MODELING AND SIMULATION AS AN APPROACH TO CREATE AWARENESS OF THAILAND AEROSPACE TECHNOLOGY AMBITION

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Abstract- Thailand's ambition to utilize space as a domain to demonstrate indigenous capacity in science and technology, not to mention the joint venture ThaiChote remote sensing satellite, has been doubtfully speculative due to pure abstraction of the program and lack of at least a visualization tool to generate project awareness. An abstract sounding rocket project's view and concept of ignition at a launch site through to a separation stage in space needs visuals and audio to convey intended messages to an audience. This research paper explains the processes that the authors adopted to turn intangible and ideal abstraction into a visualization product, which has been under continued research and development within the authors' modeling and simulation research group. The paper describes the purpose of the video version of the modeled and simulated sounding rocket when presented as a moving backdrop during the ongoing panel discussion of top executives from space-related agencies and before the eye-witness of researchers having various backgrounds in an international conference. The paper further explains how the authors explored the achievement of the modeled and simulated product as a medium to create awareness of the audience who attended the panel discussion on the topic national aerospace technology vision and ambition.A questionnaire was circulated and its contents were collected and analyzed to come up with the prior intent of the modeling and simulation tool. The survey result shows that most of the participants who attended the discussion were optimistic and aware of the sounding rocket project. Comprehension on each stage of the rocket launch and separation was visually perceived to the extent that the vision and ambition were widely embraced.

Keywords- Modeling And Simulation; Sounding Rocket; Awareness Creation

I. INTRODUCTION



FIGURE I. THE OVERVIEW OF MODELING AND SIMULATION PROCESS

Space has always challenged and attracted humankind who is ambitious to utilize space as a domain to demonstrate indigenous capacity in science and technology. Thailand is one of the countries that make use of the satellite technology for the benefits of communication, distance learning, agriculture monitoring, disaster management, navigation and military operation (FIG. 1). The first step of Thailand in space technology lies in its first satellite project called Thaicom. In 1993, Thaicom1, Thailand's first satellite was successfully sent to orbit. It was built by Hughes Space Aircraft and launched from Arianespace, France [1]. Since then, Thaicom project has been playing a significant role in the field of communication and education, particularly the distance learning via satellite. After that, Thailand's first earth observation satellite project was established by GISTDA (Geo-Informatics and Space Technology Development Agency, Public Organization). The earth observation satellite, Thai Chote or THEOS, was sent to orbit in 2008 by Dnapper rocket from Yasny rocket base, Russia. The process of sending the rocket from launching platform to space was first to launch the rocket to the south along the polar with deviate angle to the west 8.9 degrees. The rocket was driven from the ground for 110 seconds, up to an altitude of 60 kilometers, before the first stage was turned off, disengaged, and fell to the ground in Kazakhstan. Subsequently, the second stage of the rocket was ignited and propelled the rocket to climb up for another 180 seconds up to an altitude of 300 kilometers. The second stage of the rocket was separated and fell into the Indian Ocean. The rocket's last verse (Upper Stage) with the satellite as its payload continued to follow the way of submission to an altitude of 690 kilometers. At this point the satellite was ejected from the rocket's payload compartment [2].

Thailand's recent project in satellite technology was SMMS (Small Multi-Mission Satellite) project. The satellite with hyper-spectrum sensor was the cooperation between China Centre for Resource Satellite Data and Applications (CRESDA) and Kasetsart University [SMMS site]. SMMS satellite was sent to orbit in 2011. The ground station was funded by the ministry of information and communication technology. SMMS's Hyper-spectrum

sensor plays a key role in agriculture monitoring and disaster management [3].

To keep up with the advancement of aerospace technology, the sounding rocket research project was initiated by a group of organizations in Thailand. A sounding rocket is an instrument-carrying rocket designed to send measurements and perform scientific experiments during its sub-orbital flight. The goal of this project was to research and acquire knowledge in the technology related to launching a sounding rocket including its payload, and possibly develop into a prototype.

