Form B: IGEM-HERC Full Proposal Cover Sheet

Idaho State Board of Education

PROPOSAL NUMBER: (to be assigned by HERC)	TOTAL AMOUNT REQUESTED: $119,800
Proposal Track (select one): **Initial Startup**	

TITLE OF PROPOSED PROJECT:
Flexible Data Collection and Analysis Systems for Precision Agriculture and Environmental Sensing

SPECIFIC PROJECT FOCUS:

This project focuses on expanding and proving a wireless sensor network for use in precision agriculture and climate monitoring. It proposes to add new sensor communication abilities, and more data visualizations to help growers and scientists monitor important environmental variables.

PROJECT START DATE: July 1st, 2024	PROJECT END DATE: December 31st, 2025
NAME OF INSTITUTION: University of Idaho	DEPARTMENT: Computer Science
ADDRESS: 1000 W. Garden Avenue, Hedlund Building Room 202, Coeur d'Alene, ID 83814	
E-MAIL ADDRESS: meverett@uidaho.edu	PHONE NUMBER: 208-791-0745

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR	Mary Everett	Postdoctoral Fellow	Mary Everett
CO-PRINCIPAL INVESTIGATOR	John Shovic	Research Faculty	John Shovic

NAME OF PARTNERING COMPANY: Laurel Grove Wine Farm	COMPANY REPRESENTATIVE NAME: Dustin Mommen
SIGNATURE:	

Authorized Organizational Representative	NAME: Sarah Martonick, Director, OSP	SIGNATURE: Sarah S Martonick 2024.03.14 12:41:59 -07'00'

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Sections 1-2: Project Background:

The University of Idaho is the primary Idaho public institution conducting the project titled "Flexible Data Collection and Analysis Systems for Precision Agriculture and Environmental Sensing".

In 2012, the United Nations released an article stating that by 2050, the world would need to produce 60% more food in order to feed the growing world population. (Graziano Da Silva, 2014). As agriculture land worldwide is shrinking, not growing (Wilde, 2021), more efficient food production and food distribution will be needed to meet this demand.

However, the worldwide and U.S. food economy is a complex system with many competing objectives including environmental sustainability and farmer profitability. Precision Agriculture (PA), which involves incorporating emerging technology like sensor networks, remote guidance systems, and artificial intelligence into farming, has been identified as a piece of the solution to the looming issues in food supply.

Some of these new technologies (remote guidance systems for tractors, for instance) already see high usage by growers. Others, like remote sensing systems and variable rate applications, are lagging behind (Lowenberg DeBoer and Erickson, 2019). The high cost of certain precision agriculture offerings and the technical skills gaps in using them are two of the major obstacles a farmer often needs to overcome when considering adoption of a new technology (Pablo et al., 2019; technavio, 2022; P.A.C.T., 2021).

University of Idaho Innovative Approaches

In order to meet the precision agriculture needs of farmers, the University of Idaho has been developing the Sensor Collection and Remote Environment Care Reasoning Operation (SCARECRO) wireless sensing network. The first version of the SCARECRO system (Everett et al., 2023) has already been developed and implemented in two locations: a newly starting commercial vineyard, Laurel Grove Wine Farm, and the University of Idaho's Sandpoint Organic Agriculture Center (a heritage apple orchard).

A diagram of how this system operates is below. Its main components involve edge devices, including the data gator and gateway, and cloud computing, where data is collected, stored, and visualized.

The Data Gator is a custom printed circuit board developed by the University of Idaho for extending custom hardware. The Gateway is a micro-controller that receives sensor messages upstream from the Data Gator and can receive information directly from sensors as well (typically longer-distance). The Middle Agent takes sensor data from the gateways and deposits it in a database the user configures. The Dashboard is a web-based visualization and mapping suite for analyzing the collected data.

