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Lunar Exploration Web and Mobile Applications

Lunar Mapping and Modeling Portal Lighting Tool

(LMMPLT)

CS496 Senior Design

Preliminary Functional Requirements, Design and Progress

Document

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Document Change Log

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List of TBD Items

Page	Item	Description	Status
	Implementation		

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is two-fold:

a) Report upon the progress of new additions and refactoring to/of the existing **LMMPLT**.
(This section will be partially developed during CS496b)

b) Define feasible modules for the new requirements to the **LMMPLT**.
(This section will be developed during CS496b)

The complete definition of all **LMMPLT** requirements provides the source requirement inputs for the development of the subsequent supporting software subsystems documents.

1.2 Scope

This is the documentation developed as part of this cs496a class. Full implementation will be completed in a following cs 496b and 496c classes.

The scope of this document includes the following:

The progress in analysis of the current code and the source of issues that exist.

A proposal to fix the issues that currently exist within the **LMMPLT.**

1.2.1 Relationship to Other Documents

The **LMMPLT** SRD/SDD/STP/SID is a complete self contained document. Relationships to other documents in the literature are indicated below in sub-section 1.5.

1.2.2 Hardware and Software Considerations

The software being written requires the use of Nvidia OptiX. This requires the hardware to include a Nvidia CUDA compatible video card. The software is also being written on Linux Ubuntu 12.04.

1.3 Documentation of the Development Process

Section 2 is a succinct software description document. Describing changes between the code that was handed to us and code that has been added before the implementation of the new functions.

Section 3 is a succinct software description document. The overall detailed functional description is based on higher level DFDs (above level 1). All major functional units are described this part of the document. The Requirements will be added in detail in this part of the document at a later date.

1.4 References

All references used in the creation of this document are listed below.

1.4.1 Controlling Documents

There is no document controlling this document.

1.4.2 Applicable Documents

The LMMPLT is a subproject of the Lunar Exploration Web and Mobile Applications(LEWMA) project. The documentation of the full set of projects under the LEWMA can be found under the LEWMA documentation.

The Android Application has its own list of requirements which are controlled by the LMMPAA documentation. Under this same project title: Lunar Exploration Web and Mobile Applications.

Any instructions pertaining to the operation of the lighting tool on the front end can be found in documentation provided by JPL.

1.4.3 Standards

No Standard has been used in the creation of this document.

2.0 ANALYSIS AND MODIFICATIONS OF EXISTING CODE

2.1 Analyzing Lighting Tool

The Lighting Tool takes a high resolution DEM of the lunar surface and will compute the amount of light that each area would receive from the sun, earth reflectance, and terrain reflectance. The DEM is created from a user defined bounding box. To generate the DEM file, the TIFF file is run through GDAL tools to transform it. The user will also indicate a start and end time in addition to a time interval.

Before the lighting calculations can be done, the data structure that contains the necessary geometrical features for each tile or triangle of the mesh is initialized.
A ray tracer is used to perform the irradiance calculations. The plate files are comprised of a series of ordered node vectors that indicate a position from the center of the moon to a point on the surface.

At the beginning of the time loop, Spice calls are made to obtain the Moon-to-Sun and Earth-to-Sun vectors. These distances are used directly for calculating solar irradiance. The POV-Ray ray tracer interface is used to calculate the complete incident and reflected modeling.

POV-Ray appears to be the most time consuming part of the lighting tool application.

2.2 Creating Test Cases and Producing Analysis Data

Test Cases are produced by downloading the TIFF files from the LMMP web portal. Those TIFF files are then used within the lighting tool in conjunction with the config file that will contain the user defined time interval. The lighting tool will then produce the irradiance values and images.

For testing, multiple variables are considered. The location of the selection, the complexity of the selection, the different times of the same location, and the size of the selection are all compared in terms of how long each task will take the lighting tool to run.

To better determine how exactly the time changes with each variable, a modified version of the lighting tool is created in order to output exact values as to the time that each task takes. When the final product is produced, these values will be invaluable in providing definitive results as to the effectiveness of the new lighting tool.

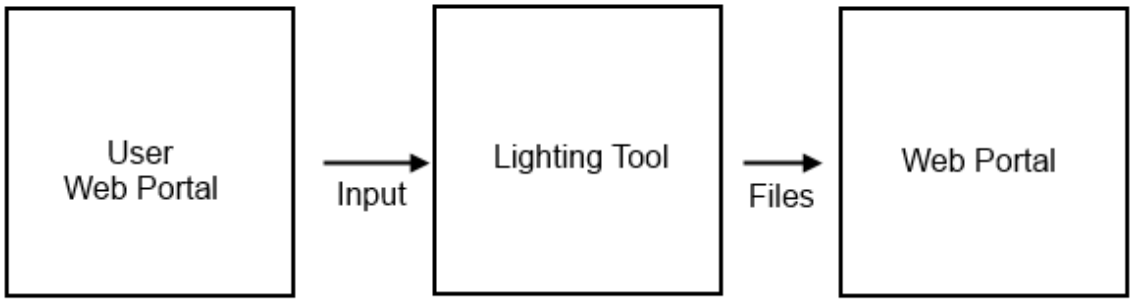
2.3 Refactoring for Nvidia OptiX

Nvidia OptiX is a ray tracing tool based on Nvidia CUDA which is a GPU parallel programming and computing platform. By using Nvidia OptiX instead of POV-Ray, it provides the lighting tool with more processing capabilities for parallel processing. This should dramatically improve the run time of the lighting tool.

3.0 FUNCTIONAL DESCRIPTION OF THE LMMPLT

3.1 LMMPLT Architecture

3.1.1 Context Diagram (DFD Level 0)



The main purpose of the LMMPLT project is to refactor the Lighting Tool so that it runs significantly quicker with the same output. Currently these calculations can take several hours. Upon completion, the lighting tool should calculate an identical calculation several orders of magnitude faster.

3.2.1 High Level DFD

The **LMMPLT**'s major functional subunits are shown in the DFD Level 1 depicted below:

3.2.2 Detailed Functional Description of the LMMPLT Major Sub-Units.

The description of the function of the **LMMPLT** major functional units shown in Figure 2.1 follows.

A. DATA DICTIONARY

None.

B. ACRONYMS

CUDA	Compute Unified Device Architecture
DEM	Digital Evelation Model
GDAL	Geospatial Data Abstraction Library
GPU	Graphics Processing Unit
LEWMA	Lunar Exploration Web and Mobile Application
LMMP	Lunar Mapping and Modeling Portal
LMMPAA	Lunar Mapping and Modeling Portal Android Application
LMMPLT	Lunar Mapping and Modeling Portal Lighting Tool
TIFF	Tagged Image File Format