Application of A Capture Technique to the 3D Harbor Construction

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Abstract—**The main purpose of this paper is to design an innovative ship handling simulation program by combining the development of Quest3D software and the Google earth harbor terrain software. The paper describes the usage of the Google earth program to retrieve the latitude and longitude elevation, through GIS conversion and 3D graphical model to generate the Quest 3D harbor construction blueprint. Projectors display the image with build-in formula calculated angle settings to achieve a better perspective for the projectors installation. A 3D virtual reality scene was built by using the Maya Model, and then we overlap with the harbor module to complete the famous world ports. The results will be tested in the ship handling simulator machine at the 3D virtual reality software development laboratory.**

Keywords-Component; Harbor Construction; Virtual Reality; Ship Handling Simulator

I. INTRODUCTION

In recent years S57 has been served as a standard format in operating the sea chart. It takes the advantage of its high accuracy in both latitudinal and longitudinal measurements as well as the precision of elevation to ensure the safety of ship docking guided by port lead ship. However the generation of such S57 nautical charts of the harbor and its 3D undersea terrain appears to be very complicated. This paper describes an alternative method of combining the Google Earth program with altitude intercept programs with virtual reality to produce a high accuracy of a complete virtual reality simulator containing both the land and sea port models with a build-in content of a harbor.

Several factors may result in a more realistic simulation allowing users to simulate the real situation with great experience, such as the rapid development of computer hardware, the maturation of the virtual reality technology, and virtual reality software with a hardware interface to form a human-computer interaction. In this study, we focus on developing the elevation matrix capture program to register records with a high degree of depth points and to further generate 3D models creating virtual reality simulator content. As computing power increases, along with the progress of web-based technology and the improvement of numerical algorithms render the advanced utilization of satellite positioning technology with Google Earth map and many are increasingly using GPS (Global Positioning System global Positioning system). To date GPS usage has reached to a level of high accuracy and reliability [5]. Currently using the commercial GPS software as a practical application has become a trend leading to the inevitable continuation of scientific development. This paper uses Google Earth software to retrieve data from the Google earth server that transmits values to the

software [6]. These data are processed with a geographic information system GIS (Geography Information System). Through multiple conversions these data generate 3D models and software and further apply in virtual reality Quest 3D, so that the simulator contains some depth and accuracy of terrain and texture, increasing the simulation of ship to maneuvering situations [2, 3].

The basic simulation system modules using 3D display technology have become very reliable and précised in the current simulator models on display, even though simulation also involves in the height and the depth of the model. However one draw back of the current system is that it exclusively depends on the S57 sea charts for the drawing of terrain elevation and collection of electronic as well as S57 charts is rather difficult. Further, S57 charts production depends on the accessibility of the company and other unfavorable factors.

The purpose of this study is to generate a 3-D virtual reality system to simulate the maneuvering of ships. The system will be housed in the Marine National Kaohsiung Marine University Institute of Information Technology Ships manipulate three-dimensional virtual reality software development laboratory to facilitate simulation of the operation of ship machinery hardware. Combining the hardware of simulators with virtual reality software to manipulate the ship was generated using Quest 3D software to build virtual scene models and simulator software system design. Centering on the functional module the function of the system can easily be expanded. Implementing the development of the elevation capture program and construction of the model terrain into the Quest 3D expandable modules, not only can enhance the visual effects but also improve the accuracy of the latitude and longitude and topographic characterization [7]. Ultimately, the utility of the system will greatly enhance the visibility of our research endeavor in the simulation systems and make significant academic contributions.