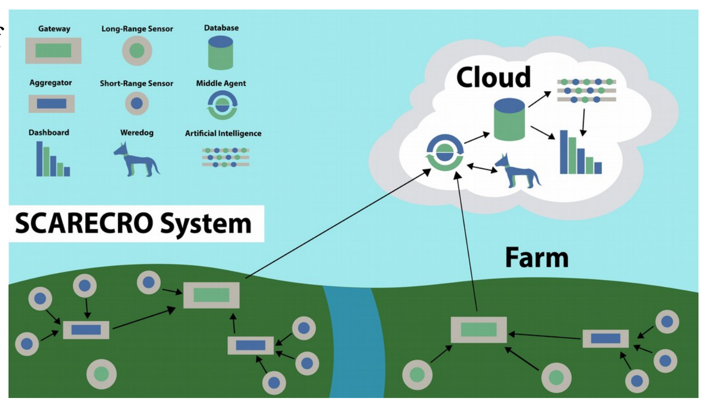

Figure 1: The SCARECRO system Diagram

The Laurel Grove Wine Farm SCARECRO system includes 8 deployed weather stations, more than 10 Data Gators, 150 temp/humidity sensors, 6 soil moisture sensors, 6 soil pH sensors, and a lightning sensor. The system has been in operation since Spring of 2022 and has assisted the proprietors in determining where to plant their vineyard based on various microclimate growing zones. Laurel Grove Wine Farms is seeking to expand the number of deployed sensors and add new sensors to monitor plant health. Sandpoint Organic Agriculture Center (SOAC) has a smaller deployment of the SCARECRO system, with 1 gateway, weather station, Data Gator, and soil moisture sensor in continuous operation since June 2023. Expanding

SCARECRO to support light sensors in order to study canopy pruning techniques is future planned research at this site.

The SCARECRO system is a proven concept (and thus far an effective farmer decision tool), but there are several aspects of the system that need to be improved and expanded to reach everyday usability. These include proving extensibility by adding additional hardware and communication interfaces, integrating artificial intelligence techniques into the system, and completing user documentation.

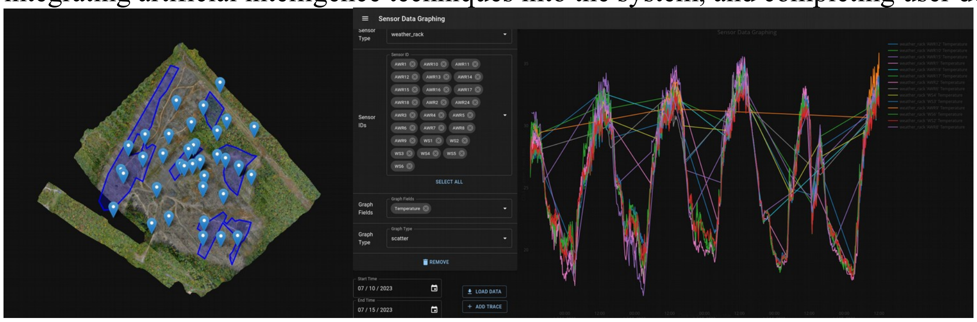

Figure 2: Dashboard Screenshots for mapping and visualization

Idaho HERC Funding priorities and Strength Areas

The SCARECRO System meets the following Idaho HERC funding priorities:

1. **Human-Environment Interactions:** SCARECRO is a fundamentally robust outdoor environmental sensing system, allowing users to understand the sensed environment (as well as their management decision impacts to the land). While primarily designed for farmers, it would work in other environmental science applications, and the University plans to deploy a system to their experimental forest.
2. **Microelectronics**: The SCARECRO system uses a custom printed circuit board in conjunction with several micro-controllers as part of the wireless sensor network. The Data Gator is the main microelectronics component of this system, which was designed to balance power, capability, and solar charging. Part of this proposal is to finish up the development of this board to allow for maximum hardware compatibility.
3. **Artificial Intelligence and Machine Learning**: The University of Idaho has been researching artificial intelligence system construction techniques for precision agriculture systems (Everett, 2023). Part of this project is expanding the existing dashboard with genetic algorithm-led quantitative association rule mining (QARM) for predicting features of interest to farmers, such as frost.

