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Technology Transfer of Humidity and Temperature Control System Using Ultrasonic Mist Maker in the Lamongan Hydroponic Farm Area, Sidoharjo Lamongan District

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ABSTRACT

Lamongan Hydroponic Farm's vegetable farming has a lot of potential, however managing humidity and temperature is a problem. While farmers there have been successful in creating fruitful hydroponic gardens, they struggle to keep the ideal growing environment. Severe temperature and humidity swings have an impact on harvest quality and raise production costs. The community service team suggested using solar energy and ultrasonic mist maker technologies to solve this issue. It is anticipated that this technology will lower operating costs, produce the perfect atmosphere for plant growth, and automatically control the amount of water in the air. Lamongan hydroponic farming may therefore be more productive and long-lasting. Lamongan Hydroponic Farm's community service program is implemented through the following phases: socializing, training, technology application, mentorship, and program sustainability evaluation. Two key technologies were developed as a result of this process: smart agricultural knowledge and ultrasonic mist makers with IoT and solar panel systems attached. According to the evaluation results, the three pretest and posttest questionnaires received resulted in an average improvement in partner knowledge from 49% to 74%.

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INTRODUCTION

Growing hydroponic plants is a particularly potential enterprise in the lowland Lamongan area. This is a result of the lowland areas' frequently unfavorable weather, which includes prolonged droughts and extremely high temperatures, making conventional crops like corn and rice unfeasible (Bimaprawira & Rejeki, 2021). Additionally, the soil in Lamongan is not as rich. In addition to the relatively high demand for vegetable consumption in the Lamongan area, a number of franchisees have recently formed and are in need of a supply of veggies. In 2017, Helmy Hadinata and Diah Afrilianti, together with a few local farmers, established the Lamongan Hydroponic Farm, a hydroponic garden based on low production costs and land (Fatori, 2022). This garden is operated by four employees and farmer partners in the village of Sidoharjo. This 2000 square meter hydroponic garden has five primary gardens, including a nursery, and is composed of four production gardens and one educational garden(Kusumawardhani et al., 2023; Thooriq et al., 2023). This garden grows more than five different kinds of vegetables: lettuce, kale, celery, spinach, and mustard greens (Pak choy, cucumber, and curly)(Siswono et al., 2023). The partner claims that they can complete two harvests and two seeding procedures in a week to meet the demands of the hydroponic vegetable market in both local and distant markets, including major cities like Surabaya. A photo of the partner's hydroponic garden (Endang Pergiwati, 2023) can be found in Figure 1 below.

It is still challenging to escape the existing situation because smart farming technology has not had any impact on partners' current state to foresee this. Farmers take steps to lower temperature and humidity, such as taking apart the greenhouse to allow airflow to carry water vapor. However, this is less effective in the rain and becomes more difficult if the greenhouse is opened, as rat pests become more active (Badji et al., 2022; Kolapkar & Sayyad, 2021).Additionally, farmers manually apply sprays if the air becomes dry and the ambient temperature rises when the humidity declines. Due to the fact that farmers' goal is to keep the hydroponic garden atmosphere between 65 and 78 percent humid and between 25 and 28 degrees Celsius. In terms of managing the output of hydroponic gardens, this approach is less successful in terms of operational expenses for power and other factors(Kalandarov & Abdullaeva, 2022; Sunik et al., 2024) .

FIGURE 1. a) Lamongan Hydroponic Farm vegetable garden, b) Rotten vegetables due to disease, Source: Author's, 2024

Technology that can solve the issues with temperature and humidity management in hydroponic plants is required to combat this. Therefore, in the Lamongan Hydroponic Farm Area, Sidoharjo Village, Lamongan, a technology transfer of the Humidity and Temperature Control System Using Ultrasonic Mist Maker is required. By dividing water into mist at a high frequency, ultrasonic mist maker technology allows one to regulate the amount of water in the atmosphere; With the use of humidity and temperature sensors, the resulting mist value may be automatically adjusted to keep the hydroponic garden environment at the proper humidity and temperature levels. It can be used in greenhouses as well to help plants resist outside disruptions from the plantation. Later on, this system will make full use of renewable energy, specifically a solar panel system, to avoid adding to the production or running expenses of the garden.

