

# VBS2 Scenarios Development for PSI Purposes

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*Abstract:* - This article presents a research focused on the Virtual Battlespace 2 scenarios development for private security industry (PSI) purposes. In the first part, the VBS2 scenario creation options are described. In the second part, a description of the scenario representing the most common workload of employees of PSI can be found. In the last part, the process of developing this scenario in 2D and 3D editor is described; especially adding entities which are essential for the simulation, and object preparation and modification.

*Key-Words:* - Burglary, Private security forces, Private security industry, Scenario development, Training simulation, Virtual Battlespace 2.

## 1 Introduction

One of the main advantages of simulators is the possibility of training life-threatening while no life, health or property is at risk, what is the reason why are training simulators broadly used in the training of security forces – army, police and private security services (PSS). [1] Nowadays, especially due to escalation of the risk of terrorist attacks, there is an increasing need of a perfectly skilled security forces. The private security industry plays an important role in the protection of life, health and property and there is a growing need of improving their skills. This research focuses on the scenarios development use of the virtual simulator Virtual Battlespace 2 (VBS2) in private security industry (PSI).

## 2 VBS2 Scenario Creation Options [2]

The possibility of a simulation in VBS2 is at a very high level. For the PSI purposes, only a part of a wide variety of different VBS2 options need to be used.

### 2.1 VBS2 Structure

A VBS2 structure has many similarities with classical modern computer games; however, it was developed primarily for educational purposes.

Compared to conventional games, most parts of the simulator are very easily modifiable. Basic environment consists of map data, which can be modified using a text file (programming), which in essence describe whole system from the

appearance and behavior of a complete user interface to the sound effects and the AI behavior. The terrain and 3D buildings are in a retrieval system loaded gradually at runtime and provide highly realistic models of the desired environment.

### 2.2 Virtual Environment

VBS2 uses a kernel that is able to provide high quality and complex terrain with emphasis on the fidelity virtual environment.

The main parts of the simulated environment:

- Weather conditions that affect the natural phenomena.
- Surfaces with real physical properties (grass, fields, roads).
- Appropriate background music in different locations.
- Shadows (all objects have their own shadows according to the current lighting).
- 24 hour format (alternating days and nights).
- The dynamic range of lighting effects (in the transition between dark and illuminated spaces).
- Fauna and flora specific to the climatic belt.

VBS2 contains a very large and variable simulation environment that can be changed (set) in response to the requirements of the simulation. Typical examples are the explosions that have left craters or damaged

fencing after the car collision. Also, some models of buildings can be destructed and new holes in the walls can be done after vehicle collisions.

### 2.3 Controlling Entities

VBS2 is first person simulator, participant of the simulation sees through his avatars eyes. The vehicles have a limited range per tank, so it is usually advisable to check fuel level before driving. The vehicles can be controlled by participants of simulation or AI drivers; also, the crew can be both AI and participants. So, entities (controlled both AI and participants) can not only control themselves and their moves (even special moves like jumping, crouching, climbing, crawling, swimming, etc.) but even a lot of vehicles like cars, vans, tanks and planes.

Units can do a lot of moves, including:

- Walking and running.
- Moving to the sides.
- Hitting the sack and crawling.
- Using items such as guns, grenades, telescopes, compasses, radios.
- Placing and detonating explosives.
- Breaking windows and doors.
- Pulling injured allies or transported them on stretchers.
- Carrying objects and loading them into vehicles.
- Laying barbed wire and traffic cones.

### 2.4 Physics

VBS2 uses its own engine with closed source, which includes ballistics, vehicles effects and various particle effects. Another part of the physical processes and effects (i.e. the change of controlling vehicle towing a trailer or another vehicle, etc.) is implemented using software support PhysX from Nvidia.

### 2.5 AI – Artificial Intelligence

The possibilities of artificial intelligence and its settings are really extensive in this simulator. In the default setting, AI follows its own algorithms, which are specific for each type of entity. AI is based on the real-time engine, which includes an A\* algorithm. This algorithm focuses on the AI motion control and decision making according to the terrain, obstacles, positions of other entities, etc.