Sections 3-4: Project Personnel:

Mary Everett, PhD, P.I.: Mary Everett is a postdoctoral researcher at the University of Idaho who has headed up the SCARECRO project since January 2022.

John Shovic, PhD, Co-PI – John Shovic is a professor at University of Idaho and the director of the Center for Intelligent Industrial Robotics.

Dustin Mommen, Industry Partner – is the owner of Laurel Grove Wine Farm who has been the main partner of the SCARECRO system since its inception in January 2022.

For the biosketches of the PI and Co-PI, please see Appendix B.

Section 5: Project Objectives:

The project involves the following project objectives:

1. Expand the Data Gator Hardware and Communication Protocol
2. Add Gateway Communication Protocols
3. Dashboard Farmer Analytics and Artificial Intelligence Integration
4. System Provisioning
5. Documentation

The total amount to be requested for this project is $119,800.

Section 6: Resource Commitments:

The University of Idaho is committed to the development and maintenance of the SCARECRO project and has committed approximately 40% of the Center for Intelligent Industrial Robotics' postdoctoral researcher's time to developing the technology. The SCARECRO system is seen as necessary infrastructure to help with other research, and a portion of all current precision agriculture grant funding has been earmarked for SCARECRO use and development. Additionally, the University has hired three undergraduate researchers for the Spring of 2024 to work on SCARECRO. The University of Idaho's Sandpoint Organic Agriculture Center has also set aside space for use and testing of the equipment.

Section 7: Detailed Project Plan and Timeline:

The project will involve the following tasks:

A. Expand Data Gator Hardware and Communication Protocol

I. Add LoRa Communication Protocol to Data Gator: The Data Gator can already send and receive sensor messages with bluetooth and wifi communication. The next step for usability is to add the LoRa communication protocol. LoRa is a low-power communication protocol that has a very high transmission range, making it ideal for sparse but highly spread apart sensor networks. When reporting rates from certain sensors are low, LoRa reduces costs by allowing less collection hardware per sensor. After the LoRa integration, we expect the Data Gator to be able to receive messages from at least 10 sensors, each up to half a mile away, at intervals of 5-minute reporting each. We also expect the Data Gator to be able to transmit to the gateway via LoRa at least one-half mile away.

II. Prove expansion interface by integrating new sensors: Sensors have been added to the Data Gator's existing interfaces on an ad-hoc basis. For this objective, a new sensor (likely a dendrometer) would be added to the Data Gator's interface, and the development process documented from start to finish to understand the process of and difficulty involved in adding new hardware. This allows the research team to quantify the development process and determine the true integration flexibility of the offering. After integration, the team expects the sensor to see if the sensor can be reliably read by the Data Gator every 5-10 minutes.

Component Timeline: Adding LoRa to the Data Gator will take place January – May 2025, allowing deployment in the test location to occur during the spring months.

B. Add Gateway Communication Protocols

I. Add LoRa to the Gateway: Adding LoRa to the Gateway software similarly allows it to receive from the Data Gators and from long distance sensors.

Expected Results: After integration, the Gateway is expected to be able to receive data from at least 10 data gators (and/or long-distance sensors) every 5-10 minutes from a distance of up to half a mile away.

II. Prove expansion interface by adding new sensors.

Similar to the Data Gator, adding new hardware to the gateway proves its capability to expand, with the process documented start to finish. In this case, the research team plans to add a densely connected light sensor array. After integration, the gateway is expected to be able to read from all sensors every 5 minutes with no more than a 5% dropout rate.

Component Timeline: LoRa will be added to the gateway July-October of 2024 to be ready for the downstream Data Gator communication.

C. Dashboard Farmer Analytics and Artificial Intelligence Integration

I. AI – Quantitative Association Rule Mining (QARM): The dashboard will be augmented with a quantitative association rule mining module artificial intelligence tool for features of interest to the user in the database. This tool will provide an interface for existing AI research at the University. Once this tool is developed, it is expected that a user can pick features of interest from their existing data and mine correlations from a front-end interface. Those correlations can then be used for predictive or investigative purposes elsewhere in the Dashboard interface.