II. METHODS

As shown in figure 1, in the built-in features of the Google Earth software screenshots mouse can be moved to any specific location to reveal its

precise latitude, longitude, altitude and elevation measurements thereby creating the map.
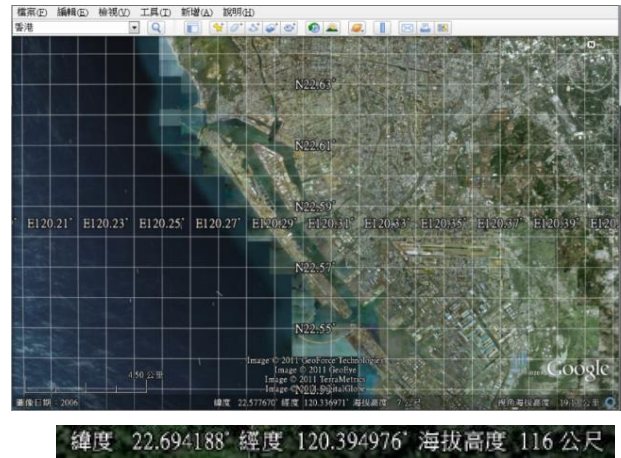

緯度 22.694188° 經度 120.394976° 海拔高度 116 公尺

Figure 1.   Range of latitude and longitude data

To develop the program with Google Earth API software the codes from both the upper left corner and lower right corner are set to make two points of latitude and longitude of the matrix, and then determine the horizontal and vertical granularity. Using the cumulative calculation to the set operation range boundary. After running the program the matrix will automatically calculate the point where all the coordinates of point range thus obtain data of all heights. After scheduling the query or interrupt data all information will be immediately stored in GeElevation.csv file name (those unfinished query due to sudden interruption can not be saved). The stored data can be directly opened in Notepad, or be imported into Excel and other applications. The data format in the order of latitude, longitude, height, will be displayed in the layout shown in Table 1

TABLE I.   CAPTURE PROGRAM PLANNING TABLE PANEL

Enactment item	Enactment content
(Left Latitude)	_____ (Decimal)
(left Longitude)	_____ (Decimal)
(Lower right Latitude)	_____ (Decimal))
(lower right longitude)	_____ (Decimal)
(Horizontal spacing)	_____ (Minimum accepted value of Google earth)
(vertical spacing)	_____ (Minimum accepted value of Google earth)
(batch search) (cancel)	

After putting the latitude and longitude values into the parameters for the query: Latitude = 22.694188; into the parameters: longitude = 120.394976 the program will immediately display outgoing parameters: height = 116 (unit: m) access in order to avoid explosive action (thousands of queries a second issue), which is too frequent to be blocked by Google for the website limits to a single-threaded query sequence. The Google restricts a maximum of 2,500 queries and the computer network will be locked with over the limit query for 24 hours without access. If one wishes to check more items, one must copy the program to other computers with different network cards.
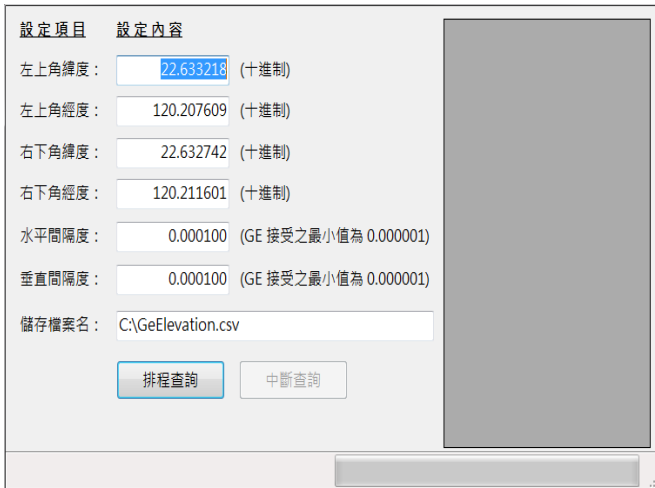
Figure 2.　Capture program planning table panel.

Figure 2 demonstrated using C # [8] program to combine with API [9], in accordance with the original design of the interface elevation capture program which the horizontal and vertical spacing after the 6th decimal point to the most basic unit.