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METHOD

Target partners are fully involved in every activity as part of the participatory approach method used to deliver Community Partnership Empowerment (PKM) programs. Partners actively participate in the following aspects of this activity: socializing, training, use of technology, mentorship & evaluation, and program sustainability:

Focus Group Discussion

Prior to PKM's deployment, the service team and partners—namely, Hydroponic Farm Lamongan—conducted a focus group discussion (FGD) as a means of socialization. Farmer groups participating in Hydroponic Farm Lamongan will also be included in FGD. This FGD activity aims to provide service workers with a way to communicate the PKM program plan that will be implemented in the hopes of receiving feedback to ensure the smooth operation of this PKM. Additionally, forming a cooperative commitment and cooperating to ensure that this PKM accomplishes its goals.

Training

Partners in this PKM program participate in training sessions, which are sequential program solutions. The specifics of the activities are as follows:

- Using an ultrasonic mist maker to design an automated humidity and temperature control system to manage pests that lead to crop loss in hydroponic food plants.
- Instruction in the creation, operation, and upkeep of an automated system for controlling temperature and humidity that uses an ultrasonic mist maker to keep pests out of hydroponically grown vegetables and prevent crop failure.
- Using solar panels as a green energy source to design an electrical power supply system for tools and plantings
- Instruction in the planning, operation, and upkeep of a solar-powered plantation power supply system that powers tools and provides green energy.
- Guidance and instruction on how to manage hydroponic gardens using science and technology, particularly smart farming.
- The development of farmers knowledgeable about smart farming technologies for the digital administration of hydroponic gardens

Partners in hydroponic farming taking part in the Community Partnership Empowerment (PKM) program in the following ways:

- Setting up a space and providing tools (projector, whiteboard, speaker, LCD, microphone) for internal meetings, practices, FGD activities, counselling, and training.
- Encouraging the public or members of farmer groups to participate in events being held in the partner region
- Supplying trial gardening tools and hydroponic gardens for the PKM technology transfer pilot project.
- Supplying the first power required for assembling the tools
- Disseminating details about specific issues and technological fixes for vegetable pests using temperature and humidity adjustments

Application of Technology

This phase of the program involves putting the training into practice since partners are now capable of designing, utilizing, and maintaining the technology they have previously learnt on their own. The technology that partners are anticipated to apply, specifically:

- Using ultrasonic mist makers to control pests in hydroponically grown vegetables
- Using power supply systems for plantations that use solar panels as a green energy-based electrification method
- Using smart farming-based digitalized garden management technologies

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Evaluation of program implementation

Determining if the solution is appropriate for the problems that the partners are facing is the goal of the monitoring and evaluation program. Every activity has a monitoring and evaluation program that includes participant attendance sheets, questionnaires for pre- and post-tests to gauge participant understanding, comparative analysis of partner knowledge levels via the distribution of questionnaires prior to and following socialization, and a percentage measure of program achievement. Following the completion of each task, assessments are conducted. These assessments include the final monitoring and evaluation of PKM as well as the monitoring and evaluation of PKM progress. The assessment results are examined, and the outcomes of the problem analysis conducted during the activity serve as the foundation for the mentoring activities that will be implemented in the ongoing program to find the best solution. Partner representatives took part in the PKM program's final evaluation by presenting program outcomes such as the development of farmers who are knowledgeable about smart farming technology, an automated system for controlling temperature and humidity that uses an ultrasonic mist maker to control pests, and an electric power supply system for tools and plantations that uses solar panels as a green energy source.

Program Sustainability

Because of the infrastructure and facilities, which include an electric power supply system for tools and plantations that uses solar panels as a green energy source, an automated humidity and temperature control system that uses an ultrasonic mist maker to control pests, and the program implementation team's training of farmers in smart farming technology, it is anticipated that partners will continue to support this PKM program on their own.

The methods used in community service as a whole can be presented in the flowchart in Figure 1.

FIGURE 1. Community Service Method

RESULT AND DISCUSSION

Focus Group Discussion

Prior to socialization, a location evaluation or field survey is conducted after coordinating with the Lamongan farmers that operate hydroponic farms. During this phase, a conversation is had regarding the problem's urgency and potential remedies that the technical service and the service team will eventually give(Ghiffary et al., 2024).

