International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Automated Plant Irrigation System and Monitoring System

Earl Joseph S. Villaruz[1], Joelyn P. Ladroma[2], Jahnna Mae R. Eyana[3], Benjamin Mahinay[4*], Iris Mae C. Mendoza[5]

[1,2,3,4,5]Department of Arts Sciences, Computer Science Program, University of Mindanao-Tagum College, Philippines.*

Email: [1]e.villaruz.487446@umindanao.edu.ph, [2]j.ladroma.497410@umindanao.edu.ph, [3]j.eyana.487397@umindanao.edu.ph, [5]irismae_mendoza@umindanao.edu.ph
Corresponding Email: [4]benjamin_mahinay@unindanao.edu.ph*

Received: 11 December 2021 **Accepted:** 22 February 2022 **Published:** 30 March 2022

Abstract: ***The objective of project is hinged on two essential features (the time and the amount of water pressure). The automated plant irrigation and monitoring system was created efficiently get things done for farmers. This capstone project used an Arduino Board. The features of the system are based on identified needs of Ladroma's Farmland, situated in Banagbanag, Montevista, and Davao De Oro. The system was configured to measure the following (temperature, humidity, water level, soil moisture and control the flow of water) either manually or automatically. Moreover, it can also sense soil moisture and supply the exact amount of water needed. The system aims to set up a wireless sensor network to monitor the soil moisture which will send information to the system to start the water pump if the soil dries up. Furthermore, the proposed irrigation system will reduce the hassle of looking after plants. Thus, improving farmer efficiency. The system will also provide a real-time monitoring status relative to plant irrigation.***

Keywords: Arduino, Monitoring System, Plant Irrigation System, Automated.

1. INTRODUCTION

The Philippines is an agricultural nation in Asia. Given the financial shape and employment structure of the country, there is a need for greater awareness in technological research. There are varied conditions that result to reduction in crop productivity, however, an integral component would be the water quality supplied to crops. Water with high pH levels affect the soil negatively. Resulting to crops not being able to absorb nutrients effectively. As such, there is a need to regulate pH levels of water used for irrigation [1]. The use of conventional irrigation procedures has significant drawbacks, such as increased agricultural labor. This frequently results to issues on irrigation as well as soil leaching. The basis for pursuing this project was to provide an automated system for watering plants. The agricultural sector of the

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Philippines does not have sufficient support from the government. A report found that the budget allotted for agriculture demonstrates the unwillingness of the Duterte administration to address farming sector issues. Moreover, government initiatives have also decreased as time passes [2]. Another compelling issue is the scarcity of water wherein small-scale farmers are the greatly affected. Because of water scarcity, there is an increasing demand for projects that can help in water conservation and reduction. Some solutions were investigated; however, the issue persists. Despite such concerns, there are ways to enhance water utilization in terms of water management and water productivity [3]. A means of addressing this is through automated irrigation. The project was developed to be more advanced and compact when compared with existing systems in the locale market.

2. DESIGN METHODOLOGY

The projects sought to aid farmers relative to improving water irrigation. Irrigation management is critical for farmers. Since crops need water on a daily basis, using irrigation systems is necessary. Moreover, lacking machine performance and maintenance costs has been a struggle for farmers. Primarily rooted in the high cost of technology [15]. The proposed automated water irrigation system and monitoring system utilized Arduino UNO for the hardware while MIT APP INVENTOR was utilized as the app admin panel. The proposed System block diagram is shown in Figure 1.