The calculation of the minimum sampling distance is about 25 cm and the maximum sampling distance is about two thousand five hundred kilometers. The calculated distance is in accordance with Google Earth layer for the image-based processing of precision. With the altitude closer to the ground, it yields more detailed and precise value to latitude: 11.362330 longitude:142.573144 Mariana trench perspective altitude 338.69 km of marked elevation of -8060 m. If we view the marked elevation 1000 meters above sea level is -10856 meters, the latitude for

due to image slicing resulted latitude is offset by 0.01 and by 0.04 in longitude. Figures 3 and 4 show the latitude: 11.362330; longitude: 142.573144; altitude: -8060 m; perspective altitude: 338.69 km
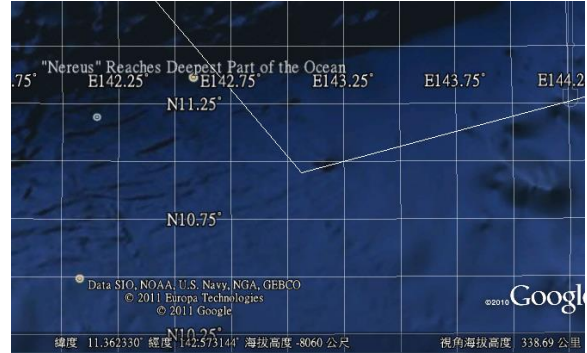

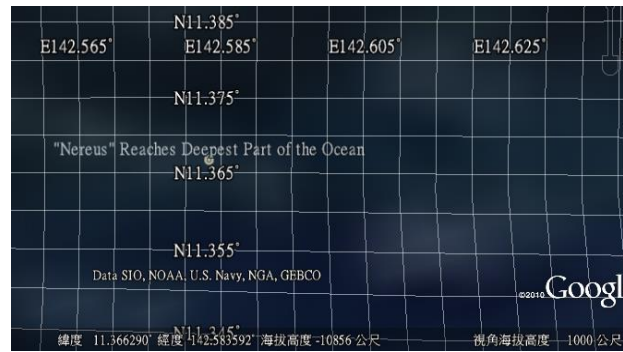Figure 3.　Capture Recognition

Figure 4.　Capture Recognition

Latitude: 11.366290; Longitude: 142.583592; Altitude: -10856 meters; perspective altitude 1000 meters

While retrieving the data is set at a fixed elevation angle between 18 to 19 km. This captured data serves as the basic perspective of altitude to ensure under the circumstances for few variability in elevation value data thereby obtain the best capture range. **Furthermore** the spacing on both horizontal and vertical spacing will be adjusted by 0.01100 degree in both latitude and longitude on each capture. The Kaohsiung Harbor will be divided into 10 portions with a 2 x 11 rectangle representing each portion, which will then be assembled into a matrix for data collection, as shown in Figure 5.
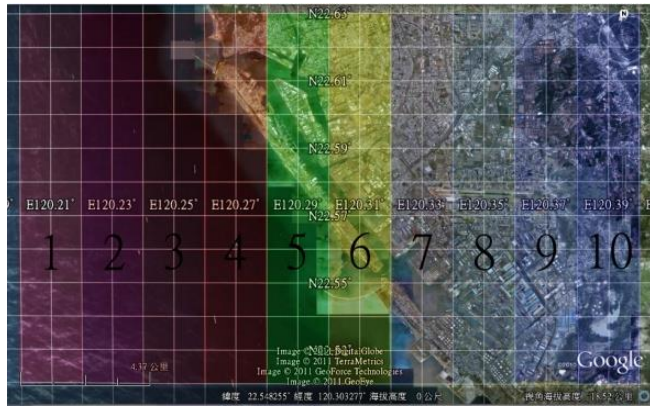
Figure 5.   Capture range

The data obtained from the block 10 after a series of deductions are fed to 10 computers to perform capturing with each capture of 2360 points (maximum of 2500 points) altitude and other values, negative values represent depth of the sea water.