II. Prove expansion interface by adding custom farmer analytics tools: Like the Data Gator and gateway, the dashboard is meant to be expandable. Integrating custom farmer analytics and documenting the process from start to finish will aid in further development efforts within the project and for the end developer user base. After integration, users will see new visualizations in the Dashboard related to the integrated sensors.

III. Climate Compare Tool: Worldwide weather data is often free or low-cost. This planned tool would allow users to select other locations of interest worldwide and download free weather data for a period of interest, and then compare the climate of that area with the user's own sensed climate. Finding similar areas/years worldwide can aid the user in management decisions. The KL Divergence metric will be used to compare distributions of climate features from location to location. After integration, a user will be able to select an area by latitude and longitude and compare the climate on selected features (such as temperature and humidity) in order to see how closely the climate aligns.

Component Timeline: Dashboard improvements will take place across the entire project period, with the Quantitative Association Rule Mining tools developed July – November 2024, the climate compare tools developed January – April 2025, and custom visualization tools developed April – August 2025.

D. System Provisioning

I. Currently, the Data Gator must be provisioned (for the types of sensors it will support) manually. Sensor provisioning through the dashboard is slightly less arduous but not much. This objective seeks to create automatic provisioning for the Data Gators via the dashboard based on a set of desired user parameters. At the conclusion of this objective, a Data Gator will be able to be provisioned directly from the dashboard.

Component Timeline: Data Gator provisioning will take place June-October 2025.

E. Documentation

Completely documenting the project will aid in its release and future development. At the conclusion of the documentation, we expect a developer to be able to add, remove, or change functionality for any aspect of the project.

Component Timeline: Documentation will take place throughout the entire project upon component completion. November-December 2025 will focus on finishing up any documentation left in the project.

Overall Project Timeline

The project will begin on July 1st, 2024, and continue for 18 months until its conclusion on December 31st, 2025. For a detailed breakdown of where the individual project tasks will fall along this timeline, see the Gantt Chart in the project management timeline.

Technology Readiness Level Spectrum

The SCARECRO System currently sits at TRL level 5 – Technology validated in a relevant environment. The system is in use at Laurel Grove Wine Farm, multiple sensors and more than a million sensor readings from approximately February 2022. Table 1 below (a snapshot from Fall 2023) details the sensors and reading amounts from Laurel Grove Wine Farm.

Sensor Name	Measurements	Approx. Recording Date	Number of Sensors	Readings in Database
Weather Rack 2	temperature, humidity, rainfall, wind speed, wind direction, sunlight	February 2022	25	1300996
Atlas Ezo pH	soil pH	March 2023	4	144169
bmp280	air pressure	August 2022	8	532075
atlas gravity pH	soil pH	December 2022	3	147917
kkm_k6p	temperature, humidity	March 2023	158	2564924
meter_teros10	soil moisture	August 2022	15	1276909
thunder_board	lightning	October 2022	1	18610
Weather Rack 3	temperature, humidity, rainfall, wind speed, wind direction, sunlight, air pressure	March 2023	1	42433

Table 1: Sensors and Reading Counts from Laurel Grove Wine Farm

In addition to the sensors, the Laurel Grove deployment includes 8 gateways, about 11 Data Gators, and an operational dashboard that which maps the sensors and visualizes farm data.

A smaller deployment of the system is also in place at Sandpoint Organic Agriculture Center (SOAC) in Sandpoint, Idaho, where one gateway receives information from multiple sensors.

Plans to Move Along the Technology Readiness Spectrum: The SCARECRO system has proven to be effective at collecting and displaying information in these relevant environments, and Laurel Grove Wine Farm has made farm decisions based on this information. However, Laurel Grove Wine Farm has not planted vines yet (planned for spring of 2024), and the team believes this is a necessary component to fully demonstrate the sensing system in the environment. Alongside a code refactor scheduled for spring 2024, these factors should move SCARECRO to TRL 6. Multiple grants and funding sources (including this HERC grant) are being sought to move SCARECRO to TRL 7 and beyond, with more complete implementations of the devices, a more functional dashboard for decision making, and additional deployments of the SCARECRO system.

