The 8th International Scientific Conference
eLearning and software for Education
Bucharest, April 26-27, 2012
10.5682/2066-026X-12-141

SERIOUS GAME APPLICATION IN ANTI-AIRCRAFT MISSILE TRAINING

Silviu APOSTOL, Fabian BREHARU
Insoft Deveopment and Consulting, Sos. Virtutii 19D, sector 6, Bucharest, Romania
E-mail:silviua@insoft-dc.ro, fabianb@insoft-dc.ro

Florin MINGIREANU
Romanian Space Agency, Str. Mendeleev, Nr. 21-25, Bucharest, Romania
E-mail: florin.mingireanu@rosa.ro

***Abstract**: A serious game application related to anti-aircraft missile training is presented altogether with strategies specific to the field. Technologies used to develop the application together with ballistic models are presented in comparison with real life training applications. The application allows the user to train using several pre-set cases for specific aerial targets. Through specific e-learning strategies the user capability and experience is enriched altogether with specific automatism directly related to the field of anti-aircraft missile training. Key advantages of the applications are presented amongst which we mention low-cost, repeatability capability, detailed analysis of missile firing tests as well as detailed equipment resemblance.*
The interface is realized with great detail and special care is given to the real-life feeling of various buttons and switches. The application tries to give to the trainee a real-life feeling with smooth performance capability.
Interaction with various equipment boards is enabled through easy mouse click interaction.
Within the application the user has the freedom to choose between training and real fire case. In training the user gets used with the equipment and the computer indicates through specific labels the specific steps that the user should perform at any stage. Limited action is enabled and the user cannot be wrong as he/she must be focused on learning the correct button position for specific targets.
Within real fire case the user is offered by the computer a random target and he/she must take the correct decisions and must set the correct buttons for the specific target. Here, he/she must use the knowledge acquired within the training mode of the application.
The entire application is set within a game scenario and should offer the users the capability to train repeatedly at lower cost than real life fire tests. Combined with the real life fire tests this application enriches the user experience and expertise within the area of anti-aircraft missile operation. The immersiveness offered through both graphical and algorithm design guarantees excellent transfer from the game frame to the real life frame for the typical user of anti-aircraft missile technology.

***Keywords:** defense, missile, air, radar, rocket, elearning*

I. CHAPTER I

Air defense systems have been used to maintain air authority over a given airspace.

With the advancements of technology both the radars and the guns/missiles became more and more efficient. Radars on one hand started to have longer range and lower surface detection threshold while the guns/missiles had their range increased together with the accuracy.

Most of the advancements were performed during the Cold War when both USA and USSR developed many air defense systems. Developments of transistors and, later, of integrated circuits and microprocessors offered the possibility to increase the performance of radars and computers, opening new possibilities for worldwide air defense systems.

At the same time, a number of great advancements were done in the field of missiles. Amongst these we can mention the development of solid rocket motors, liquid rocket motors, new alloys, increasing manufacturing precision through the use of automatic machines, command and control systems as well as warhead improvement.

Due to the strategic conditions, the USSR designed and developed a large number of air defense systems amongst which we mention: SA-4 Ganef (Fig.1), SA-19/SA-N-11 Grison (Fig.2), S-75 Volhov (Fig. 3).

Figure 1. SA-4 Ganef

Figure 2. SA-19/SA-N-11 Grison

Figure 3. Volhov missile system

The S-75 Volhov system was the most widely deployed system covering countries from 4 continents. This system is a high altitude, command guided systems intended to combat aerial targets flying at high altitudes and with high speeds. It scored the first destruction of an enemy aircraft by a SAM, shooting down a Taiwanese Martin RB-57D Canberra over China, on October 7, 1959 by hitting it with three V-750 (1D) missiles at an altitude of 20 km (65,600 ft).

Many of the countries that acquired the S-75 air defense system were integrated in various training programs that included firing exercises both in the country as well as in dedicated fields within USSR. This training involve great expenses besides the cost of the system itself but they were necessary because otherwise the efficiency of the system would be very low. This was observed especially during Vietnam War when Vietnamese operators were not able to shot down a plane even with 6 missiles fired upon that specific plane. In contrast with this, a well trained soviet operator could bring down the plane with no more than 3 missiles fired; in some cases even 1 missile was sufficient given that the operator was well trained. The decision of when to fire the missile, how to fire it, what guidance program to use, what fuse mode to use and other details were usually learned in a crush program that was more or less efficient depending on the capacity of the operators to learn under a fast pace.

Nowadays, computer technology and elearning opens up a new capability to create “serious games” intended to train a specific person for specific skills that he/she has to perform within work environment. Our paper presents a serious game application developed to train operators of air defense systems. We choose S-75 as an example due to its wide availability in the world. However the application can be personalized for any other type of air defence system.

II. CHAPTER II

The Volhov serious game application was developed using Flash technology that can run under a browser on a computer with minimum 2 GHz processor, 1 Gb RAM and 1 Gb free hard disk.

