrated combination of predictive algorithm, artificial intelligence, and database structure analyzes the provided data to generate accurate results tailored to cater the unique requirements of each house plant.

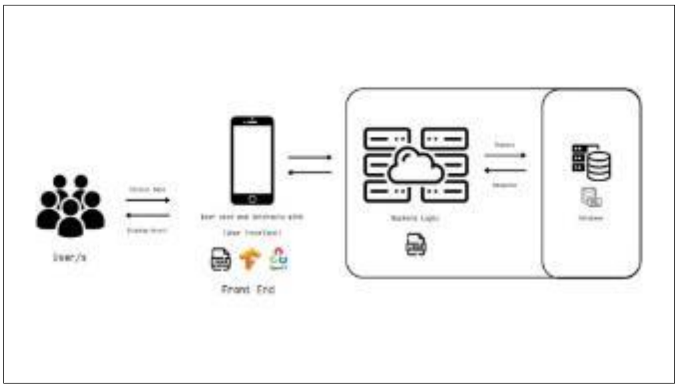

Figure 3 Infrastructural Design of the System

3.4. System Development

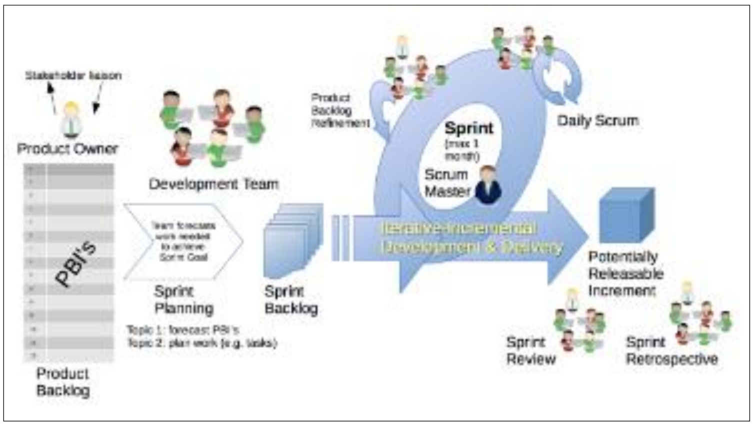

Figure 4 Agile-Scrum Framework

The developers will adopt Scrum Framework (By Dr. Ian Mitchell licensed under CC BY-SA 4.0) which is a form of an Agile Framework that encourages the continuous improvement and maintenance of the system wherein, the process starts planning, execution, and maintenance.

The Framework of this study breaks down to multiple parts. The starting phase is the planning where all scrum members are gathering information that outlines the objectives of the study. Design Phase serves as the backbone of the project and a basis of what its completed functionalities and appearance is, when implemented. The Develop Phase is where the programming of the system starts, where its end goal is to complete a fully functioning system. At the end of this phase, the system should be able to identify the life trajectory of the plants while also providing guidance and information for the plant's growth. The Testing Phase will verify if the system is in line to the planned and designed functionalities and interface. After passing the verification, the system will be deployed to the end users; this is a crucial part as the system will enter the reviewing phase where future enhancements will be discussed.

3.5. Instruments Used

In assessing the completed system developed by the researchers, including the AI gardening assistant and the project's guidance page, an online evaluation will be conducted using the ISO/IEC 25010 standard. This evaluation will measure the system's quality against high benchmarks to ensure it effectively supports home gardeners in managing their plants. Key aspects such as functionality, performance efficiency, usability, reliability, and security will be evaluated to gauge overall system performance and user satisfaction. The insights gained from this evaluation will be crucial for future enhancements and improvements to the application.

3.6. Treatment of Data

For this investigation, the developers will apply the following statistical procedures:

Percentage – Used to find the share of the total number of responses in each of the groups that were looked at. These were used to show the description of the people whose information was collected.