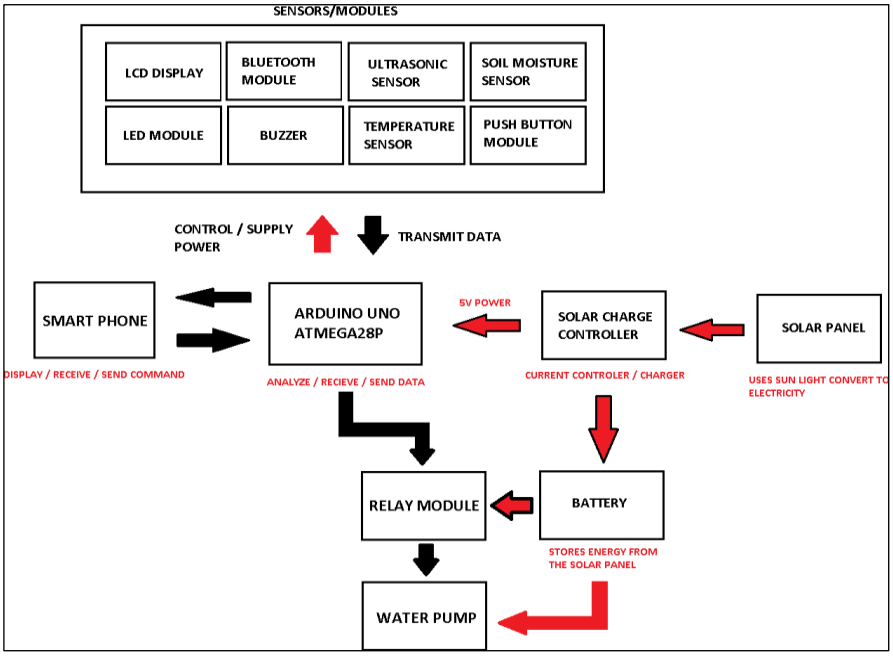

Figure 1. Proposed System Block Diagram

The Arduino Microcontroller-based automated irrigation and monitoring system comprises several sensors. There are sensors for moisture, humidity, ultrasonic, DHT11 temperature. It even includes a battery. The moisture sensor is buried in the field based on depth. When the moisture content in the field lowers to the threshold. A signal emits from the microcontroller

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

to switch ON the relay. Alternately, the Arduino system emits signals through Bluetooth toward the hand-off module and monitors the water level. The Android application can be used to monitor the system. Users can even manually switch the water flow using the Android app. Other sensors like for humidity can be used to measure the wetness of the area. The core components of the proposed research project are as follows (microcontroller-Arduino Uno ATMEGA328P-PU, temperature, moisture sensor, potentiometer, and motor). The Agile Software Development Method is designed with the intention of continuous changes during the development of a system. The stakeholders are required to interact with each other to come up with changes that will improve the development of the system. In the case of this study, the stakeholders are the developer, beneficiary, and user.

Requirement Analysis: The initial stage in developing the proposed system required to identify beneficiaries. The researchers identified the farmers of Ladroma, situated in the municipality of Montevista. The farmers can provide relevant information relative to the context of the irrigation system assistance. Interacting with the beneficiary enabled the researchers to frame ideas that will be able to address the need of the farmers. This project aims to aid farmers in terms of agricultural efficiency by minimizing human supervision during irrigation.

Design and Development: The interface of the mobile application was designed using MIT App Inventor. This project used Java as the language for programming. Moreover, Arduino IDE was implemented for the hardware as well as programming of the sensors. Arduino Uno was used as the core component of the system for the low cost, less complexity. In addition, it provided the needed features in designing the software. Both MIT App Inventor and Arduino Components were selected for design and development since both worked effectively with one another.

Quality and Assurance: The System underwent trial and error as a mechanism to comply with quality assurance. This process involved several revisions which resulted to adding improvements in the project development. The earlier stages of the irrigation system only consisted of a trigger using the mobile application. It was later improved to include manual activation. Moreover, there were two options available for system automation: Users can set the time or it can depend on the moisture level of the soil. The design of mobile application was modified to adjust to the technological fluency of farmers. The developers were able to do so by employing a navigation structure that is straightforward. Changes were also made during software development based on the feedback coming from the farmers.