A simulation of an AI unit's behavior can be called semi-automatic, the unit accomplishes its goals (e.g.

movement) following waypoints, which are placed on the map by simulation creator. Between two waypoints, the unit move is controlled by AI itself. Additional parameters, which can be set to the waypoints, can determine the combat situation (safe, danger, etc.), its movement speed and formations of an entity groups. Waypoints can be linked to each other or to trigger. The trigger allows us to set conditions by using scripting commands, when the condition is fulfilled, another (chosen) action will happen.

AI, compared to the previous version of VBS, has undergone major changes regarding to the use of the terrain during navigation. Moreover, it uses stealthy movement or covers during its movement.

### 2.6 Editor

Editor contains libraries of all units, which are available in VBS2. Units are divided into groups for easy orientation.

In VBS2, two types of editors can be used – 2D editor and 3D editor. 2D editor is usually used in the creation of the basic structures, especially for putting units, buildings and their settings. 3D editor is suitable for horizontal and vertical positioning of objects.

## 3 Description of the Scenario

In this chapter, the details of the scenario chosen for developing in Virtual Battlespace 2 are described. All necessary information is provided including security guard duties, scenario introduction and approach for handling the situation.

### 3.1 Security Guard Duties

The unit in this scenario is composed of two guards equipped with a gun, flashlight and compass. This unit is dressed in a characteristic uniform. For controlling alarms on the secured objects, the operation group uses car Toyota Land Cruiser, which is equipped with GPS navigation.

#### Duties

- Random object inspection from 6 p.m. to 6 a.m., which involves the movement in the object and checking off the lighting.
- If the alarm is signalized, the security guard goes by car to the object to inspect it.

## Principles of inspection

- Checking a condition of a protection of the shell (closed and locked windows, doors, etc.).
- Checking a condition of a perimeter protection, especially integrity of the fence.
- Checking the situation in the surroundings of the object (people, vehicles, etc.).
- In the event that the alarm was triggered in the interior of the building guards enter the building through the front door using general key.

### 3.2 Scenario Introduction

On Sunday at 8 p.m., the operator gets alarm report from building 15, which is guarded by this company. The operator sends the unit to inspect the situation in the object and determines, if the alarm is false or the object is really disrupted. The unit gets in the car and goes to the location of the object. The object is circa 1500 meters far and a car ride takes about 10 minutes.

### 3.3 Handling the Situation

At this time, the traffic is low. The weather is fine, visibility is high. The unit arrives at the house and stops the car in a safe place at a distance of about 20 meters from the object.

Firstly, the cursory inspection (basic overview) is made by group from a vehicle. The crew communicates with the operator and reports the status of the situation in the surroundings. Then, the front passenger exits the vehicle while the driver stays in the car and keeps observing the object and communicating with the operator. The passenger starts moving towards the object and observes the shell and perimeter protection. He inspects the windows and a truck with a tank, which is parked in front of the building.

After inspecting this part of object and reporting situation to driver, he is moving to the corner, behind which the gate is situated. After checking the situation behind the corner, he starts inspecting cars, which are parked near gate. Suddenly, he can hear voices from the internal part of the object. He draws his weapon for self-defence and reports the situation to the driver, who communicates with operator, who calls police. Front passenger silently spies the situation and tries to find out maximum information about intruders. He finds out, that they are at least two; the first is guarding the gate, second is moving

in the house. Probably, they are not armed and their robbing skill is not high a lot.

Suddenly, the guarding robber in the gate spots the security guard and shouts at the second robber. Both start escaping the object using side entrance. The driver watches intruders getting into a car and driving away from the place and reports this situation both the operator and his colleague. Security guard carefully keeps going through the object and discovers damages. Unit remains in place until the police arrives and then reports all events.

## 4 Developing the Scenario in VBS 2

This chapter deals with developing the scenario in Virtual Battlespace 2, both in 2D and 3D scenario editor. It describes whole process including choosing map and buildings and its editing both esthetical and functional. Also, it discusses the entities used for simulation and triggers, which allows improving the fidelity of the scenario.