III. VALUE ELEVATION MODEL GENERATION

Integration of the acquired elevation data from 10 computers into one excel file revealed a total of 22,539 measurements

Through the New Geographic Coordinate System in Display XY Data WGS84 (the earth coordinate system) is set and converted to DEM as shown in Figure 6
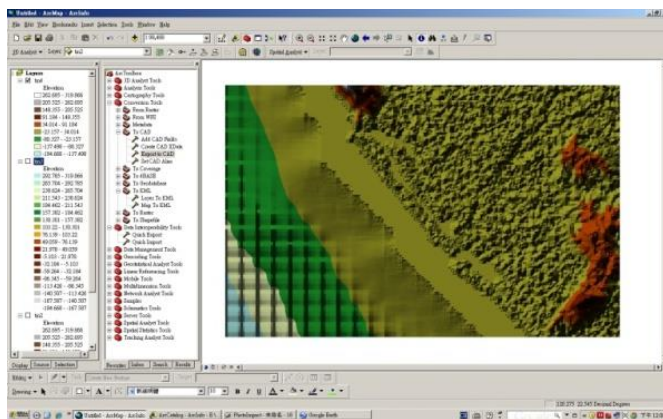

Figure 6.   The DEM conversion

After conversion, the map is imported and overlaid with that of generated from Google Earth to ensure the accuracy and compatibility of the two maps as shown in Figure 7
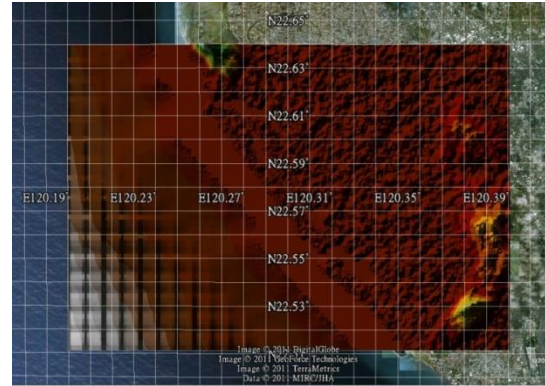

Figure 7.   After making GIS import Google Earth to confirm

After confirming the precision of latitude and longitude data on the graphics, 3D models is then generated as shown in Figure 8,9 This method is used to generate the model Singapore harbor.
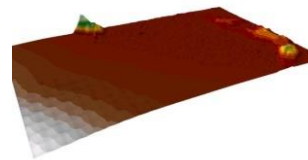

Figure 8.   3D terrain complete

Figure 9.   3D terrain complete

The majority of 3D software are able to import and export files with VRML format. Some search engines can directly upload and support a three-dimensional model of VRML format and the browser can display a Java applet providing a simple VRML experience [1.4]. To experience the full visual and interactive effects, generally it needs to install a separate browser plug-ins or stand-alone program. However using our newly developed this 3D software program enable the codes sharing to perform the DEM conversion and convert the model to other types of 3D software. This greatly improves the usage convenience, and versatility of the program. After the implementation of the VRML program, one can make good use of GIS program generated DEM files and save them as VRML compatible formats. These formats can be further converted into the post-production model called the wrl file as shown

in Figure 10, using the VRML page to confirm the implementation of GIS software generated DEM files.
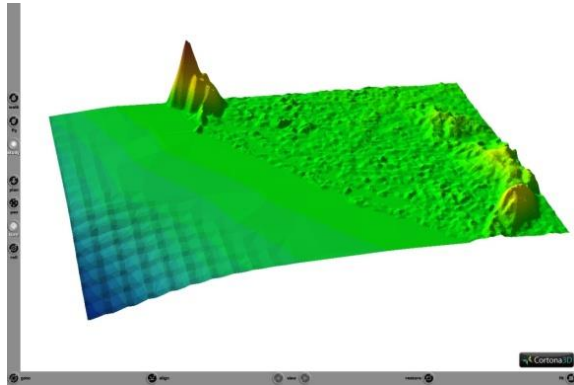

Figure 10. Vrml of the window and model

Finally, we utilized the 3D MAX 9 to convert wrl files. After several conversions to generate the port of Kaohsiung in a DEM model. Figure 11 shows both the regular map and the DEM elevation model of Kaohsiung harbor.

