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PROJECT TREE GUARD: GROWING UP A TREE FOR REFORESTATION AND DEVELOPMENT OF COMMUNITY

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ABSTRACT: *According to the Commission on Audit (COA), the P7.2-billion National Greening Program (NGP) and the Department of Environment and Natural Resources (DENR) land survey project were "unsuccessful" due to a lack of efficient/effective implementation and monitoring mechanisms. It was also true from a local standpoint, as shown by what occurred during the activities in Barangay Quibal, the adopted community of the International School of Asia and the Pacific. Out of the 150 seedlings planted, only 84 survived. This is low in comparison to the predicted result, which is expected to be over 100 percent in May 2021. To address this issue, the researchers created a system that can monitor the growth of tree seedlings. The system (Project Tree Guard) can: 1. monitor the seedlings via an internet-connected mobile application; 2. show the real-time condition of the seedlings via a real-time photo of the seedlings; 3. automatically release water if the soil moisture is low; and lastly, the system monitors the seedlings' height growth. In order to assess the system's efficiency and efficacy, the researchers put it to the test by measuring the height of ten objects with flat surfaces and plants. To evaluate the system's reliability, the objects and plants were measured using both the system and manual measurement. The researchers have found that when an object has a flat surface, the ultrasonic sensor's accuracy has a low percentage of error. However, if the item is indented or not flat, there is a high percentage of error in their accuracy. Because the researchers' objective is to have a* *high possibility of seedling survival and to have a massive influence on the globe, this system may help the ecosystem improve and prevent climate change.*

Key words: Tree guard, community development, sustainable development goal, greenhouse effect

INTRODUCTION

The Philippines, being an island country in Southeast Asia and the Pacific, is extremely exposed to the effects of climate change. As a result, it is one of the country's most vulnerable to natural calamities, experiencing devastating typhoons, earthquakes, floods, and other catastrophic events that have claimed thousands of lives.

Trees play a crucial role in the ecosystem and the global environment, even though they may not seem significant at first glance. As the largest plants on the planet, they emit oxygen, store carbon, stabilize the soil, and provide food for animals worldwide. Trees are also essential in construction, providing materials for building homes. As they grow, they absorb carbon dioxide, helping to slow down global warming. Additionally, their ability to lose water and release heat through their leaves slows down wind and cools the air. In urban areas, trees can even reduce city temperatures by up to 7°C. Furthermore, trees absorb large amounts of precipitation, aiding in flood prevention and soil erosion control.

Despite the importance of trees, there have been challenges with the National Greening Program (NGP) initiated by the Department of Environment and Natural Resources (DENR), as noted by the Commission on Audit (COA). The program faced restrictions and difficulties, and its progress has been limited due to the pandemic. Inefficient and ineffective implementation and monitoring mechanisms have also contributed to its struggles. To achieve success, a more enhanced and focused approach is needed.

Even in local communities like Barangay Quibal, the adopted community of the International School of Asia and the Pacific (ISAP), there have been setbacks in tree planting efforts. Out of 150 seedlings planted, only 84 survived, falling short of the expected outcome of nearly 100% survival from the planting conducted in May 2021.

Recognizing the challenges faced by the National Greening Program and the low survival rate of tree seedlings in Barangay Quibal, researchers sought to address the problems at hand. These issues included the high mortality rate of tree seedlings, unmonitored tree growth, and low survival rates. To tackle these problems, the researchers conceptualized "Project Tree Guard: Growing Up A tree for Reforestation and Development of the community." This environmental project aims to design and create a more effective and manageable tree planting initiative in Barangay Quibal, ensuring better monitoring and maintaining the well-being of the planted tree seedlings.

METHODOLOGY

This part will explain the design, operation and functionality of the prototype project and the components of the overall system.

This study used the Descriptive Developmental Research Design for the system. This research design was used because the researchers aim to have a proper understanding of what the research problem is about before investigating why it exists in the first place. The researchers identify the result of the difference between the two variables used in gathering of data. The system was built and conceptualized a system that can monitor a tree seedlings growth to have a high chance of survival.