Socialization

The technology transfer of humidity and temperature control systems using ultrasonic mist makers in the Lamongan hydroponic farm area, Sidoharjo Village, Lamongan, is the current title of the community service project. This topic provides a remedy to the issue of produce rot brought on by illness and pests as a result of the recent effects of La Lina and El Nino on the Lamongan area's drastic temperature and humidity fluctuations. This technology is suitable for greenhouse hydroponic plantations. The material at this socialization stage is divided into three sections: the first covers the technology of ultrasonic mist makers; the second covers the technology of using solar panels to generate green energy or environmentally friendly energy; and the third covers smart farming knowledge to create farmers who are knowledgeable about smart farming technology. The socializing paradigm takes the shape of talks and material presentations.

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About 26 persons, including young men and women interested in hydroponics and those with varying experiences in hydroponic farming, attended the first presentation on ultrasonic mist maker technology.

(a) (b)

FIGURE 2. Socialization Activities (a) and Socialization Materials (b) Source: Author's, 2024

A general explanation of the ultrasonic mist generator can be found in the materials about it. Essentially, it is a device that uses ultrasonic vibrations to break up water into tiny droplets that resemble fog. The fog maker and control sensor, which runs on temperature and humidity data, are the primary parts. The information also describes the various elements of the sensor components, which have a power supply of 3.3–5.2 volts and a detection range of -40 to 80 °C and 0–99% relative humidity. DHT 21, which will subsequently be installed in the greenhouse, is used by the temperature sensor(Rinaldi et al., 2022). The ultrasonic mist producer will turn on when the humidity falls below 70%. The ultrasonic mist maker can produce 0.11 x 10^{-3} – 0.52 x 10^{-3} kg/s mist flow(Martínez et al., 2020). hence the hydroponic garden's veggies can benefit from this cooling. farmer's smartphone can be used to access the Blynk IoT server, which powers the IoT system.

FIGURE 3. IoT ultrasonic Mist Maker view from smartphone (Source: Author's, 2024)

The second set of materials includes an overview of the technical circuits on solar panels as well as information on using solar panels in hydroponic crops. The ability of solar panels to transform solar energy into electrical energy is the basis for how hydroponic crops operate. The hydroponic system's numerous parts, including grow lights for extra lighting, sensors to keep an eye on the environment, and water pumps for nutrient circulation, are all powered by the electrical energy generated. Solar panels, then, provide hydroponic systems with the independence to function without totally depending on electricity from the

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public grid. The installation of solar panels also helps with environmental preservation initiatives and offers long-term operational cost savings. Solar panels, MCBs, solar charger controllers, batteries, inverters, and cables are the usual components of this circuit(Puengsungwan & Jirasereeamornkul, 2019).

FIGURE 4. Solar Panel activity discussion (Source: Author's, 2024)

The use of information and communication technology (ICT) to automate and monitor the process of plant cultivation in a hydroponic system is known as smart farming, and it is explained in detail in the third item, which is an explanation of smart farming in hydroponics. Temperature, humidity, pH, and nutrition are just a few of the characteristics that this system can automatically measure and control thanks to its network of connected sensors, actuators, and software(Adidrana et al., 2022). The software will evaluate sensor data to generate the best possible choices for the hydroponic system's parameters. This enables farmers to increase crop quality, maximize productivity, and use less resources(Nasrudin et al., 2023). Furthermore, farmers may operate their hydroponic plants more effectively even when they are not present by using remote monitoring. To put it briefly, smart farming in hydroponics is the application of contemporary technology to soilless plant growing for improved and more long-lasting outcomes.

FIGURE 5. Smart farming discussion session (Source: Author's, 2024)

Training

Training is carried out to directly practice how to assemble, use, and maintain technological systems(Fajrin et al., 2022). The training was carried out by showing how the device—which included the installed IoT system, solar panel, and ultrasonic mist maker—works. It also covered how to maintain and use the equipment, as well as its benefits and drawbacks. As part of the training, farmers will also learn about the functions of each component part, such as the exhaust fan, evaporation pipe, ultrasonic mist maker, and so on, as well as the air flow system on the device, enabling them to modify it as needed.