Section 8: Potential Economic Impact:

The SCARECRO system is designed first and foremost to a flexible tool applicable to many environments and setups. We project 3 potential impacts for Idaho's economy:

1. Easily-Integrated Data-Driven Farming:

SCARECRO provides high resolution on-field sensor data to farmers, augmenting the farmer's own domain expertise to make optimal growing decisions. One study found substantial economic benefits in literature from even 50% and 65% accurate forecasts (Klemm & McPherson, 2017), and the SCARECRO system should expand forecast accuracy for a grower's particular micro-climate.

2. Decreased Agriculture and Environmental Research Costs:

SCARECRO's flexibility provides an easy-to-integrate-with infrastructure for researchers in need of very specific setups. It's potential to build much-needed basic research infrastructure is projected to lower research costs for the University of Idaho and other research institutions. There has already been interest in using the SCARECRO system by the University of Idaho experimental forest, the USDA/USFS tree nurseries, and the Idaho Mica Creek watershed. Lowering data collection and analysis costs is a major costs savings (and safety improvement) where these activities may otherwise have been carried out by individuals.

3. Lower Barrier to Entry Artificial Intelligence Use:

SCARECRO can lower the barrier to entry for AI prevalent in the agriculture industry by providing these capabilities packaged with the dashboard. We project that this can increase the understanding and usage of AI in order to make more informed farming decisions, without necessarily needing to buy expensive commercial AI systems.

In the sought-after case of private company adoption of the SCARECRO infrastructure, we estimate that it would take another 3 years for the technology to be fully proven in a variety of areas, at which point we estimate another year for a small company to make a profit off selling and supporting the low-cost equipment. Table 2 gives a year 1-4 timeline.

Year	Timeline to Profitability
1	Software architecture finalized and tests systems upgraded for reliability
2	Deployment expanded for multiple new domains, 3-4 new communication structures added and verified
3	Company forms, best builds are determined, sales process begins
4	Profitability is realized from an expanded customer base

Table 2: Timeline to Profitability

Section 9: Criteria for Measuring Success :

The overall goal of SCARECRO is to be flexible, farmer-focused, open-source, and low-cost. Within these categories, several metrics will be collected:

Flexible: The ease of integration for the new sensors on the Data Gator and gateway will be tracked. This will involve collecting (1) total time spent writing new communication software by the integrators, (2) total lines of code the new integration necessitated, and (3) the number of lines of code in (4) the number of file necessary to implement the new communication feature on each component.

Farmer-Focused: The ease of use of the QARM, Climate Compare, and Custom Visualization Tools will be measured by receiving structured feedback from our industry partner. The user satisfaction with each feature will be rated. Additionally, the reliability of each system component will be tracked during the summer of 2025 (May – August). The number of expected sensor readings based on the reporting rate will be compared against the actual number of sensor readings in the database. The target is 90% reporting rate from all sensors. Finally, tools are only useful to the extent they are accurate. The prediction accuracy of the QARM rules as well as the climate comparison tool based on the datasets will have a target of 75%.

Open-Source: The source code will be released on GitHub most likely before the start of this project for the gateway, and mid-way through the project for the dashboard. The number of repository clones and the number of repository followers will be tracked on GitHub to measure engagement with the open source release.

Low Cost: The costs for all materials will be tracked and reported, as well as estimated labor and assembly costs for implementation. The target cost for materials for a full system Gateway is below $500, for and for a system Data Gator is below $150.

Finally, economic impact will be monitored through the project by tracking engagement with users of the system in both the SOAC and Laurel Grove Wine Farm sites. Reported use of the system and decisions taken based on its use will be aggregated and used to estimate its economic impact to the users, especially based on allocation of inputs and outputs to the growing areas.

