



Engineering Projects in Service Learning



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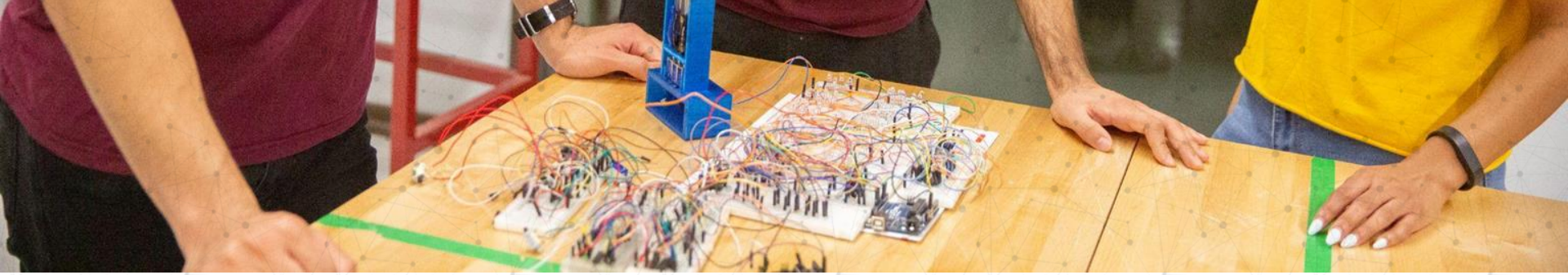
About

“EPICS is an engineering design-based service learning and social entrepreneurship program that incorporates the engineering and human-centered design processes in providing solutions to real world problems facing society.”



What makes EPICS unique?

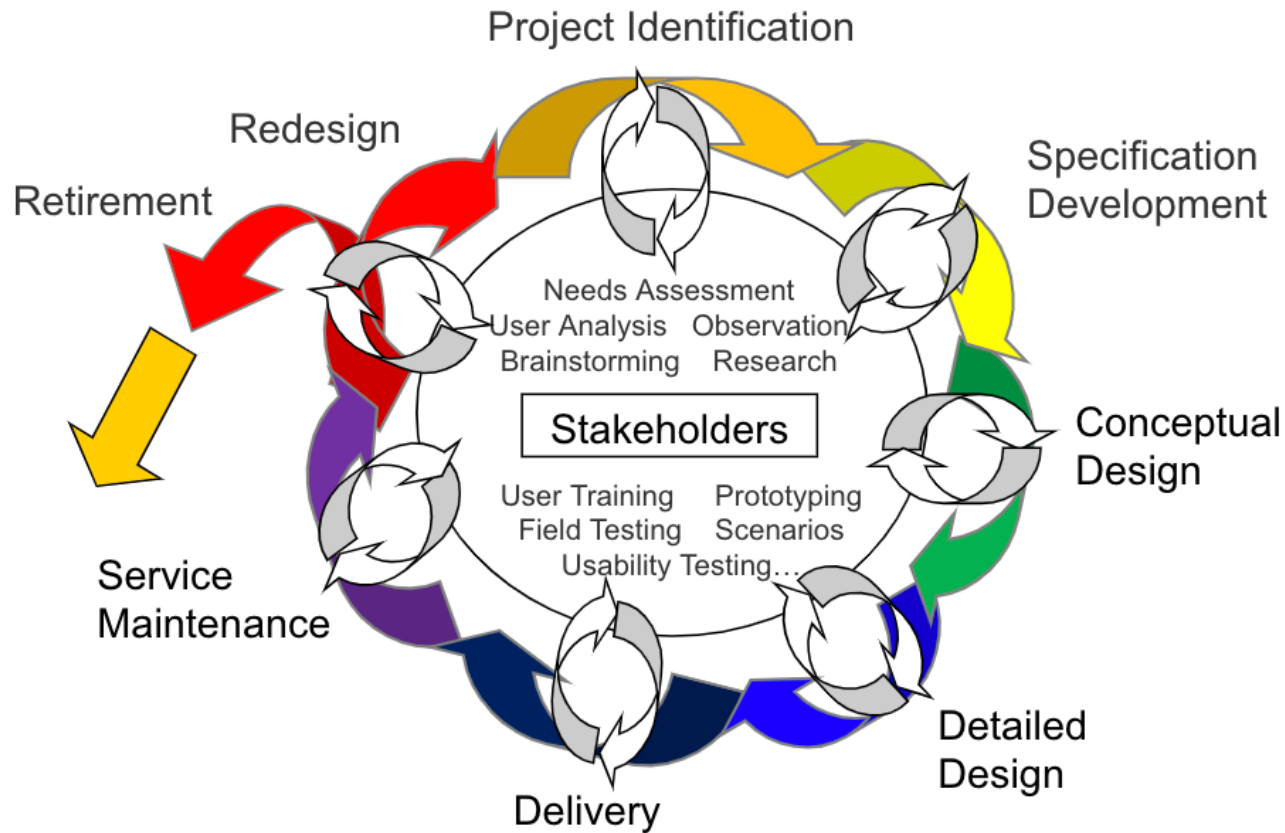
1. Real Projects
2. Industry Mentors
3. Initial prototype funding of \$300 (corporate funding)
4. Support to win grants and pitch competitions
5. Skill Sessions: 50-75 per semester
6. Opportunity to have an impact on community
7. Student mentor/mentee program