System Testing: The researchers conducted two stages of testing for the application: Alpha testing and Beta testing. This was done to check if all sensors and the system itself are functioning. For the Alpha Testing, only the researchers tested the functionality of the application and the system. For the Beta testing, the researchers tested it with the intended beneficiaries. Feedback was generated by the beneficiaries in terms of improving the system

Deployment: The team made a test run on the system together with identified stakeholders. Both software and hardware were deployed to the respective sites of the beneficiaries. The

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Arduino system parts were manually installed and securely stored. Rigorous testing was done during the delivery phase. This will guarantee that the application will optimally function. Researches also employed continuous deployment. This involved extensive testing of the project which revealed bugs in the production version. Users were able to test the software which generated the necessary feedback on the system. Allowing details that can be used for improving features in the system.

Operations: Software and hardware development continued even after the deployment of the project. Maintenance was done by the researchers regularly. This allowed the researchers to remove bugs. Thus, opening opportunities to gather further input and make the necessary modifications in revising the application used for the research project.

System Requirements: The research project sought to lessen the workload of farmers relative to plant irrigation. The projects proposed a system that provides plant monitoring thru the application and the LCD attached to the hardware. In addition, the system doubles as an automated irrigation process which has a manual feature. The irrigation is activated through a soil moisture sensor. The functions are carried out through three core features:

- The system will notify the user with a screen display that is showed on the screen whenever the application and the system are connected using Bluetooth.
- The system will enable the user to activate the soil moisture sensor and turn on the hardware manually.
- The user should have an Android device having the Android version 9.0 (Android Pie) or higher to operate the application with few problems encountered.

3. RESULTS AND FINDINGS

This portion of the paper will present the results of all testing results which are deemed relevant in improving the final version of the research project.

Mobile Device Compatibility Test: The researchers conducted a mobile compatibility device test to five selected devices. These devices were selected for testing since these devices were the mobile device used by the farmers. Moreover, all devices have Android 9.0 because this is the minimum requirement for using the mobile application. The researchers employed a mobile launch test to check if the application can function on mobile phones that used Android as the mobile operating system. Table 1 shows the five devices that were used ad their compatibility with the application. It is shown that all devices are compatible for as long as the Android is higher than 9.0. The mobile launch test was successful because all devices encountered no issues in the test.

Table 1. Mobile Device Compatibility Test Result

Mobile Device	Android Version	Compatibility Result	Launch Test Result
Oppo A5s	Android 9.1	Compatible	Passed
Tecno KE7	Android 10	Compatible	Passed
Realme 6i	Android 11	Compatible	Passed
Xiaomi Redmi Note 11	Android 11	Compatible	Passed

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Vivo V21	Android 12	Compatible	Passed

The researchers selected lady's fingers (Okra) as the identified plant to test the effectiveness of the automated irrigation system. The identified plant (Okra) was observed and watered daily for a period of two months, and a half based on level of soil moisture.