Software Development Methodology

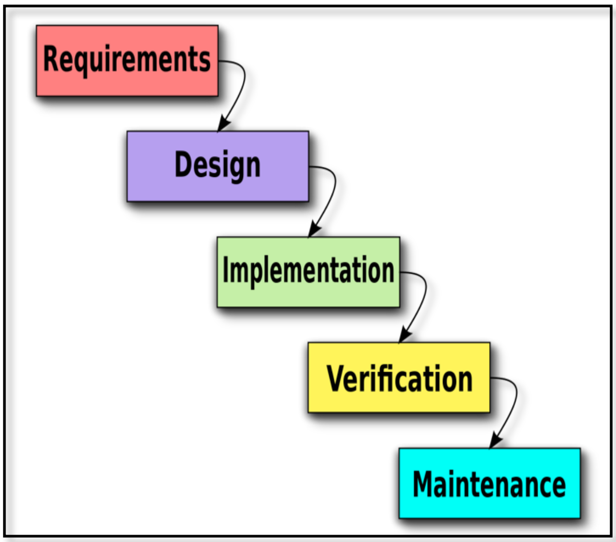

Figure 1. The Waterfall Model

In this study, the researchers used the Waterfall Model in order to succeed with less failure on the prototype project. The waterfall model is made up of phases that follow a sequence of stages and never go forward until the preceding phase is finished. This structure is best suited for smaller projects with clear objectives from the beginning. According to Ben Aston of The Digital Project Manager, waterfall is often seen as an inefficient and outmoded conventional project management technique. Waterfall may be a helpful and predictable approach if the requirements are identified, well documented, and obvious, the technology is known and mature, the project is short, and 'becoming agile' adds no further value. A Waterfall approach may deliver a more predictable final output in terms of money, time, and scope.

Project Development Phase

Third Phase: Specify Requirements. The following items presented below were the needed materials and its specification

Table 1: Hardware Requirements in Developing the Proposed System

Components/ Descriptions	Features/Specification
ESP 32 with Camera This will be the work's central processor. It is the component that receives and processes data for subsequent control actions.	• 802.11b/g/n Wi-Fi • Bluetooth 4.2 with BLE • UART, SPI, I2C and PWM interfaces • Clock speed up to 160 MHz • Computing power up to 600 DMIPS • 520 KB SRAM plus 4 MB PSRAM

	• Supports WiFi Image Upload • Multiple Sleep modes • Firmware Over the Air (FOTA) upgrades possible • 9 GPIO ports • Built-in Flash LED
Ultrasonic Sensor It is a sensor used for distance measurement,	• Voltage: DC5V. • Static current: less than 2mA. • Level output: high-5V. • Level output: the end of 0V. • Sensor angle: not more than 15 degrees. • Detection distance: 2cm-450cm. • High precision: up to 0.3cm. • Connection: VCC, trig (control side), echo (receiving end), GND
Soil Moisture Sensor It is a sensor used for soil status if it's wet or dry.	• Operating Voltage: 3.3V to 5V DC • Operating Current: 15mA • Output Digital - 0V to 5V, Adjustable trigger level from preset • Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor • LEDs indicating output and power • PCB Size: 3.2cm x 1.4cm • LM393 based design • Easy to use with Microcontrollers or even with normal Digital/Analog IC • Small, cheap and easily available

Phase 4: Develop and Prototype Solution. The researchers will create a System Architecture that will be used in the project prototype. The system architecture depicts how the system operates, how it flows, and how the many components utilized by the developers to create the project are connected.

Phase 5: Test and Redesign. During this phase, every system functionality is checked to ensure that there are no errors, and all non-functional requirements are recorded and corrected.

DATA GATHERING PROCEDURE AND TECHNIQUE

To examine the efficiency and effectiveness, the researchers tested the measuring height of the system, the researchers tested ten objects using the system and the manual measurement to determine the difference.

Data Analysis

The searchers found that in terms of the measurement of flat surfaces, the measurement of flat surface using the system achieved a 2.71% error. On the other hand, the researchers have found that there is a 15.88% error when the surface is not flat especially in measuring the height of the plants.

