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Space Environments and Effects (SEE) Program

The need to preserve works and NASA documented articles is done via the collection of various Space Environments and Effects (SEE) related articles. (SEE) contains and lists the various projects that are on-going, or have been conducted with the help of NASA. The goal of the (SEE) program is to make available the environment technologies that are required to design, manufacture and operate reliable, cost-effective spacecraft for the government and commercial sectors. Of the many projects contained within the (SEE) program the Lunar-E Library and Spacecraft Materials Selector (SMS) have been selected for a more user friendly means to make the tools easily available. This information which is still available required a person or entity to request access from a point of contact at NASA and wait for the requested bundled software DVD via postal service. Design solutions were proposed for a single step process with faster turnaround time via Materials and Processes Technical Information System (MAPTIS) database. This process requires users to register and be verified in order to gain access to the information contained within. Aiding in the progression of making the software tools/documents available required a combination of specialized in-house data gathering software tools and software archeology.

Research and Experience

- **Marshall Space Flight Center**, Summer Intern, Summer 2013
  EV40::EM60: Spacecraft Material Selector (SMS)
  - **NASA,** Spacecraft Material Selector software archaeology (Reverse Engineering), Summer 2013
  - **NASA,** Lunar E-Library, MAPTIS database software development for data retrieval and database population, Summer 2013
  - **NASA,** Space Environments and Effects Web Search Engine Optimization (SEO) software, front end web crawling link database software.

- **Marshall Space Flight Center**, Summer Intern, Summer 2012
  ES31: Composite Overwrapped Pressure Vessels Researcher

- **UTEP,** Continuing research: Evaluation of the Behavior of Optical Fibers for Structural Health Monitoring of Composite Pressure Vessels Composite / Overwrapped Pressure Vessels, Spring 2012-2013

- **Moy Computing,** Company Owner Operator, El Paso, Texas 07/10 - Present
- Gen. Consulting; Technology Management; Task Management.
- **Community Respiratory Care,** Technology Consultant, El Paso, Texas
  Computer IT Administrator

Memberships and Activities

- Institute of Electrical and Electronic Engineers (IEEE)
- Society of Automotive Engineers (SAE)
- National Association of Black Engineers (NSBE)
- Society of Robotics and Bio Cybernetics (SRBC)

Honors, Awards

A+ Essentials 2009: Configuring Displays, Peripherals, Laptops, and Printers ---- 2013
A+ Essentials 2009: Installing Windows Operating Systems (Windows 7 update) ---- 2013
A+ Essentials 2009: Operational Procedures and Preventative Maintenance ---- 2013
A+ Essentials 2009: Security and Network Fundamentals (IPv6 update) ---- 2013
A+ Essentials 2009: Troubleshooting Computers and Printers ---- 2013
A+ Essentials 2009: Using and Managing Windows (Windows 7 update) ---- 2013
NASA Certificate of Completion: ANSI C PROGRAMMING: The Standard Library and Preprocessor - 2013
NASA Certificate of Completion: ANSI C PROGRAMMING: TEXT PROCESSING ---- 2013
NASA Certificate of Completion: ANSI C PROGRAMMING: PROCESSING RECORDS ---- 2013
NASA Certificate of Completion: ANSI C PROGRAMMING POINTERS ---- 2013
NASA Certificate of Completion: ANSI C Programming: Data Representation ---- 2012
NASA Certificate of Completion: ANSI C Programming: Expressions ---------- 2012
NASA Certificate of Completion: ANSI C Programming: Flow Control ---------- 2012
NASA Certificate of Completion: A+ Essentials 2009: Computer Hardware ------ 2012
UTEP ABET Accreditation: Outstanding Performance ---------- 2007

Space Environments and Effects Program (SEE)

Dawid M. Yhisreal-Rivas

Marshall Space Flight Center

July 29, 2013

Reviewed by NASA Mentor
Dr. David Edwards
EV40

Mentor Signature Here

Space Environments and Effects Program

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The need to preserve works and NASA documented articles is done via the collection of various Space Environments and Effects (SEE) related articles. (SEE) contains and lists the various projects that are on-going, or have been conducted with the help of NASA. The goal of the (SEE) program is to make publicly available the environment technologies that are required to design, manufacture and operate reliable, cost-effective spacecraft for the government and commercial sectors. Of the many projects contained within the (SEE) program the Lunar-E Library and Spacecraft Materials Selector (SMS) have been selected for a more user friendly means to make the tools easily available to the public. This information which is still available required a person or entity to request access from a point of contact at NASA and wait for the requested bundled software DVD via postal service. Redesigning the material presentation and availability has been mapped to a single step process with faster turnaround time via Materials and Processes Technical Information System (MAPTIS) database. This process requires users to register and be verified in order to gain access to the information contained within. Aiding in the progression of making the software tools/documents available required a combination of specialized in-house data gathering software tools and software archeology.