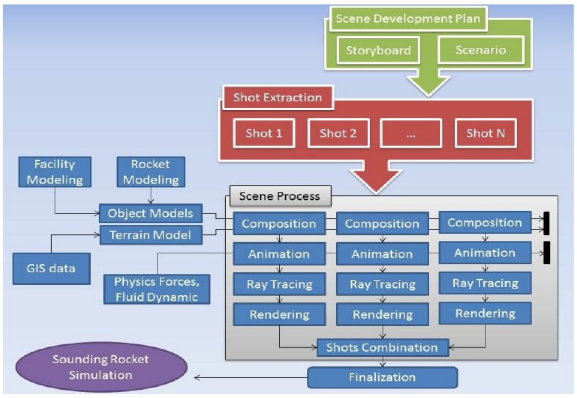


FIGURE II. THAI-OWNED SATELLITES

In April 2015, the Defence Technology Institute (DTI) hosted an international conference in Defence Technology and saw the opportunities to use this event for gathering ideas and raise awareness in aerospace technology among Asian countries. The panel discussion in the topic of "Thailand's State of the Art Aerospace Technologies for National Security and Country Development" was scheduled as a part of the conference. The panel included some of the experts in the field from several organizations such as GISTDA, NECTEC, and academic institutes. The venue let them share the visions and capabilities of each segment. The sounding rocket research project was also discussed. To better visualize what this project and outcome is all about, DTI created a sequence of video animation about the launching of a sounding rocket and played it in the background during the discussion. DTI's Virtual Simulation group used 3D visualization and simulation software to create a 3D model of the launch platform, a rocket model and payload models then simulated the launching process of sounding rocket since take-off until releasing of the payload. After the panel discussion, a questionnaire was circulated to measure the attitude of the audience about the project and towards the use of video animation as a visual aid.

II. MODELING AND SIMULATION

Simulation is the process of using models and tools to reconfigure and experiment with a specific system for the properties concerning behavior or displayed output of the system. Using a simulation tool is extremely useful in many cases such as when the actual system has not been implemented, the cost of testing is too expensive, the method is impractical, or the environment is too hazardous [4]. Moreover, simulation is used as a tool to evaluate the performance of a system under different configurations over a long period of real-world time. However, in this case, we used the video animation as a way to visually simulate the sounding rocket launch process to the audience.

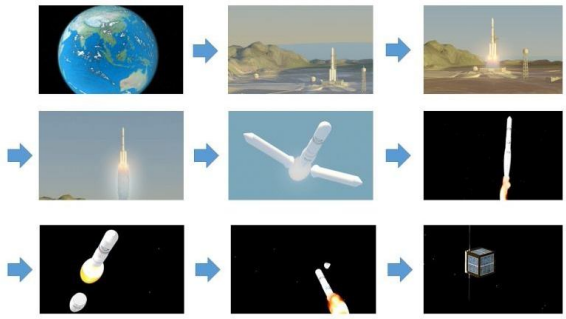


FIGURE III. LIVE PRESENTATION OF THE SOUNDING ROCKET VIDEO

The creation of the animation sequence can be divided into 3 stages(see FIG.2). The first stage was "Scripting and Creating a Storyboard". In this stage, the script for the scenario was formulated, and the storyboard of the visualization was created. There were 2 sources of information that were used as the references to create the sounding rocket launching simulation. First, the outline of the procedure was provided by DTI's board of director, who is also the representative of DTI in the panel discussion. Then, the word-of-mouth description was corroborated by videos of the actual rocket launching expeditions. The integration between the narrative and the records of the real events helped to clarify the idea of what the scene should be like in each process of the launch. As the essence of the launching procedure was gathered, the sequence of the simulation could be defined. The launching process was divided into 3 main phases. The first phase portrayed the scene of the rocket which was prompted to be launched from the base. Later on, the booster was ignited driving the rocket to the space. The second phase showed the rocket with its boosters travelling up through the atmosphere until the boosters suddenly detached. Lastly, the third phase depicted the scene in which the rocket entering the orbit and cruising above the south of Thailand in the eastern direction before the satellite was released from the rocket at the end. The second stage was "Terrain and 3D Asset Modeling". At this stage, the3D models of the launch site, the rocket, and the environment were created using 3D computer graphics software and were used as the composition in the launching process scene. The suitable terrain selection and manipulation were also done at this stage. DTI planned to use southern part of Thailand

where it is close to the equator as the launch site so that the rocket can be sent to the orbit with shortest path. Therefore, the terrain and environment was carefully created to resemble the area. The 3D model of the rocket was designed according to the aerodynamic principle. The last stage was "Launch Simulation". Creating the dynamic section such as applied physics forces to the model, construct fluid dynamic blast in the first-time ignition, control the separation of the rocket and other ignition of each state, and release the payloads to the orbit were done at this stage. Other tasks such as ray tracing, rendering and wrapping the animation to the video presentation were also done at this stage.

III. METHOD OF CONVEYING MESSAGES

A. Live Presentation



FIGURE IV. THE KEY SCENES OF THE SOUNDING ROCKET VIDEO

The video presentation of the sounding rocket was shown in the First Asian Conference on Defence Technology 2015 (ACDT2015). It was played during the panel discussion on the topic "Thailand's State of the Art Aerospace Technologies for National Security and Country Development" where the invited expertise from the leading organizations endowed the audience with their knowledge and experience in aerospace technology (FIG. 4). The video was used to support the content of the talk by illustrating the overall possible outcome from the integration of knowledge within the area. It lasts 4.24 minutes and composes of 3 main stages of the sounding rocket expedition: rocket launching from the base, rocket releasing the boosters and rocket travelling in the space.

