TeraScan Curriculum Development and Integration of SeaSpace Technology into the Classroom

haydenl@mindspring.com

Mr. Je'aime Powell
Mentor
CERSER
Elizabeth City State University
Jeaime.powell@cerser.ecsu.edu

Courtney Farmer
Junior
Elizabeth City State University
cmfarmer113@students.ecsu.edu

Dr. Linda Hayden
Principal Investigator
CERSER
Elizabeth City State University

Kalyx McDonald
Sophomore
Mississippi Valley State University
Kalyx.mcdonald@mvsu.edu

***Abstract*— SeaSpace and Elizabeth City State University (ECSU) signed a Memorandum of Understanding (MOU) in February of 2012. The MOU stated that ECSU would provide a training site for SeaSpace's technology and data products along with integration of the products into classroom curriculum. In return, SeaSpace would provide ground stations for receiving direct broadcast data from various telemetries. The ground stations include a 3.7m X/L band, 3.6m C band, and a 5.0m L band dish, along with accompanying computing hardware. The purpose of this project was to generate a training curriculum focused on the K-12 classroom, along with college courses, and outside governmental agencies. The curriculum contains 15 modules, which as a whole could be presented as a 10-hour course that qualifies as one continuing education unit (CEU) for K-12 teachers and administrators. Example modules for "Introduction to Remote Sensing" and "Introduction to TeraScan" were also created as models for further components.**

Keywords—SeaSpace,TeraScan, Remote Sensing,Curriculum development,Continuing education.

I. Introduction

Founded in 1982, SeaSpace was one of the top remote sensing companies of that time. Their work of receiving images and analyzing them using TeraScan paved the way for further research. TeraScan was a widely compatible system that could send final imagery to numerous satellites for further review. This allowed not only the military, but emergency response and research teams to use TeraScan System also. TeraScan has many versions, which include meteorological, oceanographic, and environmental remote sensing satellites. [1] Partnering up with SeaSpace, Elizabeth City State University (ECSU) must support a TeraScan Remote Sensing facility to service SeaSpace customers and clients on the east coast. This was to establish satellite data collections that included a 2.4m X/L Polar Orbiter system, 5.0m L-Band and a 3.7m C-Band to associate obtain and process servers. [2]The purpose of this was to generate a training curriculum focused on the K-12 classroom, along with college courses, and outside governmental agencies. Based on the Memorandum of understanding (MOU) between SeaSpace and ECSU, they must first have a ground station efficiently running with seven days of little to no human contact. [3] ECSU must provide the training site, technical support for user workstations, clerical support for trainers (fax, phone, photocopying, computer access, etc.), unfettered access to the acquisition systems and antennas, host at least one training event per year for local Coast Guard, Navy and NASA partners, Integrate SeaSpace's TeraScan data sets and software into ECSU-sponsored teaching and research projects, including projects involving other academic institutions in the local region. Also, provide projection capability and logistical support. [2] The project focuses on the integration of SeaSpace imagery into classroom curriculum. With the use of technology in the classroom, and the use of SeaSpace, it would greatly enhance the teacher to motivate students' to learn more about environmental changes within today's society. In order to provide teachers with the knowledge to perform this they must go through the continuing education credit (CEU) process. The North Carolina law requires everyone to take 10 semester hours or 15 units of renewal credit.[4] Coursework must be directly related to an individual's area of licensure and/or professional responsibilities as a public school professional (e.g. classes in computers; reading; exceptional children; sign language; drug, alcohol or child abuse; CPR, first aid; classroom management; stress management; assertiveness training; effective teacher training; second languages; and AIDS education). A unit of renewal credit is equivalent to one-quarter hour or one in-service credit from a North Carolina public school system. Generally, a unit reflects 10 contact hours. One semester hour is equivalent to 1.5 units of credit. [4] Within this one module learning section, teachers along with other SeaSpace users should have a better understanding about satellite imagery and what it means to the earth.

II. Methodology

The group began their research by first dissecting the MOU signed by both ECSU and SeaSpace. The required ground station systems, available data products, and target audience were expanded to meet find the needs of the ECSU training site. The target audience was expanded to include K-12 teachers and administrators with the goal of creating a curriculum that would allow student learners to attain a CEU. The American School Counselor Association specified the requirement for the CEU as a ten-hour training course. At this point the development of the course curriculum began. Sources for the curriculum included the SeaSpace TeraScan Training Guide [5] and coursework from the Introduction to Remote Sensing course taught at ECSU [6] Time for both pre and post assessment tests were included in the curriculum schedule.