### 4.1 Landscape

For the scenario described in previous chapter of this paper, the As Samawah landscape (map) was chosen, because of its flat terrain and buildings, which resembling industrial zone. Also, the environment is quite similar to the environment of Czech Republic.

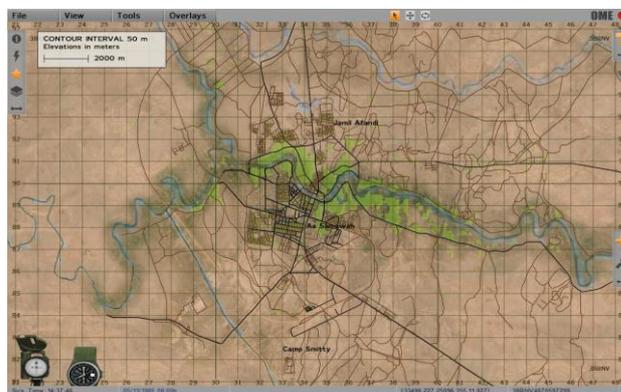


Fig. 1 – Landscape As Samawah.

### 4.2 Object

For the simulation, the most common object was chosen. This type of objects is very often guarded by private security forces. It is an area of 3000 square meters with 280 meters of perimeter. It consists of two buildings, which are about 30 meters apart. There is a gate as a main entrance and there are also door, which can be used as a side entrance. There is a concrete perimeter fence about 2 meters high.

The first building (B1) represents a store building with store in the ground floor and the offices in the first floor. This building has a flat roof accessible with a ladder. In front of the B1 building, there is enough place for parking cars and the truck.



Fig. 2 – Object in 3D perspective.

The second building (B2) is situated in the corner of the object. This building represents a store accessible only from the road.

**4.3 Modifications of Object**

The modifications of objects are made for two purposes – aesthetic and functional. The first purpose improves the fidelity of the simulation and helps to cover potential design problems. The functional purpose serves primary to repair problems found during testing the simulation. One of these problems was found in this scenario and it is described in the text below.

**4.1.1 Esthetical Modifications**

The most important esthetical modification is the road, which was created from the main road to the gate. This road was created from the 20 pieces of Asphalt – 3 objects, which are integrated in the editor and on this road, two stop signs were placed.

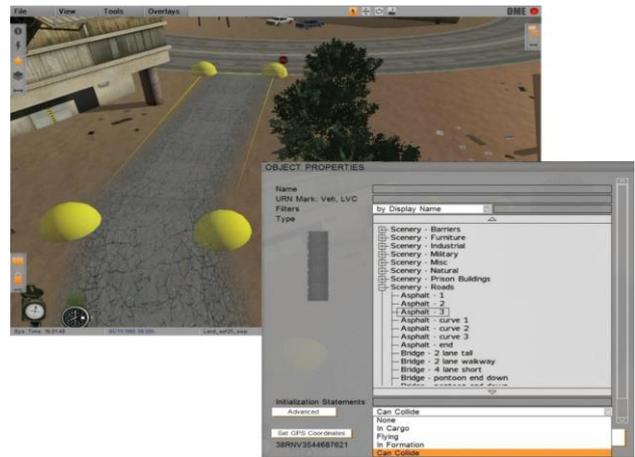


Fig. 3 – Esthetical Modifications - road.

The surrounding of the road was mounted with the vegetation (Clutter\_grass\_general) of 3 pieces.

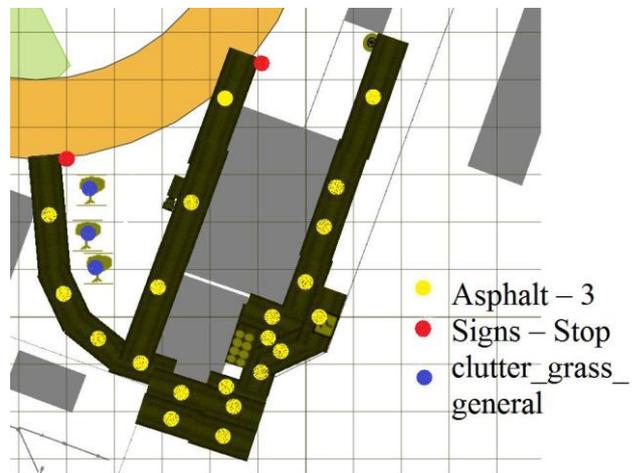


Fig. 4 – Object in 2D perspective.

