Investigator Status

☐ *Undergraduate* ☐ *Graduate Student* ☑ *Faculty member*

EURECA

Enhancing Undergraduate Research Endeavors and Creative Activities

Undergraduate research is an inquiry or investigation conducted by one or more undergraduate students, with faculty guidance, that attempts to make an intellectual, creative, or applied contribution to one or more disciplines (*MSU Quality Enhancement Plan*, April 2013)

Proposal Application

Title of the Proposed Project:

Real Time Parking Space Monitoring via Wireless Security Cameras

This project is ☑ New ☐ Continuing EURECA

For Faculty Mentor Proposals Only:

Name: Terry Griffin

College: ☐ DCOBA ☐ EDUC ☐ FA ☐ HSHS ☐ PY ☑ SM

Department: Computer Science

Email address: tery.griffin@mwsu.edu

Phone Number: 4439 Alternate phone number: 940 636-0014

Name, classification, department, both major and overall GPA, phone number and e-mail address of up to two students whom you will potentially mentor:

Anthony Enem, Junior , Computer Science , 3.927
Kevin Ellis, Sophomore, Computer Science, 3.655

Would you be willing to mentor any student interested in your project if he/she possesses the appropriate skills and experience? ☑ Yes ☐ No

For Graduate Student Mentor Proposals Only:

Name: _____

College: ☐ DCOBA ☐ EDUC ☐ FA ☐ HSHS ☐ PY ☐ SM

Department: _____ Graduate Program: _____

Email address: _____

Phone Number: _____ Alternate phone number: _____

Name of thesis supervisor: _____

Name, classification, department, both major and overall GPA, phone number and e-mail address of a student whom you will potentially mentor:

_____

Would you be willing to mentor any student interested in your project if he/she possesses the appropriate skills and experience? ☐ Yes ☐ No

For Undergraduate Proposals Only:

Name: _____

College: ☐ DCOBA ☐ EDUC ☐ FA ☐ HSHS ☐ PY ☐ SM

Department: _____

Email address: _____

Phone Number: _____ Alternate phone number: _____

Classification (check one): ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Major GPA _____ Overall GPA _____ N/A _____

Faculty mentor information:

Name: _____

College: ☐ DCOBA ☐ EDUC ☐ FA ☐ HSHS ☐ PY ☐ SM

Department: _____

Email address: _____

Phone Number: _____

Project Proposal

I. Summary: Briefly discuss the purpose and aims of the project. Please use narrative suitable for a reader outside your area of expertise. (Please use the space provided below – 250 words.)

The purpose of this project is to create an easily implemented real time parking space identification tool. There have been other approaches to this problem, but they require too much infrastructure and therefore are not financially feasible. Our approach posits that an accurate real time parking space identification system can be achieved by using 2 - 4 wireless security cameras per lot, along with a single web server to handle the running of image processing algorithms to determine the availability of parking spaces. In addition, a downloadable mobile user app will be available to show in real time the location of open spaces.

II. Introduction: Describe and properly reference the background and context of the project. State the question(s) to be addressed in the project objectives. (Please use the space provided below - 500 words.)

Most students want to know where they can park when they arrive on campus. By creating a location-based service that provides a real-time state of an existing parking lot, we can assist students in making quick decisions on where they should attempt to park. This proposal will create a system to detect vacant parking spaces using common image-processing techniques. These techniques include: edge detection, corner detection, color detection as well as object detection and can be applied to streaming images from a security camera in real-time. In addition to identifying empty parking spaces, this system could be used to record parking space utilization and help make recommendations for parking improvements.

Our objectives are:

1. Use existing image processing algorithms and training to identify empty spaces on an image.
2. Install 2-4 affordable wireless outdoor security cameras in a single parking lot.
3. Configure a single web server to capture snapshots from the cameras mentioned in 2 and process them with the algorithms mentioned in 1.
4. Write a rudimentary app to show open spaces to students and faculty.

Future Objectives:

5. Install cameras in every lot.
6. Using the same server (1 is enough for the whole system), capture stills and process them.
7. Ensure the app is easy to use, bug free, and secure.

III. Preliminary results/findings/progress: If the proposed project is a continuing EURECA project, describe accomplishments from the previous funding period. (Please use the space provided below - 300 words.)