In order to integrate the curriculum modules into the undergraduate/graduate courses at ECSU, course descriptions were analyzed individually. The then current (2012-2013) ECSU course catalog was obtained from both the Admissions and Graduate Education departments [7] Each course description was scrutinized and debated for possible integration with TeraScan data products and image processing techniques. Selected courses were then categorized by tentative module topics related to the subject matter. Once completed module generation began.

The modules selected for initial development were "Introduction to Remote Sensing" and "Introduction to TeraScan". Deliverables for each module included a self-running PowerPoint with voice-overs, an assessment, and a basic study guide for student learners. The remote sensing module included topics such as history, sensors, platforms, electromagnetic spectrum, and imagery resolution. The TeraScan module topics included, TeraScan organization, system specifications, command line functions, key features, and various imagery formats.

III. Literature Review

A document source used was a presentation that referred to the use of SeaSpace technology to measure sea surface temperature. [8]This relates to the project because they were also using SeaSpace technology. The use of this technology will allow further research and the development of more ground stations. With the ground stations they could retrieve satellite data and use the information in the classroom. In the next literary article they looked at the 5E method, which is a basic concept of teaching students within the classroom. [9] Teachers use this when communicating with the students and want to have their lesson really mean something. With integrating that means change. They must allow a change within the classroom and have different teaching techniques. When the SeaSpace technology enters the classroom the students will be receptive to it. When not used within the classroom, military and outside usage will have a more efficient way to gather data.

IV. Module Analysis

A. Curriculum

The curriculum was based on the standards of The American School Counselor Association, which mandates that faculty must obtain CEU credits which is 1 CEU credit is equivalent to ten hours. They also used the TeraScan system training, which allows them to stick to the MOU while using the given SeaSpace technology to provide one CEU credit here at the university.

TABLE I. TeraScan Curriculum

Target Audience: K-12 Teachers, Governmental Agencies & Higher Ed Faculty & Students **Standard: SeaSpace Training Guide**
Introduction
Pre-Test (30 min)
Remote Sensing (1 hr)
Linux Basics (1 hr)
Intro to TeraScan – SeaSpace Training (1 hr)
TeraScan Graphical User Interphase (30 min)
Advanced Satellites and Sensors (30 min)
Exploring TeraVision and TeraVision 11 (30 min)
Overview of Data Capture and Processing (30 min)
Operating Procedures (30 min)
TeraScan File System (30 min)
System Setup (30 min)
TeraMaster (30 min)
MODIS Data Processing (30 min)
NPPDB Data Processing (30 min)
Navigating TDF Images with TeraNav (30 min)
Vulcan- TeraScan Fire Detection/Thermal Anomoly Software (30 min)
Final Assessment (30 min)

B. Introduction to Remote Sensing (Figure 2)

In the introduction to remote sensing module the viewer is intended to understand basic concepts about remote sensing. In the self-running PowerPoint viewers will be able to learn the definition, how to obtain satellite imagery, the technology that started remote sensing, some research areas, along with take an assessment to test their new knowledge.

Remote Sensing is the art and science of obtaining information from an Electromagnetic Radiation signature without being in direct physical contact.[6] Electromagnetic Radiation ranges seven possible frequencies on The Electromagnetic Spectrum. The first being gamma ray which has faster and shorter wavelengths, to radio waves which are large but have a lower frequency. The seven frequencies include Gamma ray, X-Ray, Ultraviolet, Visible, Infrared, Microwave and Radio. The first camera was invented in 1826 while the first flight in 1903. Together in World War 1, these two technologies were the beginning of Remote Sensing. They were used to locate troops along with enemy grounds. During World War 2, both sensors and platform technology improved. Platforms such as The Zeppelin, V2 rocket and the M.E 262 Jet allowed increased range, payload and speed of aircraft. Sensing technology improved in both image resolution and a new sensor type called the radar. An early radar system first detected the

raid on Pearl Harbor in Hawaii. However, the report was ignored because it was an unproven technology. Platform technologies included the U2 Spy Plane, KH-12 Satellite and Skylab. During this time in 1960, The Office of Navel Research introduced the term Remote Sensing. Remote Sensors fall into two categories, Active and Passive. Active sensors provide their own source of illumination. Examples are the radar, which is used for speed detection, lidar for ground detection and sonar to find ships and submarines. Passive sensors measure naturally available energy and need an external energy source. The human eye will forever be a passive sensor as they observe more than over a thousand things per day and have different reactions.