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FIGURE 6. Solar panel system assembly (Source: Author's, 2024)

FIGURE 7. Ultrasonic mist maker system training (Source: Author's, 2024)

Application of technology

The assembly and application of technology to the Lamongan hydroponic farm garden are the two main steps in the application process. Beginning with the manufacturing, testing, and calibration phases, assembly is the process of combining all of the electrical components into a single unit that functions in accordance with the intended initial design(Lin et al., 2021). After the system is operational, the hydroponic garden moves on to the next phase, which involves placing the solar panel outside the garden and the equipment within. Due to the thick garden conditions and the size of the hydroponic farm garden, a space of about 20 meters is needed between the solar panel and the equipment. Subsequently, a garden humidity tool is used to detect it, and it is calibrated to operate at 70% relative humidity (between 52.5 and 52.5 RH). The upcoming chapter will provide an explanation of the specifics of the technology's implementation.

FIGURE 8. Technology application activities (Source: Author's, 2024)

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Evaluation of program implementation

A program comprehension questionnaire with pretest and posttest models and a questionnaire model—true and false answers—was used for the evaluation. Each activity is represented by 30 questions, 10 of which are multiple-choice. Filling out was done both before and after the activity. And the outcomes are displayed in the graph that follows:

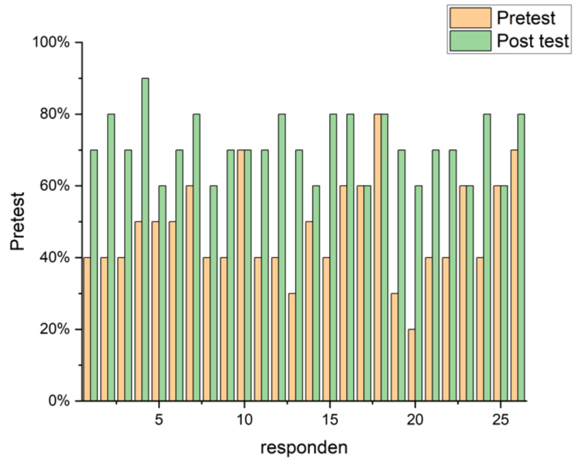
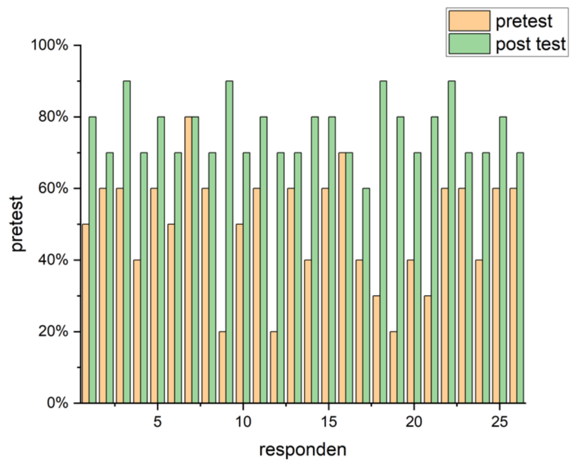


FIGURE 9. Percentage of pretest and posttest of ultrasonic mist maker activities Source: Author's, 2024

The average participant's comprehension of the ultrasonic mist maker technology that would be presented during the pretest was 48%, and after the posttest, it rose to 71%, indicating a good degree of understanding.

During the comprehension exercise involving solar panels, the following visual representation was acquired



:

FIGURE 10. Percentage of pretest and posttest solar panel activities Source: Author's, 2024

After taking the posttest, participants' understanding of the solar panel technology grew to 76% with a very excellent level, compared to an average of 49% during the pretest with a level of sufficient understanding. During the process of comprehending smart farming, the following visual aid was created.

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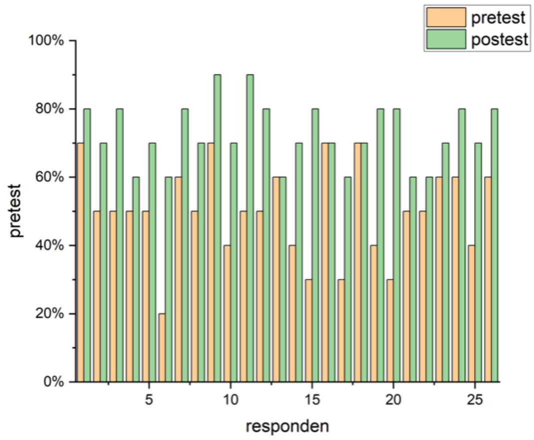