Dr. Griffin mentored a graduate student file paper in the area of parking space detection. The paper was aimed at identifying parking spaces given an arbitrary image of a lot. The paper was not aimed at finding empty spaces, but identifying the actual spaces themselves. He wanted to create a system where a camera could be placed in any parking lot and the software would 1) identify all the spaces (the lot configuration), and then 2) identify un-occupied spaces. This proved to be an extremely tough task. Even though we had some success, our identification of spaces was not accurate enough to use in a real time system. This initial research however, has given Dr. Griffin the background, knowledge, and confidence that this proposal has an extremely high probability of success. We will forego the space identification step, and simply define the parking spaces using a human brain (and a mouse). Then we can concentrate on writing the software to determine whether a space is empty or occupied. This second step is not trivial, but it is very doable.

IV. Methods/Approaches: Briefly describe the project's experimental design or creative approach. (Please use the space provided below - 400 words.)

The most important step is to write the software that analyzes a still image to determine which spaces are empty. This is the easy part. Making it 100% accurate is the hard part. Our method to increase accuracy will be to start with minimizing the variability and then slowly add in variables as we train our system. Known variables mostly involve light conditions and weather conditions, but there are always unknowns that we will have to deal with. This part of the analysis and training will be done mostly on still images taken by a phone or camera.

Another step would be to install the security cameras. This of course could be done first or in conjunction with the empty space analysis. This should be the easiest step, however there are always issues to contend with. For example we may need a cherry picker (truck with a bucket arm) to assist in the installation, but this would be the biggest hurdle to overcome. After the cameras are installed, we could then continue training the identification system using actual images.

A third step is to configure the web server and video capture software. Again this could be done in conjunction with the other steps. No experimental design to this, just some good old expertise needed. This step would glue everything together allowing us to pull image snapshots from the security cameras in real time.

A last step would be to write the user app to show the open spaces. Attention to the design methodology and user interface / user experience will be at a minimum. The other objectives are much more important at this stage.

V. Expected Results/Outcomes: Briefly describe the anticipated results or findings of the research, or the culmination of the creative activity. (Please use the space provided below - 300 words.)

Our anticipated results would be to have a web server capturing still images from 2-4 security cameras monitoring a single parking lot, coupled with a rudimentary app that would show users in real time which spaces are available. If both students work the approximated 10 hours a week, we feel confident that this could be completed in a single long semester. If the proof of concept stated above is successful, then we could spend another semester (provided additional funds are secured) canvasing the entire university. The funding for this additional stage probably goes beyond the Eureca program.

VI. References or Literature Cited. (Please use the space provided below – no more than 10 references.)

1. Abolghasemi, V., Ahmadyfard, A., An edge-based color-aided method for license plate detection, Image and Vision Computing 27, 2009, 1134-1142.
2. Canny, J., A computational approach to edge detection, IEEE transactions on pattern analysis and machine intelligence, vol. Pami-8, no.6, November 1986.
3. Cevikalp, H., & Triggs, B. (2012, June). Efficient object detection using cascades of nearest convex model classifiers. In Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on (pp. 3138-3145). IEEE.
4. Gonzalez, R. C., Woods, R. E., Digital Image Processing, Third Edition, Chapter 1, 26th June 2007.
5. Gupte, S., Masoud, O., Martin, R. F. K., Papanikolopoulos, N. P., Detection and classification of vehicles, IEEE transactions on intelligent transportation systems, vol.3, no.1, March 2002.
6. Hamarneh, G., Althoff, K., Abu-Gharbieh, R., Automatic Line Detection, Project Report for the computer vision course, May 5-7 and August 19-20, 1999.
7. Jain, R., Kasturi, R., Schunck, B. G., Machine Vision, Third Edition, Chapter 10, Published by McGraw-Hill, Inc., ISBN 0-07-032018-7, 1995.
8. Lee, S., Yoon, K. J., Lee, J., Frontiers of Intelligent Autonomous System, Studies in Computational Intelligence, Omnidirectional Vision for Indoor Spatial Layout Recovery, 97-100.
9. Maini, R., Aggarwal, H., Study and Comparison of Various Image Edge Detection Techniques, International Journal of Image Processing (IJIP), Volume (3), Issue 1.
10. Torres, F.A.J., Automatic parking lot occupancy computation using motion tracking, The college of engineering and computer science in partial fulfillment of the requirements for the degree of master of science, Florida Atlantic university, Boca Raton, at Florida, August 2013.

VII. Student Involvement: Briefly describe the specific role of the student in the project. Indicate the estimated number of hours per week the student will be working on the proposed project. (Please use the space provided below - 200 words.)

The students will do all implementation of algorithms and installation of support software. I will offer advice and direction as necessary. The implementation of the image processing algorithms will require a decent amount of programming and will take up about 60 – 70 percent of the project. The installation of software involves configuring the security cameras and the server software that will be used to capture still images from streaming video. This will take up the remaining 30 - 40 percent. I expect both students to work approximately 10 hours a week for 1 semester.

