Aircraft Recognition Training Simulator using Virtual Reality

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***Abstract*—Visual aircraft recognition (VACR) is a visual skill taught to military personnel to recognize the external appearance of the aircraft, both friendly and hostile, most likely to be encountered. It is important for air defense and military intelligence gathering. In training, many media are used such as scale models, printed silhouette charts, slide projectors, and computer-aided instruction. However, none of the above media allows practitioners to experience real environment-liked such as visibility on rainy days, cloudy days, nighttime and the actual flight characteristics of aircraft. This paper proposed a simulation system based on virtual reality for VACR training that allows training practitioners in realistic virtual environments and able to evaluate the effectiveness of the training. The system consists of the various types of aircraft models, AI modules for weather simulation and flight patterns according to the characteristics of each type of aircraft, terrain modeling, and the evaluating system.**

***Index Terms*—**

I. Introduction

Aircraft recognition plays a very important role on the battlefield. Identifying 'friendly and hostile' is the foundation of an air war dating back to World War I. The identifying of aircraft is, therefore, a skill of military personnel to visually distinguish the enemy aircraft. This skill is important for air defense and military intelligence gathering.

Visual aircraft recognition (VACR) training uses various observation skills to identify aircraft in the distance [1]–[3]. In Thailand, VACR skills are still necessary which military personnel is trained regularly. Lack of these skills can cause hesitation, errors, and delays in identifying the aircraft. In wartime, the mistake could cause fratricide (the engagement and shooting down of friendly aircraft). Therefore, VACR is a basic skill that every Soldier should know.

In the training of VACR, the practitioners have to memorize the characteristics of various aircraft. For example, the MIG-21 (operates in Vietnam and Laos), the wing is a Delta shape in mid-mounted position and has a single combustion engine. When identifying an aircraft, first the distinctive features of the aircraft seen must be extracted such as the number of engines, characteristics of the wings and tail(s), flight pattern and so on. Then eliminates aircraft that do not match those features. However, this method is suitable for beginners that may take too much time. Identifying aircraft requires expertise that is well trained. However, practicing such skill from scale models, printed silhouette charts, slide projectors, and computer-aided instruction does not allow the practitioner to experience the real environment such as visibility on rainy days, cloudy day, a direction of the sun, night vision, and real flight characteristics of aircraft.

This paper presented a simulation system for VARC that allows practitioners to experience in a virtual environment. The system consists of various aircraft models that operated in Thailand and the surrounding countries. Artificial intelligence module to simulate different weather conditions and flight patterns according to the characteristics of each aircraft, terrain simulation, and training evaluation system.

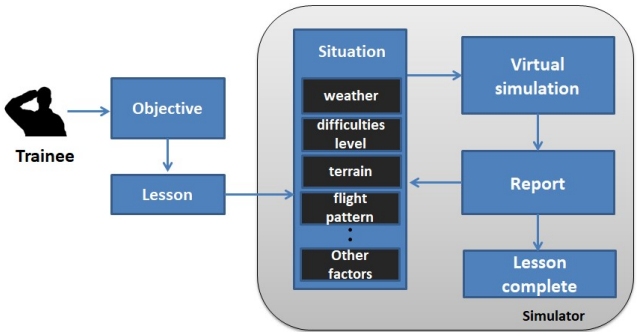

Fig. 1. System overview of aircraft recognition training simulator

II. Proposed Methodology

A. System Design

The conceptual framework of VARC training system for simulates realistic scenarios is shown in Fig. 1. The two main parts are the lessons and the real event simulation system. The first part or part of the lesson is to teach the participants to learn about aircraft in various models according to the WEFT theory (abbreviated from Wing Engine Body Tail). WEFT is an aircraft identification technique that has been accepted. WEFT theory is used by the US Army (Army, US 2006). WEFT theory suggests the characteristics of aircraft that are similar to other aircraft and the unique features of that aircraft.

The second part is the simulation of the real environment; the difficulty level adjusts the weather condition, terrain and flight patterns. In addition, there may be other factors involved such as the direction of the sun. In the simulator, trainees will

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repeat the training until they reached a benchmark requirement. In summary, the modules in second part are shown in the following:

1) Simulation according to the lesson.
2) Various variables by factors affecting detection and identification of aircraft.
3) Assessment of the simulation.
4) Situation adjustment; according to the value obtained from the result.

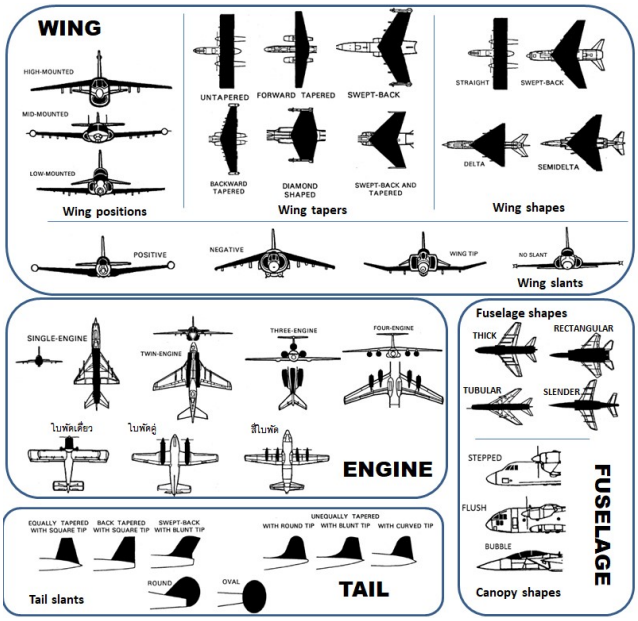

Fig. 2. Example of a recognition chart following the WEFT technique.

Fig. 3. The aircraft models used in our VACR system.

B. Difficulty Level

1) Wing Engine Fuselage Tail (WEFT): WEFT is a widely-used recognition technique for identifying an aircraft. The hints to recall the type of each aircraft are the unique characters such as its wings, engine, body, and tail. The WEFT recognition technique was used in USA Army from 2006 [4] and some parts of its learning material was shown in Fig. 2.

Fig. 4. The difficult level will raised under the changed weather and terrain.

2) Difficulty Parameters: It will be getting harder for identifying the aircraft under the bad weather like raining, snowing, cloudy. Obviously the aircraft recognition performance is related to the weather. Beside the weather, the parameters of difficulty levels are related to physical appearance like aircraft size and the viewing angle, the terrain while an aircraft is flying, obscured objects, and the additional weapon/missile/fuel-tank attached aircraft.

Aircraft size is related to the observation distance. The large aircraft will be recognized in the farther distance than that of the small aircraft. Side view is the best observation for WEFT. An influence of terrain will be matter when the similar texture/color of aircraft, and concluding that the difference between the aircraft color and the terrain is one influence.

In this system, the function of the custom skill levels will be implemented and integrated in order to enhance the learning performance fitting with novices to expertise. This can be done by adding AI module for classifying the skill levels when training/practicing. Not only the learning performance but also the recognition accuracy must be maximized to avoid the mistaken recognition.

III. Conclusions

This paper proposed a simulation system based on virtual reality for VACR training that allows training practitioners in realistic virtual environments and able to evaluate the effectiveness of the training. The system consists of the various types of aircraft models, AI modules for weather simulation and flight patterns according to the characteristics of each type of aircraft, terrain modeling, and the evaluating system.

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