Formula:

P = fn100%

Where:

P = Percentage (in %)

f = frequency of each groups of respondents in the sample size

n = Total sample of respondents

Mean - Used to find the data's average number for a certain variable. It tells developers what the parameter being studied usually has a value of.

Formula:

x = xin

Where:

$\bar{x}$ = Sample Mean

f = frequency of each groups of respondents in the sample size

n = Total sample of respondents

3.7. System Evaluation

Table 1 Likert Scale for System Evaluation

Criteria	Numerical Value
4	Very Satisfied
3	Satisfied
2	Dissatisfied
1	Very Dissatisfied

The developers will utilize the Likert Scale in interpreting the collected information as it is easy to use and understand, thus yielding much accurate results. The 4 point Likert Scale gives respondents two extremities of choices, scaling the satisfaction of clients in their user experience. Through this approach, the researchers are able to collect data efficiently and analyze them in a manner that will help SustAIn meet its objectives.

4. Results and discussion

The evaluation of this system utilizes questionnaires as an efficient research tool to gather comprehensive data from a large group of participants, including faculty members and students. These questionnaires, featuring both open-ended and closed-ended questions, blend statistical and survey approaches to capture detailed insights. Questions are structured according to ISO 25010:2011 criteria and evaluated through a 4-point Likert Scale of Agreement, allowing a focused assessment of user satisfaction, which is central to the study’s objectives. Conducted through Google Forms, the survey engaged 100 houseplant enthusiasts aged 18 to 45, offering both accessibility and diversity in perspectives, thereby enhancing the depth and applicability of the study’s results.

4.1. Evaluation

Table 2 Results of the Evaluation

Criteria	Weighted Mean	Descriptive Rating
Functional Stability	3.46	Very Acceptable
Performance Efficiency	3.01	Very Acceptable
Usability	3.44	Very Acceptable
Reliability	3.26	Very Acceptable
Security	3.62	Very Acceptable
General Weighted Mean	3.36	Very Acceptable

Table 2 provides a detailed evaluation of the system's performance, indicating strong user satisfaction across multiple key areas. User feedback reflects that the system performs exceptionally well in functional stability, with a mean score of 3.46, placing it comfortably within the "Very Acceptable" range (86.5%). This high rating implies that users perceive the system as dependable and robust in operation. Usability is also rated positively, with an average score of 3.44 (86%), demonstrating that users find the interface intuitive, easy to navigate, and accessible, which collectively enhances their experience and engagement with the system.

Security measures receive a high satisfaction score of 3.23 (80.8%), reflecting user confidence in the system's ability to protect data through effective access controls and secure authentication mechanisms. This score indicates that users feel assured in the system's capacity to safeguard their information, which strengthens their trust in the application.

While the system scores positively overall, some areas indicate room for targeted improvements. Performance efficiency, rated at 3.01 (75.3%), is an area where some users have experienced delays that slightly detract from responsiveness. Improving system speed and efficiency could significantly enhance user satisfaction in this aspect. Similarly, the reliability score of 3.26 (81.5%) suggests the need for enhanced error management to improve system consistency and reduce unexpected interruptions.

On average, the system achieves a user satisfaction score of 3.07 (76.8%), situating it well within the "Very Acceptable" range. This overall rating demonstrates that users generally view the system as effective, supportive, and beneficial for managing their plant care routines.

The system's integration of AI-driven technology for monitoring and analyzing key plant health parameters provides significant added value by delivering personalized recommendations to enhance plant vitality. This AI functionality not only gathers data on variables such as moisture, light exposure, and nutrient levels but also employs sophisticated algorithms to interpret this information in a way that aligns with the unique needs of each plant. Users have expressed highly positive feedback on this feature, citing the system's intuitive functionality and its ability to provide tailored, data-driven guidance as pivotal in supporting effective plant care routines.

