

# RSC/Presidential Grant Report

Due September 30th of the ending year of the grant

Examples of previous grant reports can be found here: <https://gustavus.edu/kendallcenter/grant-opportunities/grant-examples.php>

First Name \*

Charles

Last Name \*

Niederriter

E-mail \*

chuck@gac.edu

Date \*

MM DD YYYY

09 / 24 / 2020

Please select the grant for which you are submitting a report: \*

- Research, Scholarship and Creativity
- Presidential Faculty-Student Collaboration

### Presidential Faculty-Student Collaboration Grant Report Details

Please compose your answers offline and copy/paste into the appropriate text boxes. While answers inputted into this form should be available if you close the form and return in the same browser, we cannot guarantee that this function will work.

Please summarize the activities and outcomes of your grant. \*

Sam Maruska and I designed and constructed a low cost multispectral camera that was small and light enough to be flown on a drone. This imaging system was constructed with five spectral bands, blue, green, red edge, near infrared, and infrared using relatively inexpensive components, Raspberry Pi computers and Raspberry Pi cameras. The infrared camera is a FLIR Lepton system and was the most expensive at approximately \$300. The data from these cameras were combined to produce a variety of diagnostic images such as normalized difference vegetation index (NDVI) and the normalized difference red edge (NDRE).

Completion of the design and construction occurred before the end of the summer of 2019 and data analysis continued through the fall. In January of 2020, Sam presented the results of this work at a national conference (the American Association of Physics Teachers winter meeting). We had planned to integrate the system into one of the College's drones in the spring, but that work ended abruptly with the pandemic.

Please explain how you accomplished the goals you set for yourself in your grant proposal. \*

We succeeded in designing and building a system that was both inexpensive and comparable to expensive commercial systems. In fact our system has more features than systems that cost between \$5,000 and \$10,000. We did this through teamwork, with Sam doing most of the programming and building. I contributed to the design and found (purchased) the necessary parts.

Please summarize any outcomes (publications, revised syllabi, conference presentations, new research directions, etc.), and discuss your plans for continuing or expanding on your work in this project. \*

The abstract for the presentation is below. I plan to continue to work on this project with other students when we are able to do so. Hopefully we will have students on campus in the spring when I am on leave and will have more time to spend on this project.

AAPT Abstract – Winter Meeting 2020

The Development of an Enhanced, Inexpensive Multispectral Imaging System

Samuel Maruska and Charles Niederriter, Gustavus Adolphus College

Multispectral imaging systems have been developed for use on agricultural drones to allow farmers to manage crops, soil, fertilizing and irrigation more effectively. Although there are huge benefits both to the farmer and to the wider environment by minimizing the use of sprays, fertilizers, wastage of water and, at the same time, increasing the yield from crops, the cost of commercial systems is relatively high limiting their use. In addition, current multispectral camera technology uses Green, Red, Red-Edge and Near Infrared wavebands to capture both visible and invisible images of crops and vegetation, leaving out the important Infrared band available with IR cameras. Utilizing a Raspberry Pi computer, Pi cameras, and a FLIR Lepton Thermal imager, we developed an inexpensive system that also incorporates data from the 1.4 – 7.5 micron band in the infrared. We will report on the development of the system, its use in measuring Normalized Difference Vegetation Index (NDVI) and other surveying methods, and provide other examples of its usefulness.

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Please discuss your collaboration with your student grantee. What was successful? What aspects of the relationship proved challenging? \*

I believe that our collaboration was successful. As previously stated, we each had our roles and met daily to ensure we accomplished our goals by the end of the summer.

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Please share any observations about anything else that was important to you and/or any problems you encountered during this grant project about which the Provost's Office should be aware. \*

We didn't encounter any problems that merit reporting.

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Research, Scholarship and Creativity Grant Report Details

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Please summarize the activities and outcomes of your grant. \*

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Please explain how you accomplished the goals you set for yourself in your grant proposal. \*

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Please summarize any outcomes (publications, revised syllabi, conference presentations, new research directions, etc.), and discuss your plans for continuing or expanding on your work in this project. \*

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Please share any observations about anything else that was important to you and/or any problems you encountered during this grant project about which the Provost's Office should be aware. \*

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E-Signature

E-Signature \*

Charles F. Niederriter

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This form was created inside of Gustavus Adolphus College.

# Google Forms