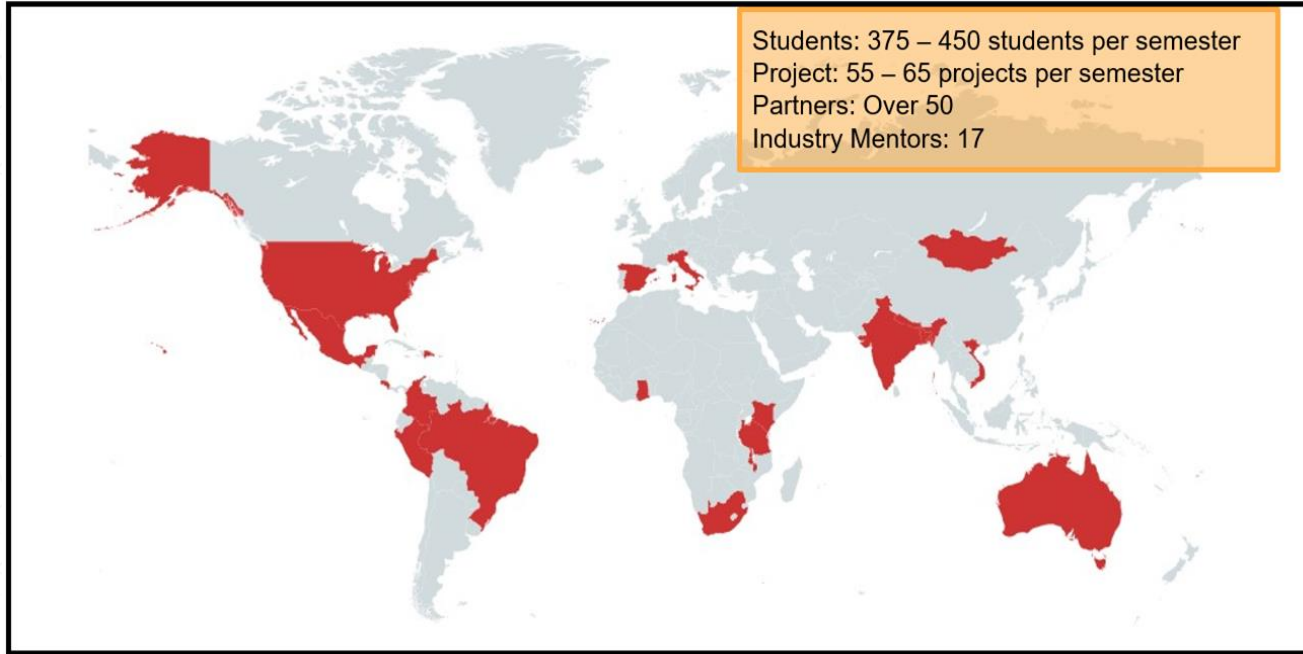
Benefits of service learning for students