VIII. Timeline: Describe in a concise manner the project timeline. (Please use the space provided below - 200 words.)

Week 1: Orientation and introduction to the development environment.
Week 2: Discussion of image processing libraries and computer learning techniques / libraries
Weeks 3-14: Writing code and training the space identification system (this is a long and ongoing process)
Week 5: Install security cameras at preferred location
Week 6: Start the configuration of web server
Week 7: Start the marrying of server and security cameras
Week 8: Introduce the space identification system to the server and start testing in real time. Also start writing the user app.
Weeks 9-14: Continue beta testing system and using what we learn to improve the accuracy of the system along with the continued development of our basic app.

IX. Time Commitment to the Project:

Faculty teaching schedule, commitments, and mentoring

TIME	**Monday**	**Wednesday**	**Friday**		**Tuesday**	**Thursday**
8:00 a.m.				8:00 a.m.		
9:00				9:30	Cmps 4103	Cmps 4103
10:00				11:00		
11:00				12:20 p.m.		
12:00				2:00		
1:00 p.m.	Cmps 2143	Cmps 2143		3:30	Cmps 4103	Cmps 4103
2:00				4:50		
3:00				5:30		
4:00	Cmps 5303	Cmps 5303		6:00		
5:00						

Student class schedule (including MWSU 2003/4000 TR, 12:30-1:50 PM*), as well as student's weekly commitment to the research/creative activity, work hours (if applicable), extracurricular activities and other commitments.*

Anthony Enem

TIME	**Monday**	**Wednesday**	**Friday**		**Tuesday**	**Thursday**
8:00 a.m.				8:00 a.m.		
9:00	WGST 2503	WGST 2503	WGST 2503	9:30	Cmps 4103	Cmps 4103
10:00				11:00	Cmps 4143	Cmps 4143
11:00				12:20 p.m.	MWSU 2003/4000	MWSU 2003/4000
12:00				2:00		
1:00 p.m.	Cmps 4563	Cmps 4563		3:30		
2:00				4:50		
3:00				5:30		
4:00				6:00		
5:00						

Student class schedule (including MWSU 2003/4000 TR, 12:30-1:50 PM*), as well as student's weekly commitment to the research/creative activity, work hours (if applicable), extracurricular activities and other commitments.*

Kevin Ellis

TIME	**Monday**	**Wednesday**	**Friday**		**Tuesday**	**Thursday**
8:00 a.m.	Cmps 3013	Cmps 3013	Cmps 3013	8:00 a.m.		
9:00				9:30	Cmps 4103	Cmps 4103
10:00				11:00		
11:00				12:20 p.m.	MWSU 2003/4000	MWSU 2003/4000
12:00				2:00	Spch 2423	Spch 2423
1:00 p.m.				3:30		
2:00				4:50		
3:00				5:30		
4:00				6:00		
5:00	Engl 2113 (internet)	Art 1413 (internet)				

Other faculty member.

TIME	**Monday**	**Wednesday**	**Friday**		**Tuesday**	**Thursday**
8:00 a.m.				8:00 a.m.		
9:00				9:30		
10:00				11:00		
11:00				12:20 p.m.		
12:00				2:00		
1:00 p.m.				3:30		
2:00				4:50		
3:00				5:30		
4:00				6:00		
5:00						

X. Budget:

Include the project estimated budgetary needs below. Funds are available up to $500 for small equipment, services, software, materials and supplies that are needed to support the objectives and outcomes of the proposed project. Enter the necessary items along with the dollar amount in the table below. Justify the expenses in the budget justification section below. Funds for student travel to conferences are also available when students are presenting their findings or creative activities. Indicate the total amount in the table. Justify in the budget justification section below the following: registration, transportation, lodging, and meals not covered by the conference.

Materials and Supplies	$
4 wireless cameras	499.99
Materials and supplies total	499.99
Student travel total	
Grand total	499.99

Budget justification

Cameras cost at most $499.99. We could go with cheaper but quality goes down. We could go with 1 or 2 cameras, but I feel to cover an entire parking lot we may need up to four.

Anthony Enem Signed Form

Kevin Ellis will send his Asap.

Signature: Terry Griffin Date: June 1, 2016

(Type name here)

Complete all applicable fields; incomplete applications will not be considered.
Submit the completed application to:
Dr. Magaly Rincón-Zachary, Director of Undergraduate Research, c/o magaly.rincon@mwsu.edu

Deadlines: June 1st for fall; December 1st for following spring