Nomenclature

Decompiler = computer program that performs the reverse operation to that of a compiler. That is, it translates program code at a relatively low level of abstraction (usually designed to be computer readable rather than human readable) into a form having a higher level of abstraction

Disassembler = computer program that translates machine language into assembly language—the inverse operation to that of an assembler

Reverse Engineering = the process of discovering the technological principles of a device, object, or system through analysis of its structure, function, and operation.[1] It often involves taking something (a mechanical device, electronic component, computer program, or biological, chemical, or organic matter) apart and analyzing its workings in detail to be used in maintenance, or to try to make a new device or program that does the same thing without using or simply duplicating (without understanding) the original.

OCR = It is a common method of digitizing printed texts so that they can be electronically searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision.

I. Introduction

The need to preserve works and NASA documented articles is done via the collection of various Space Environments and Effects (SEE) related articles. SEE contains and lists the various projects that are on-going, or have been conducted with the help of NASA. The goal of the SEE program is to make publicly available the environment technologies that are required to design, manufacture and operate reliable, cost-effective spacecraft for the government and commercial sectors. In partnership with industry, academia, and other government agencies, the SEE Program defined the space environments and advocated technology development to accommodate or mitigate these harmful environments on spacecraft; hence the technology is transferred to spacecraft developers for incorporation in design. The SEE Program established new plateaus of technical capability to reduce cost of NASA's science and exploration missions which enables new and more challenging missions. Of the many projects contained

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within the SEE program the Lunar-E Library and Spacecraft Materials Selector (SMS) have been selected for a more user friendly means to make the tools easily available to the public. This information which is still available required a person or entity to request access from a point of contact at NASA and wait for the requested bundled software DVD via postal service. Redesigning the material presentation and availability has been mapped to a single step process with faster turnaround time via Materials and Processes Technical Information System (MAPTIS) Database. This process requires users to register and be verified in order to gain access to the information contained within. Aiding in the progression of making the software tools/documents available required a combination of specialized in-house data gathering software tools and software archeology to preserve features and proper operation. The various programs and research required to accomplish the end goal of preservation and availability within the SEE Program will be touched in detail. Some material is of technical relevance and will be explained as so in detail and, assumed that the individual(s) has a moderate understanding of Computer Engineering and or Computer Science.