FIGURE 11. Pretest and posttest percentage of smart farming activities: Author's, 2024

The average participant's comprehension of the smart farming technology that would be presented during the pretest was 49%, and following the posttest, it rose to 76%, indicating a good degree of understanding. The enhanced comprehension resulting from the aforementioned three activities indicates that the program's implementation was successful since it adhered to the community service's original goal, which was to transfer technology(Zhuang et al., 2021). The results showed an average increase of almost 25%, or from 49% to 74%. It is believed that once partners comprehend the technology used, they will be able to modify it on their own to suit the requirements of the hydroponic garden that will be built.

CONCLUSION AND RECOMENDATION

Using a questionnaire that included information on comprehending ultrasonic mist maker technology (71%), solar panels (76%), and smart farming (76%), this community service project led to an improvement in awareness about these topics. It is believed that this additional information would help hydroponic farmers stay up to date on the newest developments in agricultural technology, particularly as it relates to hydroponics. Additionally, hydroponic gardens have benefited from the application of ultrasonic mist maker technology that is coupled with IoT and powered by solar panels.In addition, farmers actively engage in the socialization phase, training, technology implementation, and sustainability assessment of this service process. Because they have acquired training in soft skills for tool-making, Lamongan hydroponic farmers are also willing and actively involved in maintaining post-PKM activity equipment as well as innovating and changing to meet the needs of the garden. This initiative suggests that this technology be developed for large-scale plantations. Additionally, information can be disseminated to hydroponic gardens outside of this one, and farmers and the support team can continue to communicate in the event that equipment-related issues arise during or after the PKM activity.

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https://doi.org/10.35568/abdimas.v7i4.5450

REFERENCES

Adidrana, D., Iskandar, A. R., Nurhayati, A., Suyatno, -, Ramdhani, M., Adam, K. B., Ardianto, R., & Ekaputri, C. (2022). Simultaneous Hydroponic Nutrient Control Automation System Based on Internet of Things. *JOIV: International Journal on Informatics Visualization*, *6*(1), 124–129. https://doi.org/10.30630/joiv.6.1.865

Badji, A., Benseddik, A., Bensaha, H., Boukhelifa, A., & Hasrane, I. (2022). Design, technology, and management of greenhouse: A review. *Journal of Cleaner Production*, *373*, 133753. https://doi.org/10.1016/j.jclepro.2022.133753

Bimaprawira, A., & Rejeki, H. A. (2021). KETERKAITAN PERIODISITAS CURAH HUJAN DI DAERAH PESISIR DAN PEGUNUNGAN PROVINSI JAWA TIMUR DENGAN VARIABILITAS CUACA SKALA GLOBAL DAN REGIONAL. *Jurnal Sains & Teknologi Modifikasi Cuaca*, *22*(2), Article 2. https://doi.org/10.29122/jstmc.v22i2.4422

Endang Pergiwati. (2023, October 12). *Pasutri di Lamongan Sukses Usaha Hidroponik Sayur Mayur, Simak Kiat-kiatnya!* jatimnow.com - Berita dan Informasi Jawa Timur Terkini. https://jatimnow.com/baca-62310-pasutri-di-lamongan-sukses-usaha-hidroponik-sayur-mayur-simak-kiatkiatnya

Fajrin, H. R., Wulaningrum, P. D., & Haidar, M. I. (2022). Hydroponic Training for Women Farmers Group (KWT) in Jaten, Sendang Rejo, Yogyakarta. *ABDIMAS: Jurnal Pengabdian Masyarakat*, *5*(2), 2864–2868.

