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ACE: Next Generation - Laurence Tyler (lgt)

Outline Project Specification

**Software Engineering (Incl. Integrated Industrial
Year) (G601)**

CS39440

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Final

Project Description

The departments of Computer Science and Physics at Aberystwyth University (AU) are working on many projects based around the upcoming ExoMars 2020 Mars Rover, specifically the PanCam subsystem. This subsystem consists of a pair of stereo wide-angle cameras (WACs), plus a single high-resolution camera (HRC) mounted on a pan/tilt unit (PTU). This allows the rover to take panoramic 3D images for navigation plus detailed images for scientific analysis. The WACs are augmented with a set of 12 optical filters that allow for specific wavelengths to be studied. More details on the ExoMars PanCam can be found at: <http://exploration.esa.int/mars/45103-rover-instruments/?fbodylongid=2127>

To help researchers at AU to work with these systems without hampering the development of ExoMars, the AU PanCam Emulator (AUPE) was built. This is a system that aims to mimic the ExoMars PanCam as accurately as possible using commercially available components. As this is a fully custom system, software was needed to talk to AUPE to let the researchers control its various functions. ACE was developed to fulfil this role. Over time however ACE has become awkward to use and AUPE has now outgrown ACE with new features not being supported and researchers having to rely on custom python scripts to control AUPE.

Because of this ACE: Next Generation is needed to allow the researchers to continue to develop projects with AUPE. ACE: NG aims to replace the original ACE software by replicating all of its functions as well as implementing the new features of AUPE. Also ACE: NG aims to be portable, extendable and maintainable. This will allow for ACE: NG to be significantly more useful for a longer period of time than ACE was.

The main features required by ACE: NG are:

- Query and set exposure values in-camera
- Query and set auto-exposure values in-camera
- Query and set auto-exposure values in-server
- Move the pan tilt unit
- Image preview with zoom and pan controls
- Filter selection for WACs
- Save captured images with metadata
- Save images in a structured directory tree
- Capture sequences of images with optional settings:
 - Enable/disable auto-exposure
 - Multiple pan/tilt positions (panorama mode)
 - Multiple cameras per position
 - Multiple filters per camera (WACs only)
 - Multiple exposure brackets

Because ACE: NG will not need any particularly new or interesting programming ideas this project will focus instead on producing a well-designed, well built and well documented piece of software. I will be focusing on making the software easy to work with, by focusing on the user interface design and the extendibility/maintainability of the software. Also as ACE: NG

will be used by researchers in the field it needs to be a portable application capable of running with minimal setup on as many platforms as possible.

Proposed Tasks

My initial task for this project will be to research what platforms and frameworks are going to be best for fitting in with the portable, extendable and maintainable goals. From my experience so far I am leaning towards using Python with the Qt GUI framework but this will require more research. This stage's output will be the choices that influence the next step as well as some research notes.

Once I have decided on my platforms I will make sure to research their APIs and documentation so that I can make use of them effectively. Also I will need to study the provided Python API that ACE: NG will need to use. This stage will output mostly just a collection of links to API documentation.

The next task will be to split the project requirements, as provided by my supervisor Dr. Laurence Tyler, into tasks to be completed. This is part of the methodology I learned during my year at Broadcom and functions similarly to stories in Extreme Programming. These tasks will allow me to break up the work into short bursts which are easier to track. Once the tasks are chosen I will prioritise them and create a development schedule document to follow in the form of a Gantt chart.

The final task to be completed is to research into what user interface design techniques and ideas I would like to use for this project. This is the part which will involve the most research and will run concurrently with the initial stages of development. This will result in a design document that will become part of one of my final deliverables.

Project Deliverables

ACE: NG – This is the main project deliverable and will be the full project source code that implements the features as described above.

ACE: NG Installer/Deployable – As the project needs to be portable it should be presented as a single, or series of installers that will deploy ACE: NG on any system, or a deployable package such as a zip file. The nature of this deliverable will be dictated by the implementation limitations.

ACE: NG Code Documentation – This will be a set of documents that describe the design behind ACE: NG to allow the software to be maintainable in the future. If Python is used as a platform then the PyDoc framework will likely be used to help structure this.

ACE: NG Extendibility Manual – This document will describe to future developers how to extend the functions of ACE: NG. This item may become part of the Code Documentation.

ACE: NG User Manual – The user manual will be provided to show researchers how to use ACE: NG. The manual will need to be easily accessible and cross platform so that it can be easily viewed on any platform.

Development Schedule Gantt Chart – This document is part of my methodology and describes what tasks need to be completed and when.

Design Documentation – This will be the set of documents that describes my methodology for the design of my codebase, user interface and testing strategies. It will be strongly related to the Code Documentation Item but structured to describe my project to a supervisor instead of to a future developer.

Initial Annotated Bibliography

Project Background

- "ESA - Robotic Exploration of Mars: The ExoMars Rover Instrument Suite", *Exploration.esa.int*, 2017. [Online]. Available: <http://exploration.esa.int/mars/45103-rover-instruments/?fbbodylongid=2127>. [Accessed: 10- Feb- 2017].

This site describes the ExoMars PanCam. This will be a useful resource to get a good understanding of the background of the project, but will probably have little direct influence on the project.

Code Portability

- B. Hook, *Write portable code*, 1st ed. San Francisco: No Starch Press, 2005.

This book will help me to think about what are the best ways to make ACE: NG a portable and cross platform application. This book may lead me to look deeper into the topic using the sources in the book as a starting point.

Extendable Software

- A. Members, "ACCU :: Writing Extendable Software", *Accu.org*, 2017. [Online]. Available: <https://accu.org/index.php/journals/402>. [Accessed: 10- Feb- 2017].

I plan to make ACE: NG extendable and as this is a new concept for me I will do some reading into how to best achieve this.

User Interface Design

- L. Leventhal and J. Barnes, *Usability engineering*, 1st ed. Upper Saddle River, N.J.: Pearson/Prentice Hall, 2008.
- W. Newman and M. Lamming, *Interactive system design*, 1st ed. Wokingham, Eng.: Addison-Wesley, 1995.
- J. Preece and D. Benyon, *A Guide to usability*, 1st ed. Wokingham, England: Addison-Wesley, 1993.
- B. Shneiderman and C. Plaisant, *Designing the user interface*, 1st ed. Boston: Pearson/Addison Wesley, 2004.

User interface and usability are very important aspects of this project as such I have selected four books that cover this topic to give me a good grounding in the topic. I will also look back at my notes for CS22310 (User Centred Design and Human Computer Interaction).