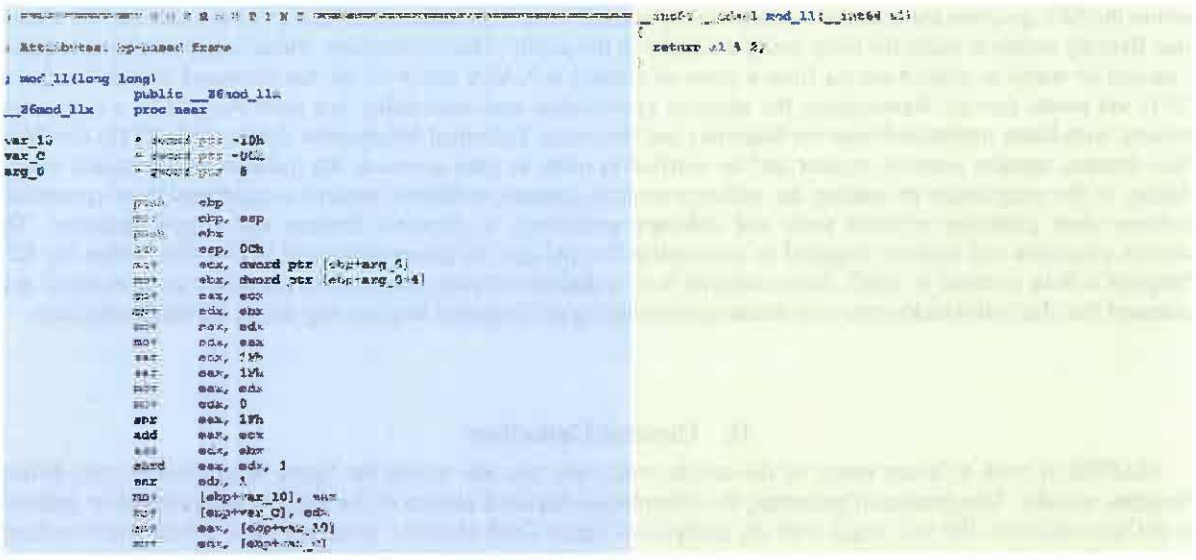
II. General Guidelines

MAPTIS is soon to house many of the articles and tools that are within the Space Environments and Effects Program website. The process of gathering the information required several of the tools to be recreated or gathered to aid the transition. We will begin with the analysis of Space Craft Material Selector Expert which was developed by Gary Pippin for selecting and evaluating performance of the selected materials given the environmental exposure for a given space flight mission.

Due to the extreme environment that materials will be exposed to, the development of a test tool to estimate the possibility of failure was developed to aid in the analysis of risk factors of failures due to the sensitive nature of cost, communications, and time to replace the systems. In its entirety SMS's operation and description is described as the following:

> Materials performance data from operational satellites and flight experiments has been collected from published results and recent laboratory measurements. This materials data has been used to assemble a knowledge base that combines available data. stores the data and then makes materials and environmental exposure data rapidly available. The data may be used to make an assessment of performance of specific materials or to predict the contribution of up to 27 different factors to the environmental exposure conditions around a spacecraft. The knowledge base in combination with an inference engine, the Boeing Expert System Tool (BEST) forms an expert system used to electronically distribute information. The knowledge base is a backward-chaining rule-based system that is used for storage and rapid retrieval of information from a specific body of information. This system is different than forward-chaining systems that gradually improve predictions as new inputs are provided. The expert system, BEST plus a specific knowledge base, is a quick screening tool that allows designers to be alerted to significant environmental factors that may influence their design and/or selection of materials. This expert system is also suitable for use by materials engineers checking their spacecraft materials selections. (H.G. Pippen 2000_1 1-2)

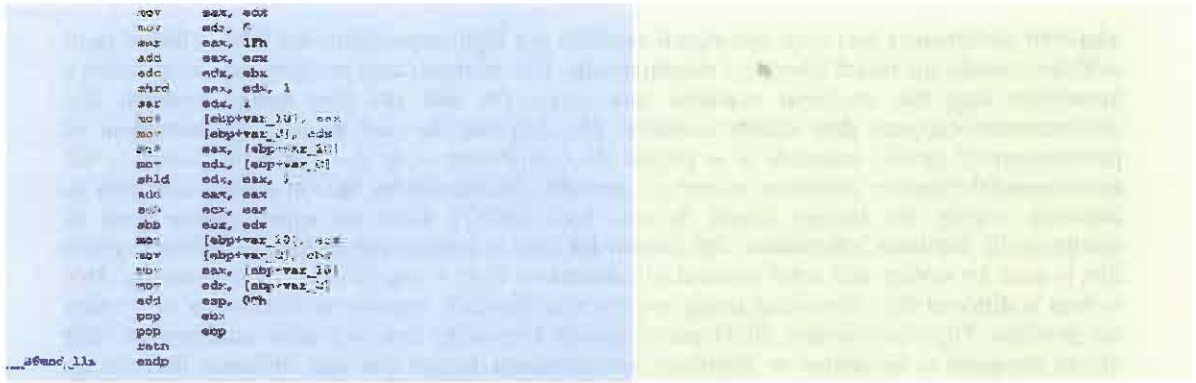
Researching the information that was available turned up that reverse engineering would be required to further the analysis of the program in order to determine its operations and achieve the goal of transferring the program over into MAPTIS. There are two different types of tools that can be used to aid in the analysis of the program . The differences would yield different results and this was the determining factor for which was chosen. A disassembler would produce an output that would not provide an end result where information would allow for data extrapolation in fast manner and would require expertise in the field of data recovery which was not available. A Decompiler would produce the information that could be used to gain information in the time available without as much expertise in a subject that would require much time to acquire.



```
; Attributes: bp-based frame

; mod_ll(long long)
                public __26mod_lla
__26mod_lla     proc near

var_10          = dword ptr -10h
var_C           = dword ptr -0Ch
arg_0           = qword ptr  8

                push    ebp
                mov     ebp, esp
                push    ebx
                sub     esp, 0Ch
                mov     ecx, dword ptr [ebp+arg_0]
                mov     ebx, dword ptr [ebp+arg_0+4]
                mov     eax, ecx
                mov     edx, ebx
                mov     esi, edx
                mov     ecx, eax
                mov     eax, 1Eh
                mov     esi, 1Ah
                mov     edx, eax
                mov     eax, 0
                mov     edx, 1Fh
                add     eax, ecx
                adc     edx, ebx
                shrd    eax, edx, 1
                sar     edx, 1
                mov     [ebp+var_10], eax
                mov     [ebp+var_C], edx
                mov     eax, [ebp+var_10]
                mov     edx, [ebp+var_C]
```

```
__int64 __cdecl mod_ll(__int64 a1)
{
  return a1 & 2;
}
```