Section 10: Potential Development Challenges/Barriers :

Anticipated development challenges include issues with on-farm connectivity, especially when adding LoRa communication. This will be dealt with by researching multiple communication hardware implementations in order to have backup technologies if a specific one does not perform well in testing. Data management for artificial intelligence integration may also be challenging, and extra time has been allotted in the project timeline to handle unforeseen data issues that may arise. Finally, there is a possibility that the climate compare tool KL divergence metric will be too complex to use in practice. Other comparison metrics will be researched alongside to prevent a single point of failure in this tool.

Section 11: Budget:

The budget spreadsheet is attached to the submission. We are asking for $119,800 for personnel (a graduate student, undergraduate student, and time for the postdoct) to work on this project.

Section 12: Budget Justification :

LINE ITEM REQUEST	**JUSTIFICATION**	**TOTAL REQUEST**
Personnel (salary and fringe)	This supports a graduate student for 3 semesters (part-time research assistanceship) and one summer (full-time), and an undergraduate student for 3 semesters (part-time) and 1.5 summers (full-time) to work on this project. This also allows for a month of PI time to manage the project and conduct research.	84,200
Equipment	We are anticipating roughly 10 agricultural sensors at $500 each.	5,000
Travel		0
Participant Support		0
Other Direct Costs	This is the cost of tuition and fees for the graduate student for 3 semester, allowing them to work on a research assistanceship. We are also including an open publication cost for papers derived from the project.	30,600
		$119,800

Section 13: Project Management:

The Gantt chart below (Figures 3 and 4) detail the tasks by month of the year for the project.

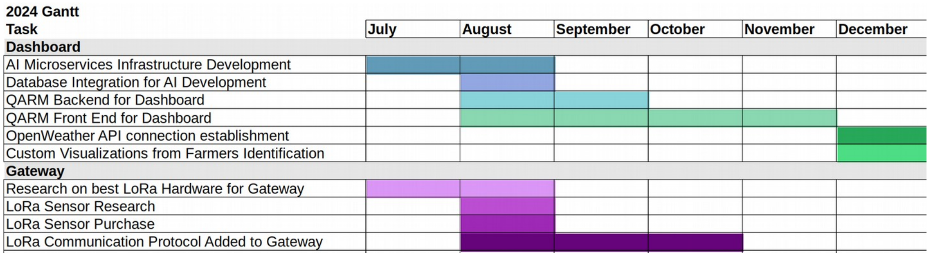

Figure 3: Gantt Chart for 2024

Figure 4: Gantt Chart for 2025

Project Management Structure: This project will be managed primarily by the P.I., Mary Everett, with the graduate student and undergraduate student researchers reporting directly to her. The Co-investigator, Dr. Shovic, will be responsible for supervising the project resources and providing feedback, research oversight, and quality control. The industry partner, Dustin Mommen, will provide input and feedback into the developed tools. The PI and Industry partner will meet monthly. The P.I. will meet with the rest of the project team at least once every 2 weeks.

Section 14: Institutional and Other Sector Support:

Institutional Commitments:

The University of Idaho Coeur d'Alene provides access to the microelectronics soldering lab and as well additional robotics lab and office space to all project team members. The Center for Intelligent and Industrial Robotics has tools and equipment necessary for building project components. Additionally, two high performance computers (with 2 A600 graphics cards) are available to researchers for running models if necessary, and the University provides access to the Falcon supercomputer managed by Idaho National Labs. The postdoctoral researcher and research professor are also committing a month of time to this project outside the scope of the budget.

External Partners:
Our industry partner in this grant has provided ample space across his 120 acre planned vineyard for install and testing of SCARECRO sensor equipment. Amazon Web Services storage and compute space are also provided for the Laurel Grove Wine Farm Dashboard.

