



**Understanding Campus Watershed Ecosystem
Through Creating An interdisciplinary Capstone Project**

FINAL REPORT

By

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Problem Statement: Sustainable use of environmental resources, such as water, is the leading issue of our time, and can only be understood and eventually achieved through integrated multi-disciplinary approaches. Motivated by such need, in collaboration with Santa Rosa Junior College (SRJC) and assistance of Center for Community Engagement (CCE) at Sonoma State University (SSU), we propose redesigning the capstone course (ES492 & ES493) for engineering students at SSU. The purpose of such redesign is (1) to ensure that all the lectures are presented in a connected approach focusing on SSU campus needs and (2) to provide a unique opportunity for STEM majors at SSU and SRJC to collaborate together and participate in campus-based projects. In this proposal we focus on developing two specific campus water projects: (1) a water consumption monitoring system to measure treated water consumption in various locations around the campus, including dormitory and building washrooms, the Recreation Center, gardens; and (2) a flood monitoring system to measure the campus water contribution to the nearby Copeland Creek, an important ecosystem in Sonoma Country. These projects are designed to utilize campus as a living laboratory, address campus water sustainability, and increase awareness and understanding of the campus community about how we interact with our surrounding natural environment, particularly in terms of our water footprint.

Project Outcome: Throughout November of 2013 to June 2014, the funding provided by this grant allowed us to support four water related projects. Two of these projects were carried out by two groups of engineering students as their senior design project. We involved two students from Santa Rosa Junior College in each project. The engineering students were acting as mentors. Student from SRJC were responsible for testing the final design and providing reliability data. Below is a summary of these two projects:

Student Name	Project Name	Project Web Site	Project Description	Abstract
Eric Waugh & Chio Saephan	SenCell	https://sites.google.com/site/sence/llssu/	The objective of this project is to design a solar powered, cellular enabled, and modular system that can monitor water and environmental conditions.	This system will consist of two basic nodes: (1) a sensory node that is placed into the field to gather data and (2) an internet enabled central server which collects sensor data from the sensory nodes for the user. The sensory nodes will communicate with the server using the GSM/GPRS cellular network. Using a PIC microcontroller and a GSM/GPRS modem, the sensory node will have the ability to send collected information to the remote server for analysis by the end user. Data will be made available to the user in the form of a comma separated value (CSV) file, containing both timestamps and data parameters for each sensory node. The first iteration of the system will be deployed onto Sonoma State University's Fairfield-Osborn Preserve.
Scott Parmley & Angelica Mendez	Smarden The Smart Garden	https://sites.google.com/site/thesmardenproject/home	The objective of this project is to create a smart garden. This garden will be controlled wirelessly connecting three nodes to monitor, control, and collect temperature, humidity, and soil moisture data.	The purpose of this project is to create a self serving garden system that can collect and measure temperature data, humidity, light intensity, and soil moisture data. With this data the garden system will be able to water itself and turn on misters. The data will be collected with wirelessly through Xbee modules using the 802.11.4 Zigbee Protocol. The will need to be powered properly to last several years.

The above projects were presented in the following events:

- Market Day at Sonoma State University
- First North Bay Entreprenoma at Sonoma State University
- 2nd Annual Sonoma State Science Symposium
- IEEE Global Humanitarian Technology Conference (San Jose)

Please refer to the following link for more information: <http://www.sonoma.edu/engineering/news/>

Unfortunately, we were not able to complete the flood-monitoring project as it proved to be difficult to get permission from University maintenance department. Furthermore, due to some unforeseen environmental issues around the creek, asking the students to work around the Copeland Creek could be dangerous for students.

Impact on Redesigning the Senior Design Project Course: The purpose of this pilot project was to provide opportunities for engineering students to get involved in interdisciplinary campus-based projects and thus, unify all their hands-on activities around their engineering solution. To this end, we believe the pilot project was successful. In fact, we were able to successfully implement several real-life interdisciplinary senior design projects on the campus. Based on this year's results, the pilot project has changed the overall structure of our senior design project in three distinct ways:

- 1- As an integral part of the first course in Senior Design Project (ES492), we continue to invite experts (faculty from other departments) and members of campus community (library, polices, etc.) to talk to the engineering students about particular projects/problems around campus. For example, this semester two new problems have been identified and two groups of student have taken up the challenge to come up with feasible solution. Consequently, these students have focused all their hands-on activities within the context of designing the real-life working systems to solve the proposed campus problems.
- 2- Throughout the campus, the engineering senior design project course has been recognized as a potential outlet where engineering students can offer practical solutions to real-life problems around the campus.
- 3- Students from the nearby college (Santa Rosa Junior College) continue to team up with SSU students towards to complete their senior design projects. As the result, senior engineering students will be mentoring the sophomore students, hopefully, future transfer students.