1. Students get to develop engineering technical and soft skills earlier in their career
2. Students working on projects can utilize their experience to help get internships and research experiences
3. Students get to have fun and make connections between coursework and real projects with real impact
4. Student mentor/mentee program to build leadership skills for mentor and develop new skills for mentee

Human Centered Design Process



EPICS Program Snapshot



Community Development



Education



Health

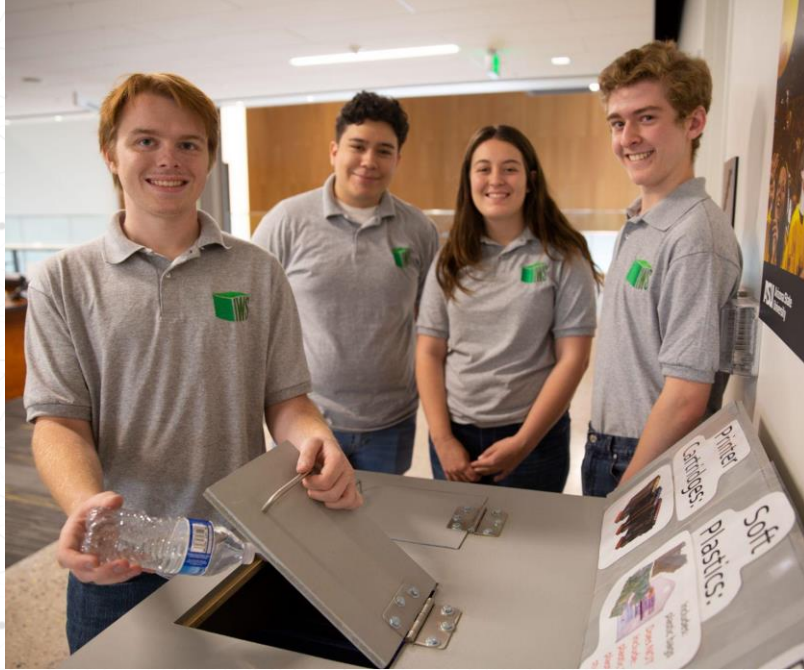


Sustainability



Project Focus Themes

Sustainability



Health



Project Focus Themes

Education



Community Development



Connections and Beyond

Fulton Undergraduate Research Initiative (FURI)

Grand Challenge Scholars Program (GCSP)

Thesis Pathways

Entrepreneurship and Innovation (E&I)

Social Embeddedness

Next Generation Service Corps (NGSC)

Pitch Competitions

Decreasing Water Usage and Increasing Income for Vietnam Small Farmers: Modeling Plant Stress with Handheld Infrared Thermometers

Katie Pascavis, Mechanical Engineering
Mentor: Joshua Loughman, Director of EPICS
Ira A. Fulton Schools of Engineering

Research Question:
"How can canopy temperature be used to determine plant stress and calculate watering amounts to optimize water usage in Vietnamese small farms?"

Introduction:
The EPICS (Engineering Projects in Community Service) Vietnam Smart Agriculture team is designing a smart agriculture apparatus that would allow Vietnamese small farmers to reduce water usage and increase their overall profit. It has been shown that more controlled irrigation techniques in Vietnam could lead to using 30% less water and a median increase in annual income of up to \$350 (Kara 2017). With an average Vietnamese annual rural household income of \$857/year, this sustainable technology could provide a 40.8% increase in annual income for many farmers (Anh 2018).
The inexpensive system would function by having a farmer take surface temperature measurements of randomly selected plants around the farm using a handheld infrared sensor. The data would be used to suggest watering amounts displayed through a mobile app. The goal of this research project was to provide necessary background for the EPICS team to continue in creating a functional and accurate system during the fall.

Fig. 1: An EPICS student manually watering crops at the 'The Que' vegetable village during the 2019 Fulton Vietnam Global Immersion Experience.