RESULTS AND DISCUSSION.

ARCHITECTURAL DESIGN

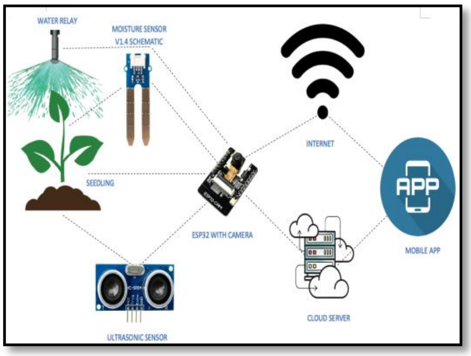

FIGURE 2. ARCHITECTURAL DESIGN OF THE PROJECT

The project's development involves using the Blynk Mobile Application Platform, which utilizes the user's e-mail address for access. The mobile application integrates an ESP32 camera to provide real-time updates on the tree seedlings' condition. It also incorporates ultrasonic sensors to detect potential intruders and soil moisture sensors to automate the watering process based on the seedlings' needs. This comprehensive system will enhance monitoring and maintenance efforts, ultimately contributing to the successful growth and reforestation of the tree seedlings.Figure 4 illustrates all the necessary items required for the project's development. The user's e-mail address will serve as the key to access the Mobile Application Platform called Blynk. Through this platform, the mobile application will be used to monitor and determine the real-time status of the tree seedlings with the help of the ESP32 camera.The mobile application will display the current condition of the tree seedlings, allowing users to see their progress and health. Additionally, the application will be equipped with ultrasonic sensors to detect any potential intruders that might attempt to harm the tree seedlings. If an intruder is detected, the user will receive immediate notifications, allowing them to take appropriate action to protect the seedlings.Furthermore, the mobile application will automate the watering process by using soil moisture sensors. If the sensors detect that the soil is dry, the system will automatically release water to ensure the tree seedlings receive the necessary hydration. Conversely, if the soil is already moist enough, the watering process will be automatically turned off, preventing overwatering and ensuring optimal growth conditions for the seedlings.

Table 2: The Testing Between the Experimental and Control

Variables	Groups	Mean	t-value	p-value	Decision
Height	**With System**	3.48	3.75	0.001	Significant
	Without System	1.10			
Number of Leaves	**With System**	1.60	3.15	0.003	Significant
	Without System	0.70			

The table shows the growth progress of a seedling over a span of 20 days, with and without the system. The measurements include the number of leaves and the height of the seedling in inches.Initially, both the system and the control (without system) show no growth for the first four days. However, starting from day 5, the seedlings with the system begin to show positive growth, with an increasing number of leaves and height in inches. In contrast, the control seedling without the system does not exhibit any growth in terms of leaves or height.The growth trend continues for the seedlings with the system until day 11, where they reach a height of 4.01 inches and maintain two leaves. From day 12 onwards, the control seedling stops growing, showing no leaves or height increase, while the seedlings with the system continue to grow steadily.By day 20, the seedlings with the system have reached a height of 6.89 inches with two leaves, while the control seedling remains stagnant at zero growth. Overall, the table demonstrates the positive impact of the system on the growth and development of the seedling, leading to a significant difference in growth compared to the control without the system.

Further statistical analysis shows that there is a significant difference between the system deployed and without the system deployed in terms of the number of leaves and height of the seedlings. The t-values of 3.15 and 3.75 and p-values of 0.003 and 0.001, respectively, indicate that the system is effective in reducing the mortality rate of the seedlings and increasing their chances of survival with proper maintenance.TaherMechergui (2022) emphasized that tree shelters/guards can play a crucial role in environmental and livestock management. These guards have been shown to significantly promote height development, surpassing any other protective approach. According to Carlos J Ceacero (2014), the use of tree guards for seedling protection leads to greater height growth, improved regulation of photosynthesis, potential enhancement of winter gas exchange, reduced photoinhibition processes, and enhanced seedling vitality from a photochemical perspective.Hence, the implementation of Project Tree Guard proves to be highly beneficial for the overall height growth, soil moisture monitoring, and automatic watering of the seedlings."