The other modifications were made by placing smaller objects into the map. These objects can be found in the figure 5 and are used primary for improving the appearance of the landscape and fidelity of the simulation.

Previously empty space was filled with the models of the common items, which can be found in this type of objects. Now, the simulation looks much real.

| Used Models                |
|----------------------------|
| Pick-Up (red)              |
| Barrels                    |
| FuelTank                   |
| Tire                       |
| Dog House                  |
| Dead dog 3                 |
| Carbagecontainer – glass   |
| Carbagecontainer–plastic   |
| Carbagecontainer–paper     |
| Carbage pile – pallet      |
| 20ft ISO Container–Defecta |
| Freight – fragile box      |
| M872 Flatbed Trailer       |
| Shop 5 double              |
| Phoneboot 2                |

Tab. 3 – Models for esthetical modification.

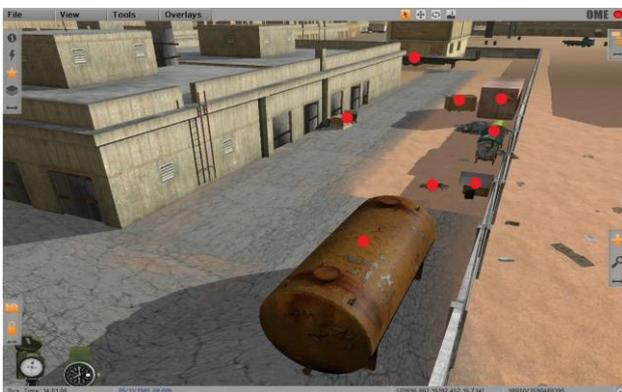


Fig. 5 – Esthetical modifications - courtyard.

**4.1.2 Functional Modifications**

Since the VBS2 contains really huge map sources with a huge collection of map details and information, once a time, the problem in functionality can be found. Most these problems are caused by AI, which acts the unwanted way. In this simulation scenario, the AI were able to move through the fence near the main road, and it chose this option rather than going through the building (B1). To force AI to go through building, the additional fence was made. This fence helped the AI to choose the right way, because it could not go through the fence. For this modification, the suitable models were chosen to keep the appearance consistent. These models can be found in Table 2.

| Model name  | Description               |
|-------------|---------------------------|
| Hut_old02d2 | 2 meters barrier          |
| Hut_old02d1 | 1 meter barrier           |
| Fen_01d3    | 3 meters chain-link fence |

Tab. 2 – Models for functional modification.



Fig. 6 – Object modifications in 2D perspective.

Another problem was during the ride of the participant of the simulation and AI driver, when the AI once a time crashed one of the houses near the road. This was repaired by using more waypoints for facilitation the navigation of the AI.

**4.1.3 Entities**

In whole simulation, eight AI entities and one playable entity were used. If the simulation were focused on the training of the two participants, the driver would be set to playable state too. Also, in case of need, all the rest of the entities can be set to playable state. This is usually used for maintaining advanced behaviour of the intruders by taking control of this unit by operator of the simulation.



Fig. 7 – Entities in scenario.

| Unit | Description                           |
|------|---------------------------------------|
| X1   | PSI employee (simulation participant) |
| AI1  | PSI employee (driver)                 |
| AI2  | policeman                             |
| AI3  | policeman                             |
| AI4  | civilian (pick-up driver)             |
| AI5  | civilian (off-road driver)            |
| AI6  | civilian (Ural driver)                |
| AI7  | intruder                              |
| AI8  | intruder                              |

Tab. 3 – Models for functional modification.

| Unit | Group    | Playability  | Unit         |
|------|----------|--------------|--------------|
| X1   | BLUEFOR  | Player       | Guard        |
| AI1  | BLUEFOR  | AI           | Guard        |
| AI2  | Civilian | AI           | Policeman    |
| AI3  | Civilian | AI           | Policeman    |
| AI4  | ALL      | Non Playable | Pick-Up      |
| AI5  | ALL      | Non Playable | Offroad      |
| AI6  | ALL      | Non Playable | Ural (civil) |
| AI7  | OPFOR    | AI           | Civilian 02  |
| AI8  | OPFOR    | AI           | Anchroman    |

Tab. 4 – Models for functional modification.