Figure 11. Terrain texture

To alignment texture and overlapped to complete Kaohsiung Harbour model shown in Figure 12, 13.
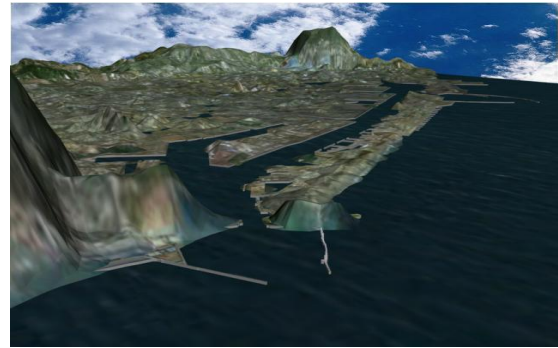

Figure 12. Kaohsiung port model

Figure 13. Build the terrain and Kaohsiung Harbor

Previously described the use of the software Google Earth virtual globe software to generate Singapore the electronic map with the following steps:

A. First, used the software in Google Earth ruler function to draw the map image of Singapore harbor as shown in Figure 14.

Figure 14. The scope of the map image to draw in Singapore

B. Use Google Earth to divide the above map into 26 parts as shown in Figure 15. Refine each part for highest resolution and precision because Google Earth satellite images were acquired at different time intervals, resulting in color difference among pictures. In order to obtain high-resolution Pixel the scale of each part was chosen at 1 km / 2,000 feet, and the height set at 12.21 km. After these manipulations all 26 segments were imported into Photoshop to generate a complete map.
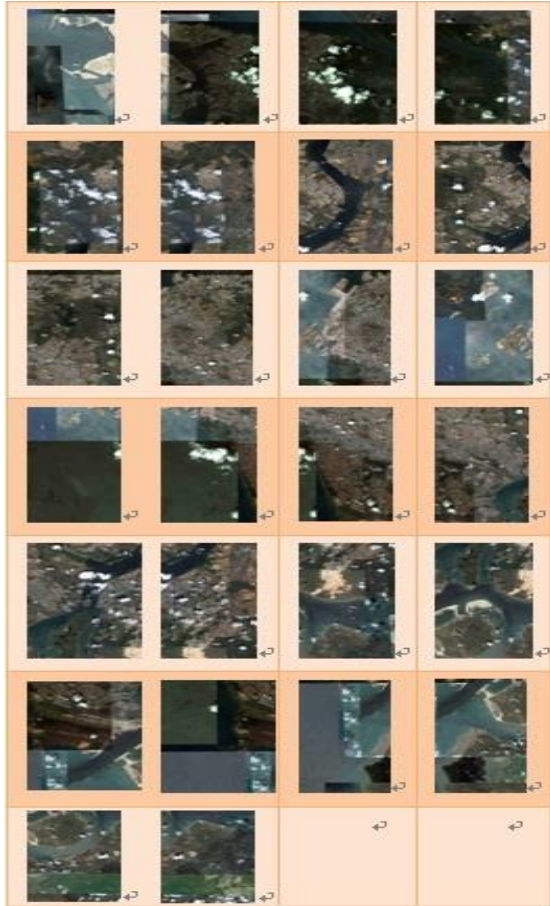
Figure 15. 26 intercept of Figure