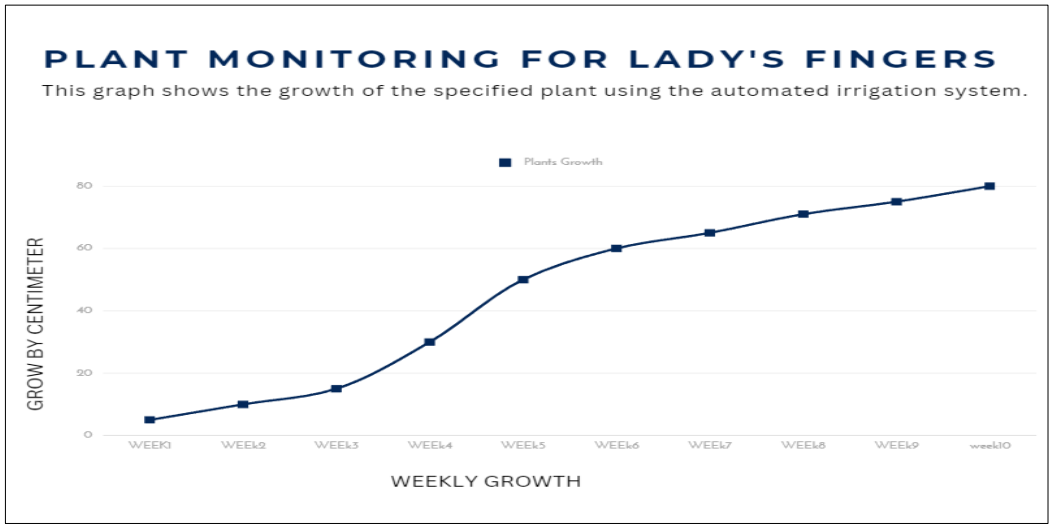

Figure 2. Plant Monitoring in using Automated Irrigation System

Figure 2 shows the weekly growth of the plant. The Y-axis represents the growth of the plant in centimetres, while the X-axis represents the timeline of growth in terms of weeks. It can be observed that in the first week the plant grew by 5 centimetres. There is also an observed plant growth in the following weeks. Data shows that the plant growth can be attributed to the effectiveness of the automated irrigation system.

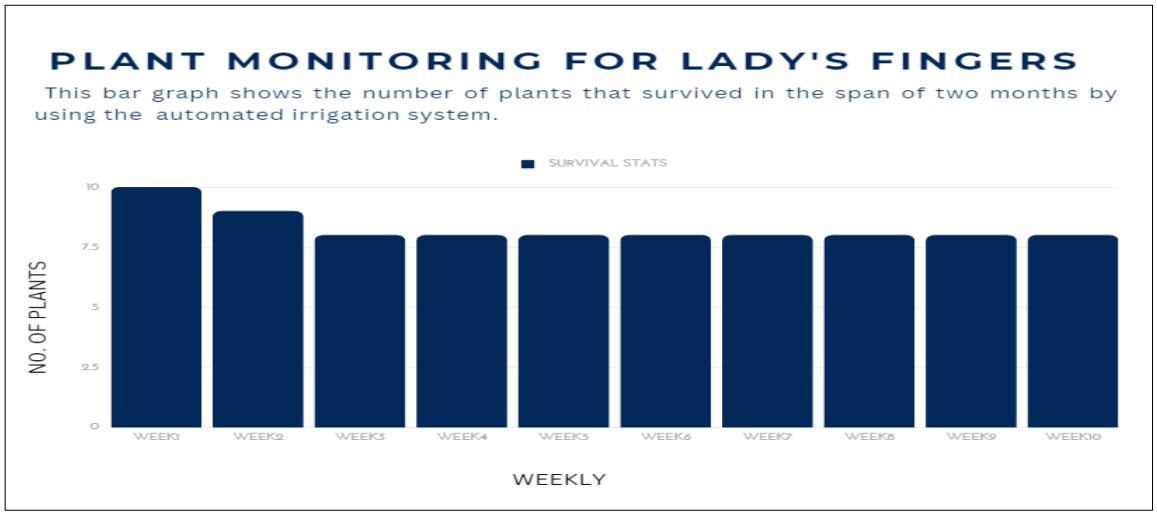

Figure 3. Lady's Finger Survival Rate

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Figure 3 shows the survival rate of lady's finger in the ten-week implementation of the research project. The x-axis represents the number of weeks, while the y-axis represents the number of plants that survived. It can be observed that in the first week, all plants adjusted to the environment and the soil moisture. Only one plant died each week. This occurred only for first three weeks. This can be attributed to the inconsistent water dispersal. In the following weeks, other plans survived but with an uneven development.

4. CONCLUSION

The system benefits the agricultural sector because it is manageable for farmer use. The system can improve daily operations of farmers by making things convenient. The automation of the irrigation method aids farmers saves time. It can even lead to a higher harvest of crops. The researchers were able to successfully achieve the objectives through this research project.

Recommendation

Based on the results, the researchers propose the following recommendations for further improvement of the system.

