TEMPLATE OF UNIVERSITY'S INNOVATIVE PROGRAM

(To be used by WURI Foundation for Record-keeping)

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Program Profile		
Program	Program name	Technology Transfer of an Arduino-Based Solar-Powered Hydroponic System for Urban Farming in Brgy. 611, Sta. Mesa
	Category	B3
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School, College, or Headquarters to Which the Case Belongs (Please review the list below and write the corresponding number in the box.)	
From the list below, please enter **only one department number** between 1 and 22.	14
Cross-Cutting & Institutional **1.** UH – University Headquarters **2.** AI – Artificial Intelligence & Data Science **3.** IN – Interdisciplinary & Emerging Fields **Professional & Career-Oriented Schools** **4.** BS – Business / Management **5.** LW – Law **6.** MD – Medicine **7.** DS – Dentistry **8.** NS – Nursing & Health Sciences **9.** PH – Pharmacy **10.** PB – Public Health	**Science, Technology & Applied Fields** **11.** EN – Engineering **12.** CS – Computer Science & Information Technology **13.** AR – Architecture & Urban Planning **14.** AG – Agriculture & Life Sciences **15.** EV – Environmental & Sustainability Studies **Humanities, Arts & Social Sciences** **16.** HU – Humanities **17.** SS – Social Sciences **18.** ED – Education **19.** AD – Art & Design **20.** MU – Music **21.** PF – Performing Arts (Theatre/Film/Dance) **22.** DV – Divinity / Theology / Religion
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(To be used by Evaluators and Judges for WURI Ranking 2026)

WURI's Serial Number		**(Leave this box blank.)**
Summary of Program		
Program Name		Technology Transfer of an Arduino-Based Solar-Powered Hydroponic System for Urban Farming in Brgy. 611, Sta. Mesa
Category		B3
Abstract of Program		This study aimed to design, implement, and transfer a solar-powered hydroponic system integrated with an Arduino-based monitoring and control mechanism to Brgy. 611, Zone 61, Mahistrado, Bacood, Sta. Mesa as a community extension initiative. The primary objective was to provide a sustainable, technology-driven solution for urban agriculture by enabling local residents to cultivate crops efficiently without soil while addressing global concerns on food security and environmental sustainability. An experimental research design was employed, initially developed and tested at Hydro Terrace Farms in Antipolo, then implemented as a community-based model in Brgy. 611. The system utilized an Arduino Uno microcontroller connected to sensors that monitored water parameters such as pH, Total Dissolved Solids (TDS), and temperature. Real-time data visualization and control were facilitated using the Blynk mobile application. Solar energy was harnessed to power the system, promoting environmental sustainability and reducing reliance on grid electricity. Key findings revealed that the system effectively maintained ideal water solution conditions. Statistical analysis showed no significant deviation in pH levels, while TDS levels approached statistical significance and water temperatures consistently exceeded the standard range, indicating areas for further optimization. The use of dosers was proven effective in adjusting pH and nutrient levels. The implementation in Brgy. 611 demonstrated positive outcomes in terms of increased plant growth, operational efficiency, and community adaptability to smart farming practices. The success of this project underscores the role of state universities in reimagining extension work—translating research into practical, local solutions that address global challenges such as sustainable food production and climate resilience.
Details of Program		
Planning		
Objectives	Long-term Goals	1. Establish hydroponics as a reliable source of fresh, safe, and nutritious vegetables for urban households, reducing dependency on external food supply chains. 2. Encourage adoption of water-efficient and renewable energy–powered farming systems that are resilient to climate variability and power interruptions.