C. Using Google Map to enlarge the vector-based maps to the same size of electronic charts as shown in Figure 16. The 26 segment maps were assembled into a rough map and used Illustrator to polished the map as shown in Figure 17.
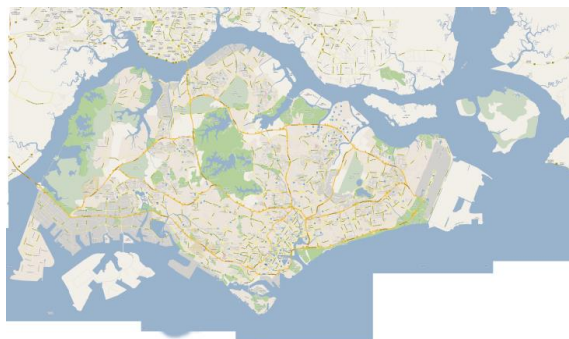

Figure 16. Vector collage map

Figure 17. Vector map transfer line of draft

D. Using the same method as described previously for building the map of Kaohsiung Harbor a good digital elevation model [7], to generate Singapore Harbour virtual 3D model is shown in the Figure 18.

Figure 18. Singapore Harbor Model

IV. CONCLUSION

In this study, we use the Google Earth software to design elevation capture program. Through the Google Earth server to we can retrieve required range of data for any terrain in Google Earth database. These information can then be imported into GIS program and 3D drawing software to create 3D models. The process is rather rapid and with accuracy allowing the virtual simulation of port activities such as ship maneuvering. Although it is not as accurate as S57 charts however the ease of generation the 3D map and its compatible accuracy render it potentially a popular and widely use application.

Our innovative process of building 3D virtual model utilizing the satellite pictures from Google

Earth, gradually implementation of Maya software to build a scene with the surrounding areas and outer contours of the inner harbor, and production of electronic maps using Photoshop to generate the 3D virtual harbor maps is an effective method to save manpower and money without affecting the quality and accuracy of the map.

Therefore, the accuracy of the model or the latitude and longitude for positioning the accuracy of harbor the program features of this application to provide for future development and recommendations:

1) To further develop Pro version of the program allowing the production of latitude and longitude of the high-precision terrain elevation data to produce Harbor. The Institute of Ship Handling Simulator latitude and longitude positioning research will conduct a more accurate simulation of the terrain and build a more precise database for the latitude, longitude, and elevation for various harbors.

2) The use of 3D graphics software to build a variety of ship models and coordinate the information and date from ship models and the ship RS232 module corresponding to the real message to distinguish between types of ships, ship building simulator database.

3) To utilize the operating systems in ship simulator Quest 3D by adding RS232 communication, which receives the ship modules with a variety of terrains and latitude and longitude identification module the system allows accurate ship simulation in the harbor. Further the information of real vessels within the harbor will be input into the simulator to generate the real-time 3D simulation model system.

REFERENCES

[1] Ka-Hou Lam,「A Vrml/X3D-based Interactive Three Dimensional Spatial Information Mangement System」, 2005.

[2] Shan-Zhi Yang, 「Quality Assessment for Digital Elevation Models」, 2006.

[3] Yen-Nan Pan, 「Computer Aided Algorithm for Automatic Lineament Detection in Digital Elevation Model」, 2007

[4] Chun-Huang Wang, 「Research and Implementation for the Web3D Virtual Reality Based on Java3D」, 2007.

[5] Wan-Chien Chang, 「A Study of Maritime Mobile Navigation System」, 2008.

[6] Jeng-Wei Lai, 「The Study for E-learning Of High School's Geographic Education – Based On Google Earth」, 2009.

[7] Wen-Tzu Lin, 「The Application of 3D-GIS Techniques for Landscape Visualization」, 2009.

[8] Micorsoft Visual C# Developer Center http://www.microsoft.com/taiwan/vstudio/vcsharp/default.mspx

[9] Google Earth API Code http://code.google.com/intl/zhTW/apis/earth