It must be noted that not all the engineering students will become interested in doing campus-based projects. However, we believe we have created a well-recognized outlet to attract interested students.

Working with Facilities Team: Working with campus facility has proven to be very challenging for students. Often times, there are too many restrictions for students to implement their projects on the campus. Such restrictions can be due to security or safety issues. The overall communications between students and representatives from facility and maintenance departments was very weak and student had a very difficult time contacting them. Only the projects that were implemented on parts of the campus that were off-limit to facilities were successfully completed. At Sonoma State University we have several Preserves (<http://www.sonoma.edu/preserves/osborn/>) and since the maintenance department has very little to do with the Preserve the students were free to implement their prototypes. We realized that a major challenge in successfully implementing campus-based projects is in fact establishing a solid protocol between students and campus maintenance and facility departments. For example, it will be very useful to have a student-project coordinator on campus that students can reach and communicate with. Therefore, we believe that it would be very helpful to include one or more budget items for personnel from these departments in order to compensate them for their time and effort. We also learned that it is very critical that the projects are initially clearly discussed with facility personnel in order to ensure they will in fact support and assist the students throughout their project.

Additional Outcome: Between May to June of 2014, in addition to the above two projects, two additional projects were conducted mainly by students from SRJC. The title of these projects were as follow:

- Water Level Monitoring Using Low-Cost Ultrasonic Sensors
- Solar Powered Wireless Network for Osborn Fairfield Preserve to Monitor Water Quality

These students were expected to provide their design idea to the senior engineering students at SSU. Through detailed discussions, first, the students validated the final design. Then, the SRJC student started building and testing their designs. Through such interactions, the students had to fully understand the overall project and its design parameters. Strong communications between the SRJC and SSU students was required to make the project successful.

The first project was fully implemented and tested successfully. The second project could not be completed due to some cost constraints. In fact, it turned out that additional solar panels are required to guarantee the continuous functionality of the system. It is our intension to ask the next group of students to carry on this project in the next year.

It is important to mention that the participation of SRJC students was only made possible through the funding provided through the grant.

Project Impact: The proposed project model proved to be very successful. Over all, through this grant we were able to pay six students from Santa Rosa Junior College to collaborate with SSU engineering students. We asked each student from SRJC to write a short narrative describing his or her experience. In all the cases student feedback were very positive.

In addition, working on real projects directly related to the campus proved to be a great idea for our engineering students. Through these projects students learned to pay closer attention to sustainable design and how their engineering skills can be used to optimize our use of natural resources. This was clearly evident from SSU engineering students feedback following their final presentation. Furthermore, such projects helped the department to provide direction for senior design projects.

Being involved in real projects also gave great opportunity for student to build confidence. The two engineering groups of students working on these projects where both offered scholarship from external sources to continue working on their projects and try to convert their water related projects into real products. All the participating students were offered jobs in the local industry.

As for SRJC students, all six of them transferred to SSU and they are currently pursuing EE degree and expected to graduate in 4 semesters. This is particularly interesting since three of these students were undecided about attending Sonoma State University before joining the projects.

Final Budget: For the most part we followed the original budget request. All together, we paid about \$3000 for student salary and \$1000 to the faculty advisor from Santa Rosa JC. Throughout this project we supported six non-SSU students and we paid for four projects each conducted by team of students from SSU and SRJC.

Expenses	Funds Requested	Description
Salaries	\$4000	Covering all participating faculty members from SSU.
Benefits	\$0	None
Stipend	\$4000	\$1000 to cover the participating faculty from SRJC. The remaining \$3000 will be used to encourage students from SSU and SRJC to mentor and take active involvements in working freshmen students and assisting with community. outreach programs.
Travel	\$400	This portion of the grant will be used to send students to one or two local conferences, including 350 Challenge and the 9th annual Sustainable Enterprise Conference both in Sonoma County.
Equipment/Supplies & Services	\$3000	We are also requesting \$3000 for electronic supplies, sensors, equipment, and enclosures.
Hospitality	\$250	The portion of the fund is used for inviting students from SRJC to visit our campus and meet the SSU teams. It will cover food, transportation, printing materials, etc.
Evaluation	\$0	None
Dissemination	\$250	This portion of the funding is dedicated to cover outreach programs and increase awareness regarding campus water footprint and our findings. It will be used for posters, publications, prints, etc.
TOTAL	\$ 11,900	None