The algorithmic evaluation reveals that the AI's predictive accuracy is high, with models trained on extensive datasets to account for various plant types, climates, and growth stages. This adaptability allows the system to offer actionable insights that not only promote plant health but also anticipate potential issues before they become problematic, fostering a proactive approach to plant maintenance. Moreover, the AI's adaptive learning capabilities mean that, as users engage with the system over time, it refines its suggestions to better align with individual plant needs and user preferences, creating a more personalized experience.

To maintain and potentially increase user satisfaction, it is essential to prioritize regular collection of user feedback alongside periodic system updates. Incorporating user insights into the AI's ongoing learning process will ensure that the system remains attuned to the evolving needs and preferences of plant enthusiasts, while algorithm updates will enhance prediction accuracy and recommendation quality. This proactive, user-centered approach not only fosters trust but also enhances the system's relevance and long-term value, securing its position as a vital tool within the plant care community.

5. Conclusion

The study successfully developed an application that enhances plant care by providing personalized insights through predictive algorithms, comprehensive plant profiles, and tailored guidance, addressing the limitations of traditional gardening methods. With an overall mean rating of 3.07, the system is deemed highly acceptable and effective in promoting sustainable and consistent plant management.

Recommendations

The study recommends enhancing SustAIn by expanding its coverage to include a wider range of plant species and detailed diagnostics for plant diseases and conditions. Additional suggestions include integrating IoT devices for more accurate data collection and improving usability to create a more engaging, user-friendly experience for all age groups.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] BOBADILLA , C. G. V.Home Gardening Amidst Pandemic: Addressing Students’ Personal Welfare. IJAMS. https://www.ijams-bbp.net/wp-content/uploads/2023/03/1-IJAMS-FEBRUARY-2023-306-317.pdf

[2] Valdeavilla, T. M., SMARTER TECHNOLOGIES PROMISE A GREENER FUTURE FOR AGRICULTURE AT NSTW 2023’S TECHNOFORUM ON AGRICULTURAL RESOURCES MANAGEMENT. DOST. https://www.pcaarrd.dost.gov.ph/index.php/quick-information-dispatch-qid-articles/smarter-technologies-promise-a-greener-future-for-agriculture-at-nstw-2023s-technoforum-on-agricultural-resources-management

[3] Using Digitalisation for Smart Agriculture in the Philippines. OPENGOV. https://opengovasia.com/2022/11/09/using-digitalisation-for-smart-agriculture-in-the-philippines/

[4] Villegas, B. M., Calling All Plantitos and Plantitas. Bernardo M. Villegas. https://www.bernardovillegas.org/index.php?go=/Articles/1230/

[5] 6 Reasons Why Being a Plantito and Plantita Is Good For You. MyPharma. https://mypharma.ph/articles/6-reasons-why-being-a-plantita-is-good-for-you

[6] Featuresdesk., Smart Gardening For Food Sufficiency. PAGEONE. https://pageone.ph/smart-gardening-for-food-sufficiency/

[7] Gloria, M. J. E., Mobile apps for smart agriculture. HORIZON. https://horizon.uplb.edu.ph/3q-horizon-magazine-2019/mobile-apps-for-smart-agriculture/

[8] Smart Agriculture. Ateneo Innovation Center. https://www.ateneo.edu/sose/aic/projects/smart-agriculture

[9] Architectural Digest. (2021, September 15). The most iconic houseplant trends through the decades. Architectural Digest. https://www.architecturaldigest.com/story/houseplant-trends-history

[10] Petersen, A. H. (2022, March 6). The age of houseplants. The Age of Houseplants - by Anne Helen Petersen. https://annehelen.substack.com/p/the-age-of-houseplants

[11] Gwak, Y.-K. et al. (2020, March 13). Evaluation of IAQ management using an IOT-based indoor garden. MDPI. https://www.mdpi.com/1660-4601/17/6/1867

[12] Cruz, S., & Gómez, C. (2022, July 19). Effects of daily light integral on compact tomato plants grown for indoor gardening. MDPI. https://www.mdpi.com/2073-4395/12/7/1704