		3. Develop long-term competence among community members in operating, maintaining, and innovating technology-driven agricultural systems. 4. Strengthen sustained partnerships between the university and barangays for continuous knowledge exchange, extension, and innovation. 5. Support the development of small-scale urban farming enterprises that can generate additional household income through vegetable production and sales.
	Short-term Targets	1. Install and commission a fully functional Arduino-based solar-powered hydroponic system in the target community. 2. Train selected residents on system operation, sensor calibration, nutrient management, and basic troubleshooting. 3. Achieve at least one to two successful crop cycles of leafy vegetables (e.g., pechay, lettuce, kangkong) with measurable improvement in growth rate and yield. 4. Designate and prepare community members to serve as system operators and maintenance personnel. 5. Monitor pH, TDS, temperature, energy usage, and crop growth to assess system effectiveness and identify improvement areas. 6. Conduct orientations and demonstrations to increase understanding, trust, and interest in hydroponic and solar technologies.
	Rationale	Urban communities face increasing challenges related to limited space for food production, rising food costs, climate change, and unreliable access to fresh and nutritious vegetables. Traditional soil-based farming is often not feasible in dense urban settings due to space constraints, poor soil quality, and pest-related issues. The technology transfer of an Arduino-based solar-powered hydroponic system addresses these challenges by introducing a space-efficient, water-saving, and energy-independent farming solution. By integrating automation, real-time monitoring, and renewable energy, the system enables communities to produce food sustainably while building technological literacy. This initiative also supports the university's mandate to translate research outputs into practical solutions that improve community resilience, food security, and self-reliance.
Subject (Leader)	Initiator(s)	ZOLETA, Minerva C.
	Champion(s)	MAMARADLO, Rogelio T.
	Major team member(s)	FABRO, Bernard C.; FELIPE, JR., Jose C.; UTULO, Ador G.; Association of Computer Engineering Students (ACES)
Environment	Nature/Society	The technology transfer of the Arduino-based solar-powered hydroponic system has a positive environmental impact by reducing land and water use compared to traditional soil farming. It minimizes soil degradation, pesticide runoff, and pollution since crops are grown without soil and with controlled nutrient delivery. The use of solar energy lowers carbon

		emissions and decreases reliance on fossil-fuel-based electricity. For society, the system improves access to fresh and safe vegetables, contributing to better food security and nutrition in urban communities. It also promotes environmental awareness and sustainable practices by demonstrating how technology can support eco-friendly food production.
	Industry/Market	The technology transfer of the Arduino-based solar-powered hydroponic system encourages industries and markets to adopt more sustainable and resource-efficient food production methods. It reduces operational costs for small agri-businesses by lowering water consumption and dependence on grid electricity through the use of solar power. The system supports consistent, year-round production, helping stabilize vegetable supply and reduce market price fluctuations. It also promotes the growth of urban agriculture enterprises, creating new opportunities for green jobs and local Agri-tech markets. Overall, it pushes the agricultural industry toward environmentally responsible and technology-driven practices.
	Citizen/Government	The technology transfer of the Arduino-based solar-powered hydroponic system supports citizens by improving access to affordable, fresh, and locally produced vegetables, enhancing food security and public health. For government, it promotes sustainable urban agriculture practices that reduce pressure on land, water, and energy resources. The use of solar power helps lower carbon emissions and supports national renewable energy and climate action goals. It also aids local governments in implementing community-based environmental and livelihood programs. Overall, the project strengthens citizen participation and government efforts toward sustainable and resilient communities.
Resources	Human resources	BS in Computer Engineering student-volunteers, Faculty members, Extension workers, Barangay Officials, and trained Community caretakers.
	Financial resources	Minimal institutional cost for training and capacity building; materials and supplies sourced through student projects; barangay partners for snacks; Department Head for nutrient solutions, seedlings and minor repairs; and student organizations
	Technological resources	Arduino microcontroller platform, sensors, solar power system, hydroponic system components, software tools and calibration tools.
Mechanism	Strategy (Weight/Sequence)	The project strategy focused on community-centered technology transfer by designing an accessible, low-cost, and sustainable hydroponic system powered by solar energy and controlled via Arduino automation. It emphasized capacity building, ensuring the community can independently operate and maintain the system. The approach also integrated real-time monitoring and data-driven evaluation to optimize performance and encourage adoption. Sustainability and scalability were key, aiming to create a replicable model adaptable to similar urban communities.
	Organization	EARIST Administration provided financial assistance for the conduct of training. Computer Engineering Faculty members and students led the technical design, system assembly, training, and monitoring. Barangay 611 local government unit (LGU) facilitated community engagement, logistics, and provided support through MOA agreements. Community members participated as trainees, operators, and caretakers, forming the local operational unit. This structure balanced technical expertise with community involvement for effective technology adoption.
	Culture	The culture fostered by the project is one of **collaboration, learning, and sustainability**. It encouraged a **participatory mindset** where community