Figure 1 The above shows the difference between outputs
Disassembler vs. Decompiler
Generated Source



```
                mov     eax, ecx
                mov     edx, 0
                mov     eax, 1Fh
                add     eax, ecx
                adc     edx, ebx
                shrd    eax, edx, 1
                sar     edx, 1
                mov     [ebp+var_10], eax
                mov     [ebp+var_C], edx
                mov     eax, [ebp+var_10]
                mov     edx, [ebp+var_C]
                shld    edx, eax, 1
                add     eax, eax
                adc     ecx, ecx
                sbb     eax, edx
                mov     [ebp+var_10], eax
                mov     [ebp+var_C], ecx
                mov     eax, [ebp+var_10]
                mov     edx, [ebp+var_C]
                add     esp, 0Ch
                pop     ebx
                pop     ebp
                retn
__26mod_lla     endp
```

Figure 2. Continuation of Figure 1 above

Observing the above the code generated on the left is by a disassembler which is much harder to decipher rather than the generated code on the left which is produced by the decompiler. The amount of time it would take to recreate the program would far exceed what was available. Whereas the code on the right is far easier and closely resembles something a human would produce and thus greatly reduces the effort required to regain information that could prove to be valuable in the aid of recreating or porting the program to a web based or enabled technology. The need for readable source is so that the we may determine how the program communicates with the knowledge bases and gathers the information from the user to calculate whether a particular material under scrutiny would be able to perform given a duration within harsh conditions that will be meet in orbit. Many equations where within the program as well and any information that could be obtained would be valuable in furthering the life of the program which currently had a mission forecast of 2020. This date was only possible due to the knowledge bases that the engine used to determine the outcome of material. So by gathering information on the equations , program logic, and how the knowledge bases were being interfaced with the entered user information recreation could be attempted. With this information porting the entire source code to another language that would aim for the web would enable NASA to place the application within MAPTIS. Making the program web based allows for changes that are seen by all users that may access the program. The current means of distribution (mailed DVD) can cause the misuse of the

tool and waste of resource. Once a DVD is sent to an individual the data may be copied or misused. The ability to maintain the program on government owned systems allows the organization to have full control of who can access the tool and find out who the entity is and if ever comes the need to deny access to this tool. It should be understood that to not provide the tool in the from should not be halted and not frowned upon as it is available. If an entity or person would like to gain access to the DVD more scrutiny should be placed in obtaining the tool, but in the mean time understood that it is still available via a government system while the information of who and what is going to receive the physical software medium. The added advantage to hosting a web based (cloud) application is the ability to make updates to the knowledge base and provide additional features that are requested or developed by person(s) or entities to the SMS application. Allowing this type of interactivity furthers the development of not only the tool but its capabilities, lifespan, complexity and usefulness but allows other subject experts to add to an existing tool to aid others and truly strengthen the involvement of NASA and the public. MAPTIS is evolving and the information it contains will as well. Another technology that is listed on the SEE website is Lunar-E library which contains various information that documents the Apollo era.