C. Introduction to TeraScan

In the Introduction to TeraScan module viewers learn about the SeaSpace technology known as TeraScan. Also the module shares key signature features that are used, how data is obtained and commonly used commands. To better their understanding within this module, it comes along with a basic study guide, an assessment and also a self-running PowerPoint.

Created in 1982, SeaSpace is one of the world's largest and leading remote sensing companies. Their work allows ground stations images to be captured for further research. TeraScan is integrated system software designed for reception of data from environmental satellites for processing data into images. Things needed to make the TeraScan operating system to work effectively are a interface, bit synchronizer, frame synchronizer, antenna for satellite signal, uninterruptible power supply (UPS), global Positioning System (GPS) antenna, computer workstations with TeraScan software, and a receiver for tuning to the correct satellite and the sensor data. TeraScan system can receive data through the x-band, c-band, and L- band from various telemetries including GOES, MODIS, NOAA EOS, NPP, TERRA, AQUA, and LANDSAT. TeraScan software is based on the Linux operating system, which consist of TeraScan Data Format (TDF), a set of daemons and services, a set of reference files and databases, 600 or more command- line functions, and a set of graphical user interfaces (GUIs). TeraScan software includes many reference files and databases that supply the information that TeraScan needs to run all of its operations. Some key features of TeraScan software are Advance Dvorak Technique, Automated Data Retrieval, COMS Functions, Doppler Radar Import, GOES Ingestion, MODIS, PULSE, and Shapefile Import. All of the key features are important because they all help receive the data and in return put them in technique satellite imagery. Some of TeraScan primary commonly used commands that group the reception and processing of satellite data are thelp, launchpad, listsched, trackeye full, stu, pulse, tvis, lspass, and ac.

TABLE II. Introduction Modules

Introduction to Remote Sensing	Module Assessment Study Guide
Introduction to TeraScan	Module Assessment Study Guide

D. Voice Overlay and Self Running

As the slides transition automatically the voice was relayed about what was presented. The narration was captured using a

blue snowball microphone within PowerPoint. This allowed the clear vocals on the computer.

E. Assessment

This assessment was intended to test the viewers' knowledge about the introductory module after watching them. They consisted of 15 questions that are derived from the associated PowerPoint. The viewer was not tested on anything not covered or discussed. The assessments can either be given by an instructor or converted to an online form.

F. Study Guide

The study guide was a PDF file of the actual presentation. With speaker notes students will be able to look over the notes before or during the presentation. The guide is meant to be a helpful tool so the viewer will have the option to self-pace. The study guide could later be used as a personal instruction sheet.

V. CONCLUSION

The purpose of this project was to first create a curriculum that would introduce SeaSpace technology to students, faculty, and administrators; secondly, identify classes in which SeaSpace data would integrate; and lastly, create initial modules for the training course. They will be viable for continued education credit for teachers and administrators on the K-12 level and governmental agencies. These purposes address points listed in the MOU signed between ECSU and SeaSpace. In order to create a curriculum for training, the SeaSpace Training guide was used to provide a clear timeline of needed skills for TeraScan/TeraVision usage. Once the curriculum was developed, analyses of current courses available at ECSU were completed to determine suitable integration of SeaSpace collected data and image processing techniques. Tentative suggestions as to which modules would best apply to targeted courses were then made. The curriculum was then used to generate a schedule which would conform to the CEU time requirements as outlined by the American School Counselor Association and ECSU Distance Learning department. Lastly two modules named "Introduction to Remote Sensing" and "Introduction to TeraScan" were developed including several deliverables. Those deliverables included a self-running PowerPoint with voice-overs, an assessment, and a study guide for each module. Each module was designed using the 5E learning methodology in order to assure student learner comprehension and engagement.

VI. FUTURE WORK

To complete this research, installation of the SeaSpace ground stations must take place. This installation was expected to occur in the month of July 2013 on the ECSU campus. The

remaining modules must be completed using the 5E methodology in order to ensure insight into both TeraScan techniques and research directions. Once all modules in the CEU course are completed, the learning modules must be tested from respective educational categories including governmental agencies, K-12 teachers and undergraduate/graduate students. Once any adjustments are made, certification of training curriculum must be sought by the ECSU Distance Education Department to allow CEU accreditation. Any faculty that instruct targeted classes for SeaSpace system integration could then be contacted in order to facilitate classroom use of the various technologies. Lastly, periodic training schedules could be sent to local schools, governmental agencies, and SeaSpace partners for continued use of the training site at ECSU.

VII. Acknowledgments

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