The below amounts are for leveraging purposes only, are not considered cost share, and will not be tracked as such:

A. LIST INSTITUTIONAL/ OTHER SECTOR DOLLARS (Source & Description)	**Amount**
Laurel Grove Wine Farm – time, expertise, resources	$50,000

B. FACULTY/ STAFF POSITIONS (Description)	**Amount**
Postdoctoral Researcher Time (Month)	$7,774
Research Professor Time (Month)	$12,627

C. CAPITAL EQUIPMENT (Description)	**Amount**
UI High Performance A600 Graphics Card Computers	$20,000
UI Falcon Supercomputer Time	$50,000

D. FACILITIES & INSTRUMENTATION (Description)	**Amount**
Microelectronic Soldering Lab, Robotics Lab & Equipment	$10,000
Laurel Grove Wine Farm Testing Areas	$40,000
Sandpoint Organic Agriculture Center Testing Area	$10,000

Section 15: Future Funding:

SCARECRO is considered necessary infrastructure for a variety of Center for Intelligent Industrial Robotics projects and funding has been and will continue to be sought from many sources to ensure its continuation. The USDA NIFA program puts out yearly research grants that SCARECRO fits well within, and a “Data Science for Food and Agriculture” grant has been submitted related to SCARECRO in November 2023. If unsuccessful, this will be resubmitted in fall 2024. Additionally, a Cyber-Physical Systems grant from the National Science Foundation will be submitted to investigate some of the communications engineering challenges within the SCARECRO system, which is planned for May 2024. University of Idaho Summer Undergraduate Research Fellowship (SURF) grants are offered each year, and the program has already been awarded two of these grants for students to work on SCARECRO in 2022 and 2023. We anticipate continued application to these grants. In fall/winter 2024-25, we also anticipate submitting research grants to the Northwest Center for Small Fruits Research, as the vineyard component of SCARECRO fits well within their technology development section. We also anticipate using SCARECRO in a Department of Energy grant for Aquifer Pumped Hydro (APH) research, to be submitted in Fall 2024. YES DO MENTION RANGELAND The Idaho NASA Space Grant Consortium supports summer research experience for undergraduates, and we have submitted grants in this capacity to support SCARECRO in 2025. (Have already). We anticipate this funding to move SCARECRO from TRL 5 and 6 to TRL 7, which would expand the prototypes of SCARECRO to more complete operational environments.

The SCARECRO system is planned to be released open-source for public use. One of the goals is for the system to be adopted by industry companies who will package the necessary components for its implementation and provide technical support. These factors are currently missing from the system and are a necessary step for the system to be complete and qualified and move to TRL level 8. Adoption from a company would also allow its full use in an operational environment for TRL level 9.

References

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J. Lowenberg-DeBoer and B. Erickson, ‘Setting the record straight on precision agriculture adoption’, *Agronomy Journal*, vol. 111, no. 4, pp. 1552–1569, 2019.

Klemm, T., & McPherson, R. A. (2017). The development of seasonal climate forecasting for agricultural producers. *Agricultural and forest meteorology*, *232*, 384-399.

M. Everett, G. Wells, and J. Shovic, ‘The SCARECRO system: open-source design for precision agriculture adoption gaps’, in Precision agriculture’23, Wageningen Academic, 2023, pp. 415–421.

M. Everett, ‘Exploration of Artificial Intelligence Techniques for Model Usability with Multivariate Time Sequence Data’, Ph.D. dissertation defense, Dept. Computer Science, University of Idaho, Coeur d'Alene, ID, 2023.

M. Wilde. Farmland loss threatens food supply. [Online]. 2021. Available: https://www.dtnpf.com/agriculture/web/ag/news/article/2021/02/01/land-use-farmland-loss-threatens

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technavio. (2022, 5) Precision agriculture market by product and geography - forecast and analysis 2022-2026. [Online]. Available: https://www.technavio.com/report/precision-agriculture-market-industry-analysis

Appendix A: Facilities and Equipment

The University of Idaho computer science department in Coeur d'Alene includes office space for faculty, graduate, and undergraduate students, as well as a microelectronics assembly and soldering laboratory. The students also have access to the robotics laboratory, project assembly space, a 3D printer, and a CNC machine for custom building needs. The University has access to the Falcon supercomputer, which allows for significant processing power on artificial intelligence models to be handled by the cluster.