- Future researchers are encouraged to improve the adaptability and responsiveness of the interface. This may be done by incorporating features that were not explored by the current study. This study will serve as the basis for future systems relative to an automated irrigation system.
- Farmers also suggested improvement for the system. Farmers mentioned to make the system straightforward and tidier. Future researchers may consider this suggestion to improve the system.
- Farmers also advised the following improvements: (1) full-length tube, (2) bigger pump, and (3) long-lasting spray mist. Moreover, the following suggestions were provided by the farmers to for protect the irrigation device. First, farmers added to use materials which are pest-resistant materials. Second, the use of long-lasting water-resistant paneling, and Third, fire-prevention hazard detectors.

5. REFERENCES

1. Poyen Phd, Faruk & Kundu, Palash & Ghosh, Apurba. (2018). pH Control of Untreated Water for Irrigation. Journal of the Institution of Engineers (India). Journal of the Institution of Engineers (India) Series.
2. Cristina Eloisa Baclig. (2021). Pandemic worsens gov't neglect of P.H. agriculture. INQUIRER.net.Retrieved from https://newsinfo.inquirer.net/1507264/pandemic-worsens-govt-neglect-of- ph-agriculture
3. Inocencio, A., & Barker, R. (2018). Current challenges in agricultural water resource development and management in the Philippines. DLSU Business & Economics Review, 28(1), 17.
4. Retrieved from https://newsinfo.inquirer.net/1507264/pandemic-worsens-govt-neglect-of- ph-agriculture
5. A. Susmitha et al. (2017). Automated Irrigation System using Weather Prediction for

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol : 02 , No. 02 , Feb-Mar 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.22.23.29

Efficient Usage of Water Resources. IOP Conference Series: Materials Science and Engineering.

6. J. Uddin, S. M. T. Reza, Q. Newaz, J. Uddin, T. Islam and J. -M. Kim. (2012). Automated irrigation system using solar power. 7th International Conference on Electrical and Computer Engineering, (pp. 228-231). doi:10.1109/ICECE.2012.6471527.
7. Joji Mitto K S, Dr. Preeti Savant. (2022). A Research paper on Auto Controlling Irrigation System Using Arduino UNO. doi:https://doi.org/10.22214/ijraset.2022.41401
8. L Kamelia1, M A Ramdhani1, A Faroqi1 and V Rifadiapriyana1. (n.d.). Implementation of Automation System for Humidity Monitoring and Irrigation System. IOP Publishing Ltd. Retrieved from https://iopscience.iop.org/article/10.1088/1757-899X/288/1/012092/meta
9. LIXIA, W., YANG, Y., LIN, Z., QIFEI, D., & CHANGQIU, S. (2022). China Patent No. CN114063537A.
10. M. V. C. Caya, A. H. Ballado, K. C. Arrogante, et al. (2018, December). AIP Conference Proceedings 2045. Retrieved from https://aip.scitation.org/doi/pdf/10.1063/1.5080862
11. Shiraz Pasha B.R., 2, Dr. B Yogesha. (n.d.). The International Journal Of Engineering And Science, 3(7), 06–9. Retrieved from www.theijes.com
12. Singla Bobby et al. (n.d.). A study on smart irrigation system using IoT. International Journal of Advance Research, Ideas, and Innovations in Technology. Retrieved from https://www.ijariit.com/manuscripts/v5i2/V5I2-1894.pdf
13. V. Ramachandran, R. Ramalakshmi and S. Srinivasan. (n.d.). An Automated Irrigation System for Smart Agriculture Using the Internet of Things. 15th International Conference on Control, Automation, Robotics and Vision (ICARCV, (pp. 210-215). doi:10.1109/ICARCV.2018.8581221
14. YUEFENG, Z., JUNYONG, Z., YONGLEI, L., & XIAOFEI, L. (2019). china Patent No. CN209768492U
15. Lubag, M., Bonifacio, J., Tan, J. M., Concepcion, R., Mababangloob, G. R., Galang, J. G., & Maniquiz-Redillas, M. (2023). Diversified Impacts of Enabling a Technology-Intensified Agricultural Supply Chain on the Quality of Life in Hinterland Communities. Sustainability, 15(17), 12809.