Design Additions:
This project has revealed important additions that could be made to the design to increase functionality. First, adding a level system to the handheld device could aid accuracy of the human-performed measurements. Second, using human input and both the Ido and Jackson methods (which use different variables to calculate CWSI) would provide better understanding of the accuracy of results. Finally, connecting the app to weather station data would be required in order to gain access to the necessary variables for computing CWSI without overcomplicating the system.

Fig. 2: Three app calculation CWSI and suggested watering amounts.



Fig. 3: A diagram displaying the process of using the team's updated device.

Fig. 4: The size of a small plot of crops in the 'The Que' vegetable garden in Noi Ai, Vietnam.



Key Insights and Future Research:
As baselines are dependent on crop and climate, a large number of baselines would be required for the average Vietnamese small farms as they typically feature a variety of plants. Furthermore, Vietnam has a tropical, fluctuating climate. Since this technology is more often used for certain crops on large farms in locations such as the south west USA, more data is necessary to determine baselines for calculating crop water stress indices for the small plots found on the farms and gardens in Vietnam.
Future research will focus on finding suitable baselines to be used in the EPICS team's product algorithm, along with creating a procedure for the farmers to use when taking plant canopy temperatures in order to minimize human error.

References:
Kara, S. The Secret to Growing More Food with Less Water. Farming First. 26 June 2017.
Anh, D. Smallholder Farm Policy Support Review: Lessons from Vietnam. 14 May 2018. <https://epi.org/hub/entries/1288>
Nanda 2018. <https://doi.org/10.1016/j.agwat.2018.05.008>. Canopy Temperature-Based Water Stress Indices: Potential and Limitations. 10.1007/978-981-13-1813-0_14.
Yu, L., Wang, W., Liu, L., Zheng, W. (2016). A Non-destructive Temperature Sensor Measurement Methods and Application. 476. 10.1007/978-3-319-48357-3_21.
Peters, D., Frank, S. (2006). Variable Upper and Lower Crop Water Stress Index Baselines for Corn and Soybean. Biological Systems Engineering. University of Nebraska-Lincoln.

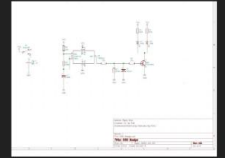
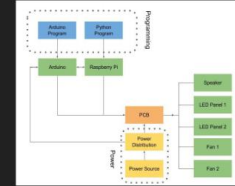
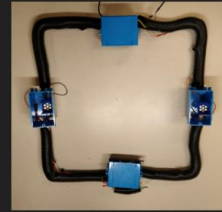
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FURI
Ira A. Fulton Schools of
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Arizona State University

Project Highlight: Phoenix Zoo Elefit Team



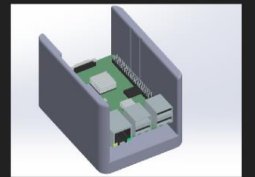
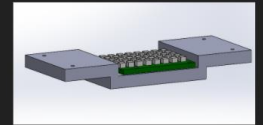
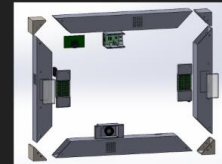
Electronics Prototyping



Mechanical Prototyping



- Working Towards Full Metal Frame Prototype
- Design of mounting sleds for internal components



Project Highlight: Mayo Radiology Project



- Patient in need of an X-Ray
- Uncertain of the condition of the patient
- Falls and causes injury
- Costs Hospitals 4 million dollars every year on Settlements

PDQ Supportive and Palliative Care Editorial Board. Cardiopulmonary Syndromes (PDQ): Patient Version, 2019 Oct 11. In: PDQ Cancer Information Summaries [Internet]. Bethesda (MD): National Cancer Institute (US); 2020. [Figure. X-ray of the chest. X-rays.]

Our Solution

Key Modifications:

- **Booster Seat**
- **Zipper Backing**
- **Removable Oxygen Tank Holder**



Human Centered Design Study Abroad

- Extensive design project working with an international team of interdisciplinary students
- Field-testing and deploying their engineering solutions
- Intensive experience of design collaboration, rapid prototyping, field testing, presenting to international audiences, and cultural immersion in Vietnam.



ASU® Ira A. Fulton Schools of **Engineering** Arizona State University

Learn more at:

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