Totaling currently as of this writing of one thousand and one hundred documents can be acquired via the same methods as the SMS program. This information is available via request and is stored via DVD. The transformation of this database system on a cd required that we take the existing table and expand on the information that currently existed Developing an algorithm which first read in an excel sheet which contained the document title, Authors , Document source, keywords, publication date, and finally the documents number of pages. This information is then saved into memory for the following step of OCR of the document which will allow information of the document to be reported back in the form of text and searchable.

```
Excel.Application xapp = new Excel.Application();
            Excel.Workbook xworkb = xapp.Workbooks.Open(Globals.path2Xcel);
            Excel.Worksheet xworksheet = xapp.Sheets[1];
            Excel.Range xappRange = xworksheet.UsedRange;
            List<SEE_Index> SEE_listings = new List<SEE_Index>();
            List<string> smallFiles = GatherFiles(Globals.path);  //<----call to Files()

            int rowCount = xappRange.Rows.Count;
            int colCount = xappRange.Columns.Count;
            int cellCount = xappRange.Cells.Count;

            for (int i_main = 1; i_main <= rowCount; i_main++)
            {
                var xSEE_listings = new SEE_Index();
                for (int j = 1; j <= colCount; j++)
                {
                    String CellString = "";
                    int column = j;
                    if (xworksheet.Cells[i_main, j].Value2 != null)
                        CellString = xworksheet.Cells[i_main, j].Value2.ToString();
                    else
                        CellString = "";

                    {

                        switch (column)
                        {
                            case 1:
                                xSEE_listings.Title = (string)CellString;

                                break;

                            case 2:
                                xSEE_listings.Author = (string)CellString;
                                break;

                            case 3:
                                xSEE_listings.DocNumber_Source = (string)CellString;
                                break;

                            case 4:
                                xSEE_listings.keywords = (string)CellString;
                                break;

                            case 5:
                                xSEE_listings.publication = (string)CellString;
                                break;

                            case 6:

                                xSEE_listings.pages = (string)CellString;
                                break;

                            default:

                                break;
                        }//case statement
                    }//if statement
                }/*'j' inner for loop*/   SEE_listings.Add(xSEE_listings);
```

Matching the information within the title and then searching the returned text to find the information needed to extend the fields was then done an then written out to the excel sheet. The remaining process was to repeat this task

using the newly added fields to the database while also uploading the file along with the information that was gathered.

Acknowledgments

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References

[1] H.G. Pippin, "Development of the Spacecraft Materials Selector Expert System," *AIAA 2000-0243*

(SEE) Space Environments and Effects Program Web Application Tools

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University of Texas at El Paso

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Introduction

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Abstract

Design solutions were proposed for a single step process with faster turnaround time via Materials and Processes Technical Information System (MAPTIS) database. This process requires users to register and be verified in order to gain access to the information contained within. Aiding in the progression of making the software tools/documents available required a combination of specialized in-house data gathering software tools and software archeology.

Space Craft Material Selector Expert

- The Spacecraft Materials Selector (SMS) knowledge base is a preliminary design tool that provides estimates of environmental exposures and/or materials performance for selected spacecraft materials by means of inputting the launch date, altitude, inclination, mission duration, and satellite motion to determine if a material is a good choice.

- Currently SMS is designed to have an end date of 2020. Redesigning or reverse engineering the program was attempted to further its lifespan or gather information to recreate another version.

Lunar E Library

- The Lunar E-Library is a database of 1100 PDF documents that were produced during Apollo/Saturn era that document Science Reports Evaluation Reports along with various other reports.

- This library is under the process of being placed on MAPTIS which will serve as backbone for delivery and access control.

Automated Web Crawler

- The Automated Web Crawler was designed to relieve the task of finding the various links that were no longer valid and assist with automating the process of searching for the document of interest that existed at the broken link.
- A number of publications are available within the SEE website and maintaining this information for those who would like to access the material is task of its own.
- The crawler enables automating scouring of the website to populate the information about links that no longer valid. Using a custom search engine it will search for requested documents and read through them and determine the document under scrutiny has relevant information and should be saved.

End Result

Redesigning the SMS program to become web application is feasible given enough man-hours dedicated to the project now that compiler optimized source code is now available. This result is of 2000 lines and will require porting to web capable language. Providing the output for the Lunar-E library Database was a success and will be in the process of transitioning to MAPTIS within the future.