The Volhov project was made with Adobe Flash CS5 for its ease of implementation of graphical aspects. The simulation is separated into different types of modules that work independently and one module that correlates the actions of the user with the simulation. For example, the user interface (starting menu and the panels) is managed by one module which sends notifications to the control module when something needs to be updated. Due to simulation considerations, the radars, enemy planes and missiles are also different modules thus providing a behavior close to the real missile system since the missiles’ (and enemy targets) only goal is to reach their target and the radars’ only goal is detecting an enemy threat (if the user manages to switch on the radars) and forwarding the information to the main panel monitoring equipment for altitude, distance from base and velocity. Of course, if the generator is switched off, the panels become inoperable, but do keep track of button presses so when the generator is switched on, the changes are displayed accordingly.

All of this is then correlated with the graphical user interface which uses vector drawings and a minor 3D effect when switching from one panel to another. So for instance, if you launched a missile towards an enemy plane and you decide to view the missile at any stage in its flight, the “outside view” module will be updated regarding the status of the simulation within a minor time interval (so for example if you launch the missile, you will be able to see the launch even if you where 5-6 seconds later in clicking the “outside view” button, you will also be able to see missile hits/misses).

The application was structured in two modes:

- Training
- Firing exercise

In training mode the operator is shown tooltips with relevant information on what to do next and why it should do it. Basically in this mode the operator familiarizes himself/herself with the buttons and panels of the real system. All the panels and buttons were built using high-resolution photos of the real equipments embedding them in a easy to use graphical interface. In the training mode the operator is presented with several types of targets (3 types) and for each type he/she is taught how to combat that specific type and what configuration to setup on the panels in order to maximize the chances to combat that target.

Figure 4. Simulator modes

In the firing exercise the operator is randomly presented a target and he/she should perform all the needed tasks without receiving any assistance from the computer. In this mode, the operator proves what he/she learned in the training mode. Depending on the type of target (high/low altitude, high/low speed) the operator has a certain amount of time within which has to complete all the configurations on the panels and fire 1/2/3 missiles against the target.

Figure 5. Command and control radar

The time limitation is yet another realistic feature of the application since it adds the time factor which is very important in a real situation. In other words, even if the operator performs all the configurations needed for a specific target, he/she must also perform the configuration within a limited time. If he/she goes over the time then game is lost because the target reached the air defense location before it was destroyed. In reality, this is equal with the destruction of the air defense base or of mission objective that the target might have had.

Two of the most important parameters for serious game applications are the following [1], [2], [3]:

1.) Validated content

The content is very important and the models on which the content is based should be as realistic as possible. In order to let people experience causal relations in concept testing it is of crucial importance to develop, validate and combine models that define the behavior of the action-response patterns of the simulated world. Some examples of various categories are models of the physical, cognitive and group behavior of virtual characters, public governance models, dispersion models of chemical and biological warfare agents, models of the explosion sensitivity of built constructions, and models of interdependencies within the critical vital infrastructure, etc. The content is also intended to be validated in a greater detail through collaboration with Technical Military Academy from Bucharest, Romania.

2.) Intuitive while realistic interfaces [4], [5]

As with any other computer applications, an intuitive interface is needed in order to gain maximum knowledge from the content presented. More than being intuitive, the interface should be as realistic as possible and provide the user, especially in the training mode, as many indications as possible. However, the interfaces should be kept as realistic as possible; otherwise the danger is that the trainee might not recognize the specific equipment in reality. In other words, the interface should give the trainee the possibility to immediately recognize the components of the real device.

Future plans for developing this application include an extension of the interface toward 3D as well as a closer to reality resemblance of all graphical components. An extension of algorithm behind the guidance of missiles is considered in order to offer more realistic ballistic characteristics.

All of these improvements would create an increased immersiveness as well as a better training performance for the operator.

III. LUSIONS

Through the use of computers, realistic training applications for air defense systems can be developed. The costs of training are reduced because the operators need less actual firing hours at the firing range this providing an increased efficiency of the training process.

If in reality an error means a lost missile, on the computer this can be repaired by just resetting the application. The operator can repeat the firing many times over and automatic reflexes are trained. For an air defense operator, having automatic reflexes is a must. During a real firing exercise or during the real combat there is no time to “think it over”; you must act and the act should be automatic. If the automatism is not correctly trained then this might be the difference between loosing or winning a battle.

Acknowledgements

The authors thanks Ionel Fertu for providing some details of the system and INSOFT Development and Consulting for providing the technical capabilities to produce the demo application as well as graphical components.

The authors also thanks to Technical Military Academy from Bucharest, Romania for the overview and feedback they provided regarding the anti-aircraft missile simulator.

References

[1] Peter J. Werkhoven, Jan B. F. Van Erp, “Serious gaming requires serious interfaces”- http://hmi.ewi.utwente.nl/brainplay07_files/werkhoven.pdf

[2] Millán, J. del R., Renkens, F., Mourino, J. & Gerstner, W. (2004). Noninvasive brain-actuated control of a mobile robot by human EEG. IEEE Trans Biomed Eng., 51(6), 1026-1033
[3] Friedman D. Leeb R., Guger C., Steed A., Pfurtscheller G., Slater M. (2007). Navigating Virtual Reality by thought: What is it like? Presence Vol. 16, No. 1, pp. 100-110.
[4] Taylor, D., Huiskamp, W., Kvernsveen, K. & Wood C. (2006). Preliminary Analysis of Tactical Data Link
[5] Representation in Extended Air Defense Simulation Federations. Proceedings of Simulation Interoperability Workshop SIW, Huntsville, USA.