CONCLUSION

In conclusion, Project Tree Guard: Growing Up a Tree for Reforestation and Development of the Community is a system developed to address the challenges faced by reforestation efforts, particularly in Barangay Quibal, Philippines.The researchers aimed to design a system that could effectively monitor the growth and development of tree seedlings to improve their chances of survival. The system utilizes the Blynk Mobile Application Platform, incorporating an ESP32 camera for real-time updates on the seedlings' condition. Additionally, ultrasonic sensors detect potential intruders, and soil moisture sensors automatically release water if needed, promoting proper hydration for the seedlings.

The experimental results showed a significant difference between the seedlings with the system and those without, highlighting the system's effectiveness in reducing the mortality rate of the seedlings and increasing their chances of survival. Further analysis supported the potential role of tree shelters/guards in environmental and livestock management, emphasizing their positive impact on height development and seedling vitality. The implementation of Project Tree Guard proves to be a valuable tool for height growth, soil moisture monitoring, and automatic watering of seedlings. By utilizing this system, communities can work towards a greener and more sustainable future, ensuring the survival and growth of vital tree populations for reforestation and overall ecosystem improvement.

RECOMMENDATIONS

The researchers recommended that the future researchers will consider the following to attain the best results.

1. Scaling up Implementation: The success of the system in promoting tree seedling growth and survival warrants consideration for scaling up the implementation. The Department of Environment and Natural Resources (DENR) and other relevant government agencies should explore the possibility of integrating Project Tree Guard into their reforestation programs and initiatives across different communities and regions.
2. Capacity Building and Training: To ensure the effective deployment and maintenance of the system, capacity building and training programs should be conducted for local communities and stakeholders. This will enable them to understand the functionalities of Project Tree Guard, its benefits, and how to properly use and maintain the system for optimum results.
3. Public-Private Partnerships: Collaboration between government agencies, private organizations, and non-governmental organizations (NGOs) can enhance the adoption

and sustainability of Project Tree Guard. Public-private partnerships can provide resources, technical expertise, and financial support to expand the implementation of the system.

4. Long-Term Monitoring and Evaluation: Establishing a long-term monitoring and evaluation framework is essential to track the performance and impact of Project Tree Guard over time. Regular assessments will allow for necessary adjustments and improvements in the system to address emerging challenges and ensure its continued effectiveness.
5. Community Engagement and Awareness: Raising awareness about the importance of reforestation, climate change mitigation, and the benefits of Project Tree Guard is crucial. Engaging local communities in the reforestation process and encouraging their active participation will foster a sense of ownership and responsibility for the success of the initiative.
6. Research and Development: Continuous research and development efforts should be encouraged to enhance the functionalities of Project Tree Guard. Exploring innovative technologies, such as artificial intelligence and data analytics, can further improve the system's efficiency and accuracy in monitoring and caring for tree seedlings.
7. Adoption of Sustainable Practices: Alongside the implementation of Project Tree Guard, communities should adopt sustainable practices in land management, conservation, and reforestation efforts. This includes ensuring the use of native tree species, promoting agroforestry, and employing sustainable farming practices to create a more resilient and biodiverse ecosystem.
8. Policy Support and Incentives: Government policies that support reforestation initiatives and provide incentives to adopt and maintain Project Tree Guard can encourage wider adoption and long-term commitment. Tax incentives, grants, or other forms of support can motivate communities and organizations to actively participate in reforestation efforts.
9. Collaborative Research and Knowledge Sharing: Collaboration between research institutions, universities, and relevant stakeholders can contribute to the continuous improvement and innovation of Project Tree Guard. Sharing knowledge, data, and best practices will foster a collective effort in addressing climate change and

environmental challenges. Specifically, the following should be done to enhance the system:

a. Use more accurate sensors
b. use full image processing
c. use of the security camera more capable of securing the system from the intruders
d. use of sustainable source of energy.