		members were active learners and co-owners of the technology rather than passive recipients. The project promoted **innovation grounded in local needs**, valuing practical solutions and adaptability. EARIST's extension culture of **service and knowledge sharing** was central, nurturing trust and long-term commitment between the university and the barangay.
Doing		
Launch date		September 23, 2024
Responsible organization		Eulogio "Amang" Rodriguez Institute of Science and Technology EARIST Extension Services College of Engineering Computer Engineering Department
Program content and process		The program content focused on introducing sustainable urban farming through a solar-powered hydroponic system integrated with Arduino-based automation and sensor monitoring. It covered hydroponic principles, crop management, sensor calibration, system operation, and maintenance, combining agricultural knowledge with practical engineering skills. The program process followed a structured sequence that included system design and testing, community deployment, orientation, and hands-on training of residents. Post-implementation monitoring and evaluation were conducted through scheduled visits and community feedback to ensure effective technology adoption and long-term sustainability.
Key highlights of the content/process		Design & Development: Built an Arduino-based, solar-powered hydroponic system integrating sensors (pH, TDS, temperature) for automated real-time monitoring. Community Engagement: Partnered with Brgy. 611 for deployment, orientation, and hands-on training of residents. Data-Driven Monitoring: Conducted scheduled monitoring (Nov 15, Dec 6, Feb 24) to collect environmental and growth data, ensuring system performance and adoption. Sustainability Focus: Used renewable energy and trained local caretakers for long-term maintenance and scalability.
Differences from traditional approaches		Unlike traditional soil-based farming, this project uses a soilless hydroponic system that allows crops to grow in a controlled nutrient solution rather than relying on soil quality. The system is powered by solar energy, reducing dependence on grid electricity and making it suitable for urban areas with limited resources. Instead of manual checking, plant conditions are monitored automatically using sensors and an Arduino controller, allowing real-time adjustments. The setup requires significantly less space and water, making it ideal for rooftops and densely populated communities. Overall, this approach reduces pest and disease problems while improving efficiency, sustainability, and crop productivity.
Progress as of today		System fully deployed and operational in Brgy. 611. Multiple crop cycles completed with positive growth results. Residents trained and active as system caretakers. Continuous data collection confirming stable pH, TDS, temperature levels. Barangay expressed interest in replicating and expanding the system.
Problems in implementation		Occasional sensor drift requiring recalibration. Limited technical knowledge among some community members leading to inconsistent maintenance. Algae growth in nutrient reservoirs due to light exposure. Scheduling