### Units X1 and AI1

These units represent the private security guards, which are at the beginning of the simulation placed in their base about 1.5 kilometers far from the object.

The behaviour of the AI1 is set through the waypoints; the participant of the simulation behaves according to his best knowledge and belief in accordance with the relevant procedures for managing the situation.

### X1 and AI1 Waypoints

AI1 gets in a car, which is parked near the base as a driver and waits until X1 gets in a car as a front-passenger. Then, AI1 follows the first waypoint. During this way, the unit activates the first trigger, which activates unit AI5 and AI6. During following the next waypoints, AI1 and X1 meets AI5 and later AI6. This action represents the traffic on the road and serves to improve the fidelity of the simulation.

A larger number of waypoints were placed on the road; when reducing the number of waypoints units collide and have problems with navigation.

The last waypoint is placed circa 20 meters far from the object. From this time, only X1 (participant) is moving, AI1 stays in the vehicle and no more waypoints are needed.

### Units AI7 and AI8

The initial position of these units is in the object. AI7 simulates the burglary attempt (in real stays on one place) while the AI8 is guarding the gate and moving in triangle.

### AI7 and AI8 Waypoints

The AI8 has its own 3 waypoints, which allows her to move in cycle in a triangle. After trigger, the waypoints of the two units are merged, because they are programmed as a group. Their waypoints lead to the car and when both get into it they follow the last waypoint placed out of the town.

### Units AI2 and AI3

These units representing policemen are merged into one group and are placed about 2 kilometers far from the object. Their move is activated by trigger, which is triggered by the X1. After trigger activation, both units get into the car and moves through waypoints to the object, where they meet AI1 and X1. In this phase, the simulation is over.

### Units AI4, AI5 and AI6

As was mentioned above, these units improve fidelity of the simulation. They represent the traffic on the street (civil Ural and off-road). The waypoints are placed for the minimization of the probability of collisions and the beginning of the movement to the first waypoint is started by trigger.

#### 4.1.4 Triggers

There are two triggers in the simulation. The first is placed in the middle of the way of the units X1 and AI1, the second is placed near the truck in the corner of the B1 building.

Trigger T1 serves as an activator of the AI7 and AI8 movement, which represent traffic in this scenario.

Trigger T2 activates movement of AI7 and AI8 (intruders), so they get out of the object by car. Also, the T2 trigger serves as a police call.

| Name              | T1     | T2       |
|-------------------|--------|----------|
| Text              | p2MOVE | (p2MOVE) |
| Size (Left-Right) | 10     | 10       |
| Size (Up-Down)    | 10     | 20       |
| Activation        | BLUFOR | BLUFOR   |
| Type              | Switch | Switch   |

Tab. 5 – T1 and T2 triggers settings.

| Trigger 1 |  |
|-----------|--|
| Unit      | Description                              |
| X1        | Activates trigger                        |
| AI1       | Activates trigger                        |
| AI5       | Is activated (starts moving to waypoint) |
| AI6       | Is activated (starts moving to waypoint) |
| Trigger 2 |  |
| Unit      | Description                              |
| X1        | Activates trigger                        |
| AI2       | Is activated (starts moving to waypoint) |
| AI3       | Is activated (starts moving to waypoint) |
| AI7       | Is activated (escapes place)             |
| AI8       | Is activated (escapes place)             |

Tab. 6 –Functions of triggers.

## 5 Conclusion

In the first part of this paper, the VBS2 scenario creation options were described. A description of the scenario was successfully presented in the second part of this paper. The third part described the development process of this scenario in 2D and 3D in detail; especially object preparation and modification, and adding entities which are essential for the simulation.

This research shows the process of transformation the scenario paper to virtual simulator scenario. Moreover, the research proves the suitability of the VBS2 simulator for the training of the employees of the private security industry; however it is primarily designed for army.

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