REFERENCES

Bundang, R. B. (2015). *Solon seeks inquiry of DENR's National Greening Program due to low replanting and survival rates of seedlings* https://www.congress.gov.ph/press/details.php?pressid=8566

Close, D. C., Ruthrof, K. X., Turner, S., Rokich, D. P., Dixon, K. W. (Ecophysiology of Species with Distinct Leaf Morphologies: Effects of Plastic and Shadecloth Tree Guards, Copyright © 1999-2021 John Wiley & Sons, Inc. All rights reservedhttps://doi.org/10.1111/j.1526-100X.2007.00330.x

Dollery, R., Bowie, M. H., Dickinson, N. M. (2018). Tree guards and weed mats in a dry shrubland restoration in New Zealand, © 2008-2021 ResearchGate GmbH. All rights reserved.

Ewane, E. B., Lee, J., Lee, H. (2016). Eight-year monitoring of the height growth and survivorship of seedlings of Pinusthunbergii Parl. planted with sand fence and bush hedge protection in a coastal sandy environment in Korea,Copyright © 2021 Informa UK Limitedhttps://doi.org/10.1080/21580103.2016.1150357

Gamarra-Diezma, J. L., Miranda-Fuentes, A., Llorens, J. , Cuenca, A. , Blanco-Roldán, G. L. , Rodríguez-Lizana, A. (2015). Testing Accuracy of Long-Range Ultrasonic Sensors for Olive Tree Canopy Measurements © 2015 by the authors; licensee MDPI, Basel, Switzerland

Grossnickle, S. C., MacDonald, J. E. (2017). Why seedlings grow: influence of plant attributes, © 2021 Springer Nature Switzerland AG. Part of Springer Nature.https://10.1007/s11056-017-9606-4 http://10.1111/emr.12341

https://doi.org/10.3390/s150202902

Israel, D. (2015). Taking stock of the National Greening Program six years hence https://www.think-asia.org/handle/11540/6755

Lai, P.C. C., Wong, B.S. F. (2005). Effects of Tree Guards and Weed Mats on the Establishment of Native Tree Seedlings: Implications for Forest Restoration in Hong Kong, China, Copyright © 1999-2021 John Wiley & Sons, Inc. All rights reservedhttps://doi.org/10.1111/j.1526-100X.2005.00016.x

M. A. M. Tejada, J. V. P. Querol, and R. C. Fontanilla, "Extending the Capacity of an RFID Technology and Real Time Clock in Controlling the Power Distribution of MCNP-ISAP," Seybold Report, 2020. [Online]. Available: https://doi.org/10.17605/OSF.IO/CHBXD

Miller, A. M., O'Reilly-Wapstra, J. M., Potts, B. M., McArthur, C. (2011). Repellent and stocking guards reduce mammal browsing in eucalypt plantations, © 2021 Springer Nature Switzerland AG. Part of Springer Nature.https://10.1007/s11056-011-9253-0

Ramos, M. (2015). COA: P7B tree-planting project of DENR a failure https://newsinfo.inquirer.net/687426/coa-p7b-tree-planting-project-of-denr-a-failure

Santilli, F., Mori, L., Galardi, L. (2004). Evaluation of three repellents for the prevention of damage to olive seedlings by deer, © 2021 Springer Nature Switzerland AG. Part of Springer Nature.https://doi.org/10.1007/s10344-004-0036-1

Teves, C. (2018). DENR chief seeks ways to raise NGP seedlings' survival rate https://www.pna.gov.ph/articles/1056443

Vista, A. (2016). Impact Assessment of the National Greening Program of the DENR: Scoping or Process Evaluation Phase (Economic Component) https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwitu8XxkoP0AhWSh1YBHcpSBGsQFnoECA0QAQ&url=https%3A%2F%2Fdirp3.pids.gov.ph%2Fwebsitecms%2FCDN%2FPUBLICATIONS%2Fpidsdps1629.pdf&usg=AOvVaw23ZR7Eo34Dsl9fHcRhxGgJ