	conflicts reducing full participation during training. Resource constraints for spare parts replacement.
Approaches to solve the problems	Implemented regular calibration schedules and trained residents on calibration procedures. Developed simplified maintenance manuals and conducted refresher training sessions. Covered nutrient tanks to block light and reduce algae growth. Offered flexible training schedules and hands-on coaching to improve participation. Engaged barangay officials for budget support and sourcing affordable spare parts.
Completion date, if completed	Technology Transfer: September 23, 2024 Post Implementation Monitoring and Evaluation: February 24, 2025 (Ongoing for monitoring and sustainability)
Seeing	
Impacts on students	Students gained practical experience in embedded systems, renewable energy, and urban agriculture through real-world project involvement. Enhanced skills in programming Arduino, sensor integration, data monitoring, and troubleshooting. Increased awareness of social responsibility and extension work by directly contributing to community development. Access to interdisciplinary research topics combining engineering, agriculture, and sustainability. Improved readiness for careers in Agri-tech, environmental engineering, and IoT applications.
Impacts on professors	Enabled translation of academic research into practical community solutions, enriching teaching and scholarship. Strengthened roles as extension facilitators and mentors in bridging technology and society. Provided updated, real-world case studies and lab exercises for courses in embedded systems, renewable energy, and sustainable agriculture. Expanded partnerships with local government units and communities for future projects and funding. Opportunities for publishing and presenting interdisciplinary work in conferences and journals.
Impacts on university administration	Enhanced the university's image as a socially responsive institution committed to community service and sustainability. Demonstrated successful fulfillment of government extension and outreach mandates. Positioned the university for increased grant funding from government and private sectors for community-based research. Fostered cooperation across engineering, agriculture, and social sciences departments. Showcased leadership in promoting green technologies and sustainable urban development.
Responses from industry/market	Increased demand for affordable, modular automated farming kits. Emerging micro-enterprise opportunities in urban agriculture supported by the technology.
Responses from citizen/government	Barangay officials and residents expressed strong support and willingness to replicate and scale the system. Recognition of the project's role in improving food security and sustainable livelihood. Local government units considering budget allocation for maintenance and expansion. Community engagement in trainings and system operations indicating readiness for technology adoption.
Measurable output (revenues)	Non-monetary gains include increased volunteer participation, growing learner enrollment, improved numeracy performance, and consistent tutorial documentation. Partnerships and community goodwill generate sustained support and resource sharing.
Measurable input (expenses)	₱15,000–₱25,000 total project cost including materials, solar components, sensors, and training.20-30 residents trained, including project team

	members and barangay officials involved. Number of systems deployed (1 main system in Brgy. 611), sensors calibrated, solar panels installed. Approximately 15–20 hours of orientation and hands-on training.
Cost-benefit analysis for effectiveness	The cost-benefit analysis shows that although the initial investment for the Arduino-based solar-powered hydroponic system ranges from ₱15,000 to ₱25,000, the long-term benefits outweigh the costs. Operational expenses are minimal because the system uses solar energy and recirculates water, resulting in significant savings on electricity and water consumption. The system produces faster-growing crops and higher yields, which helps reduce household food expenses and provides potential livelihood opportunities. Environmental benefits such as reduced carbon emissions and minimized pesticide use further increase its overall value. Overall, the project demonstrates that the technology is a cost-effective, sustainable, and impactful solution for urban farming.
Future Planning	
Where does the project go from here?	Expand the hydroponic system to more households and community sites within Brgy. 611 and neighboring barangays, adapting the design to varied urban spaces. Incorporate additional sensors (dissolved oxygen, light intensity) and develop remote monitoring and alert systems to improve crop management and maintenance. Conduct refresher trainings, create "local champions" or caretaker groups, and develop easy-to-follow manuals or video tutorials for sustained operation and troubleshooting. Support residents in forming cooperatives or micro-enterprises to market surplus produce, linking them with local markets and sustainable business models. Continue monitoring to gather long-term data on system performance, crop yields, and social impact; explore integration with AI or IoT for smarter farming solutions. Work with local government units to secure budget allocations, promote urban agriculture policies, and build partnerships with NGOs, private sector, and other academic institutions. Seek additional funding sources and grants to maintain, upgrade, and scale the project, ensuring its long-term viability and community ownership.
Addendum	
Exhibits, pictures, diagrams, etc.	GDrive https://drive.google.com/drive/folders/1Mok81I83dyCZikjurghLnFI-XLlmRUQe
Reports, mimeos, monographs, books, etc.	**GDrive** https://drive.google.com/drive/folders/1Mok81I83dyCZikjurghLnFI-XLlmRUQe
Others which may help explain the program (including website links)	GDrive https://drive.google.com/drive/folders/1Mok81I83dyCZikjurghLnFI-XLlmRUQe