B. Questionnaire

A questionnaire was used as a means to measure the viewers' attitudes towards the modeled and simulated sounding rocket. It was given out to the attendees who joined the aforementioned panel discussion after the conference ended. The questionnaire comprises of 3 parts: personal information, the opinion about the sounding rocket video related to the discussion content and the attitude towards the aerospace technology in Thailand. In the first part, participants were asked to provide their basic information about their age, gender and organization. Moving on to another 2 parts, participants were asked to give the rating score referring to their level of agreement to the given statements. The aim of this questionnaire is to scrutinize if the visual representation can convey clearer message and stimulate Thailand's aerospace technology recognition to the audience.

IV. RESULTS AND DISCUSSION

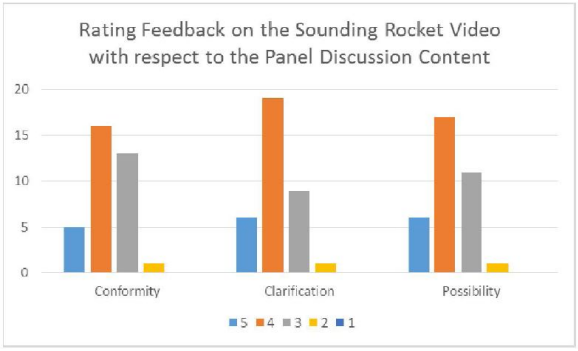


FIGURE V. THE RATING SCORE OF THE SOUNDING ROCKET VIDEO OBTAINED FROM THE PARTICIPANTS

The feedback of the video was collected from 35 attendees of ACDT2015: 27 males and 8 females. All of them are Defence Technology Institute staffs in the 20-49 age range with different levels of fundamental knowledge about the sounding rocket project. Most participants rated themselves as having moderate acquaintance with the proposed subject. It was confirmed that the content of the video conforms to the substance of the talk as the rating scores of 4 and 5 were obtained from 60 percent of the participants. Furthermore, there was quite a high degree of assertion on the usefulness of the video in clarifying and communicating the idea of the talk with 19 participants choosing the score band of 4 and 6 participants choosing the score band of 5. The majority of the surveyed group also showed the appreciation on utilizing the visual representation to enhance the viewpoint on the possibility of the project at a fair extent.



Apart from measuring the cognitive response, the participants' implicit response was observed so as to analyze the influence of visual aid on their attitudes towards the proposed technological leap. The result shows that most participants perceived the importance of the aerospace technology in the human

resource development of Thailand. 16 out of 35 participants even expressed strong belief in the impact of the technology. Moreover, a relatively large proportion of participants agreed that Defence Technology Institute should be the central organization to take charge of cooperating and pushing forward the aerospace technology in the country. The level of anticipation in the occurrence of the sounding rocket project was noticeably high as more than half of the total number of participants rated their aspiration at the score of 5 followed by about 30 percent at the score of 4.

As seen in FIG. V, the results from each part of the questionnaires aligned in the same direction. They portray that the gist of the panel discussion was made clearer with the aid of the visualization. Consequently, participants were able to comprehend the prospect of the aerospace technology of the country not only through the oral communication but also through visuals which offer a more concrete sense. The effectiveness of using the video also inherently invokes the positive impression towards the project as the visual cue lessens the audience's idealistic perception about the aerospace technology.

CONCLUSION

Traditional methodology was adopted to test the awareness of viewers towards Thailand's aim to utilize space as a platform to demonstrate the space science and technology capability. The sounding rocket research project was simulated for better visualization of the project and its outcome. A sequential video animation was produced to convey the intended messages of the top executives from space-related agencies to an audience. How the animation created awareness was more focused on instead of how the animation was created. However, the animation lasts 4.24 minutes to cover 3 main stages of the sounding rocket expedition. The questionnaire designed to measure the viewers' attitudes towards the modeled and simulated sounding rocket collects audience's aerospace technology recognition. The statistics confirmed that the content of the video conforms to the substance of the talk. A high degree of assertion on the usefulness of the video in clarifying and communicating the idea of the talk was attained and the appreciation on utilizing the visual representation was at a fair extent. The survey result shows the optimism and awareness of the sounding rocket project from each stage of the rocket launch and separation. The study statistically supports that the concept of modeling and simulating an expected outcome is often a classic tool to create public awareness and form part of public hearing [5, 6].

ACKNOWLEDGMENT

The questionnaire developed in this study is a traditional way of the test and evaluation of DTI's simulators. Thus, the authors acknowledge gratitude to those who filled in the survey form. It will be further improved to conform to the objectives of upcoming simulators of DTI. Researchers in the sounding rocket project are also highly appreciated for the time of talks and discussions right from the sketch through to the visual stage. The authors believe in autonomy and harmony and cherish the collaboration among partners of all aspects to achieve the realization, recognition and implementation of the sounding rocket project.

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