Appendix B: Biographical Sketches

Mary Everett
Postdoctoral Fellow, University of Idaho
Coeur d'Alene, ID, 83814
ORCID: 0009-0001-8606-1271

Professional Preparation

University of Idaho	Marketing	Bachelor's of Science, 2020
University of Idaho	Computer Science	Master's of Science, PhD, 2023
University of Idaho	Computer Science	Postdoctoral Fellowship, 2023-present

Appointments

2023-present	Postdoctoral Fellow, University of Idaho, Coeur d'Alene, ID, USA
2023-2023	Research Assistant, University of Idaho, Coeur d'Alene, ID, USA
2020-2022	Teaching Assistant, University of Idaho, Coeur d'Alene, ID, USA
2021-2021	Research Intern, NASA Ames Research Center (Remote) Mountain View, CA, USA
2020-2020	Research and Development Intern, Idaho Forest Group, Coeur d'Alene, ID, USA
2016-2019	Biodiesel Education Intern, University of Idaho, Moscow, ID, USA

Publications

Everett, M. (Accepted for publication in proceedings, 2024). Explainable Neural Network Alternatives for AI Predictions: Genetic Algorithm Quantitative Association Rule Mining. International Conference on Precision Agriculture, Manhattan, KS, USA.

Everett, M. L. (2023). Exploration of Artificial Intelligence Techniques for Model Usability With Multivariate Time Sequence Data (Doctoral dissertation, University of Idaho).

Everett, M., Wells, G., & Shovic, J. (2023). The SCARECRO system: open-source design for precision agriculture adoption gaps. In Precision agriculture'23 (pp. 415-421). Wageningen Academic.

Synergistic Activities

Associate Director, Center for Intelligent Industrial Robotics, University of Idaho, 2023-present
University's research center in advanced automation/robotics and industrial artificial intelligence

Member, Experimental Forest Research Advisory Committee, University of Idaho, 2022-present
Committee to determine direction of research in experimental forest and bring together multiple colleges

John C. Shovic, PhD
jshovic@uidaho.edu

PROFESSIONAL PREPARATION

Montana State University	Electrical Engineering	Bachelor of Science, 1979
Montana State University	Electrical Engineering	Master of Science, 1981
University of Idaho	Electrical Engineering	PhD, 1988

APPOINTMENTS

2017-current	Research Faculty, University of Idaho, Coeur d'Alene (CDA), ID, USA
2016-2017	CS Program Manager, North Idaho College/University of Idaho, CDA, ID, USA
2003-2005	Visiting Professor, Eastern Washington University, Spokane, WA, USA
2003-2004	Research Appointment, Washington State University, Pullman, WA, USA
1998-2201	Associate Professor, Washington State University, Pullman, WA, USA
1985-1989	Assistant Professor, University of Idaho, Moscow, ID, USA
1982-1984	Instructor, Idaho State University, Pocatello, ID, USA

PUBLICATIONS

J.C. Shovic, James Lasso, Garret Wells, Jeremy Fromm, "ROS2 Driver for FANUC Robots", ROSCON, October 2023

M. Everett, G. Wells and J. Shovic, "Precision Agriculture: Addressing Adoption Gaps with Open-Source System Design", The 14th European Conference on Precision Agriculture, Bologna, Italy, July 2023

J.C. Shovic, Alan Simpson, "Python All-in-One for Dummies (includes AI, Robotics, Data Science) 3rd Edition", Wiley and Sons, January 2024

J. C. Shovic, "IOT Applications for the Raspberry Pi, 2nd Edition", APress (Springer Daniel), May 2021

J. C. Shovic, "Raspberry Pi Weather Applications - Chapter", Quatro Books (UK), March 2017

SYNERGISTIC ACTIVITIES

Director, Center for Intelligent Industrial Robotics, University of Idaho, 2019 – Current
University's research center in advanced automation/robotics and industrial artificial intelligence

Appendix C: Senior Personnel

The only senior personnel on this grant expected other than the investigators and industry partner are graduate and undergraduate students. These students undergo research training from the Center for Intelligent Industrial Robotics on how to prepare papers and presentation, and receive mentorship and guidance from faculty and staff.

Appendix D: Other

The researchers do not have other documentation of sector resource commitments at this time.