Fatori, M. M. F. (2022). Aplikasi IoT Pada Sistem Kontrol dan Monitoring Tanaman Hidroponik. *Jurnal Pendidikan Sains Dan Komputer*, *2*(02), Article 02. https://doi.org/10.47709/jpsk.v2i02.1746

Ghiffary, L. E., Alfaris, A., Azis, W. N., & Mubin, A. (2024). Edukasi dan Pelatihan Penanaman Hydroponik, Solusi Pemanfaatan Lahan Sempit Pemukiman Padat. *Jurnal Pengabdian Masyarakat Sains Dan Teknologi*, *3*(3), Article 3. https://doi.org/10.58169/jpmsaintek.v3i3.533

Kalandarov, P. I., & Abdullaeva, D. A. (2022). Innovative approach to the development of hydroponic green feeds. *IOP Conference Series: Earth and Environmental Science*, *1043*(1), 012012. https://doi.org/10.1088/1755-1315/1043/1/012012

Kolapkar, M. M., & Sayyad, S. B. (2021). Greenhouse Microclimate Study for Humidity, Temperature and Soil Moisture Using Agricultural Wireless Sensor Network System. In K. C. Santosh & B. Gawali (Eds.), *Recent Trends in Image Processing and Pattern Recognition* (pp. 278–289). Springer. https://doi.org/10.1007/978-981-16-0493-5_25

Kusumawardhani, L. O., Aryani, G. S. D., Syah, M. A., & Witjaksono, G. S. B. (2023). Sosialisasi Penggunaan Pestisida Nabati Untuk Pengendalian OPT Sayuran Hidroponik Pada Kelompok Wanita Tani Kirani. *Jurnal Pengabdian Pada Masyarakat Indonesia*, *2*(4), Article 4. https://doi.org/10.55542/jppmi.v2i4.733

Lin, Y.-W., Lin, Y.-B., & Hung, H.-N. (2021). CalibrationTalk: A Farming Sensor Failure Detection and Calibration Technique. *IEEE Internet of Things Journal*, *8*(8), 6893–6903. IEEE Internet of Things Journal. https://doi.org/10.1109/JIOT.2020.3036859

Martínez, P., Ruiz, J., Martín, Í., & Lucas, M. (2020). Experimental study of an ultrasonic mist generator as an evaporative cooler. *Applied Thermal Engineering*, *181*, 116057. https://doi.org/10.1016/j.applthermaleng.2020.116057

Nasrudin, N., Bahtiar, Y., & Pratiwi, E. H. (2023). Business Opportunity from Hydroponics: A Research on Community Service Angle. *Jurnal Abdimas*, *27*(2), Article 2. https://doi.org/10.15294/abdimas.v27i2.47551

Puengsungwan, S., & Jirasereeamornkul, K. (2019). Internet of Things (IoTs) based hydroponic lettuce farming with solar panels. *2019 International Conference on Power, Energy and Innovations (ICPEI)*, 86–89. https://doi.org/10.1109/ICPEI47862.2019.8944986

https://doi.org/10.35568/abdimas.v7i4.5450

Rinaldi, R., Dewi, T., & Oktarina, Y. (2022). Implementasi Fuzzy Logic dalam Mengendalikan Input dan Output pada Penyiraman dan Pemupukan Tanaman Otomatis Berbasis IoT. *Journal of Applied Smart Electrical Network and Systems*, *3*(02), Article 02. https://doi.org/10.52158/jasens.v3i02.520

Siswono, G. O., Lina, Y. A., & Pricila, V. (2023). The Application of the Long-Short Term Memory (LSTM) Forecasting Method on the Impact of Tropical Cyclones in Indonesia. *Jurnal Matematika, Statistika Dan Komputasi*, *20*(1), Article 1. https://doi.org/10.20956/j.v20i1.27151

Sunik, S., Yoedono, B. S., & Manao, R. N. R. (2024). Memanfaatkan Setetes Air: Teknologi Irigasi untuk Produktivitas Tanaman. *Yayasan DPI*. https://badanpenerbit.org/index.php/dpipress/article/view/1512

Thooriq, M. A., Sujatmika, A. R., & Umami, I. (2023). Rancang Bangun Alat Penyiraman Dan Pembasmi Hama Otomatis Pada Tanaman Bayam Dengan Monitoring Berbasis Website. *Jurnal Sains Dan Teknologi (JSIT)*, *3*(1), Article 1. https://doi.org/10.47233/jsit.v3i1.554

Zhuang, F., Qi, Z., Duan, K., Xi, D., Zhu, Y., Zhu, H., Xiong, H., & He, Q. (2021). A Comprehensive Survey on Transfer Learning. *Proceedings of the IEEE*, *109*(1), 43–76. Proceedings of the IEEE. https://doi.org/10.1109/JPROC.2020.3004555

https://doi.org/10.35568/abdimas.v7i4.5450