A Knowledge-Based Generator for After Action Review Interactive Documents

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Abstract
The aim of the PPTS project (Pedagogical Platoon Training System) is to design and implement an evaluation environment for strategic and tactical skills, coupled with a network of full-scale simulators. PPTS on-line evaluates the simulation exercise while running. At the end, PPTS off-line generates the AAR interactive report. One of the major assets of PPTS is to point out expert knowledge supported assessment results. The interactive After Action Review report comprises markers based on the expertise of the domain. Assessment graphic objects represent in a similar way sporadic evaluations and distant dependences.

INTRODUCTION

For many years, crew simulators have been used in civilian and military contexts for training purposes. In the industrial context, many simulation-based training systems incorporate intelligent tutoring systems in order to improve user-related functionalities (Gecsei and Frasson 1994; Richard and Gouardères 1999; Stottler and Jensen 2002). The PPTS project (Pedagogical Platoon Training System) is a joint project between the LIP6, the LIRMM and Thales Training & Simulation. It covers the design and the implementation of an evaluation environment for strategic and tactical skills within the framework of a LECLERC platoon simulator (Joab et al 2002). PPTS takes advantage of the evaluation component to generate After Action Review interactive documents to be used by the instructor. PPTS is composed of both on-line and off-line software components. The on-line component is in charge of evaluating the simulation exercise while running. At the end of the exercise, the off-line component generates the After Action Review interactive documents to be used during the After Action Review (AAR) phase. Section 2 describes tank platoon training using simulators, presents the instructor needs while preparing and carrying on AAR and focuses on our approach. Section 3 describes the architecture of PPTS on-line following the three considered levels of skills. PPTS off-line is presented through sections 4, 5 and 6. Section 4 presents the design of the interactive AAR report design, section 5 the user interface and section 6 its implementation. Section 7 provides conclusions and perspectives.

AAR AND TANK PLATOON TRAINING

A LECLERC platoon is composed of four LECLERC tanks. The platoon trains using four networked Leclerc tank crew simulators communicating via the DIS (Distributed Interactive Simulation) standard and exchanging data under the form of PDUs (Protocol Data Units) on an Ethernet network. Four instructors are in charge of the four tank crew simulators. An exercise takes place in *three phases*. During the *briefing*, the platoon leader is informed about his mission and its context. During the *exercise run*, the platoon tries to achieve his mission. During the *AAR*, the instructors comment on how the exercise progressed and provide feedback on both crew individual and collective behaviours. The assessed skills are of *three kinds*. Each instructor estimates the *technical* skills of the crew he is supervising. The chief instructor pays special attention to the *tactical* behaviour of the platoon. At the end of the exercise, he estimates the *strategic* choices which led either to a successful or to a failed mission.

The simulation environment currently supplies too much information and incomplete information. During the rapid phases of the exercise, the instructors are continuously in demand and cannot simultaneously make use of all available inputs.
They take some notes in mid air and capture a few screenshots. Some outstanding events may then go unnoticed. Furthermore, existing simulation does not allow a detailed situation analysis, certain events remain unknown. The AAR generally follows the progress of the exercise: the instructor finds his way through the phases of the original scenario and focuses on some particular situations, but his criticisms are not supported enough to make the trainees adhere. The presentation of well-argued criticisms would allow to propose thoroughly studied conclusions taking into account instructors' evaluation criteria and illustrating various points of view.

From our observations of training exercises on simulators (led in the Training Centre of Saumur), we determined how to enrich the existing Instructor Operating Station (IOS). We studied and developed a first application (Joab et al 2002) which provides *technical* clarifications on the following issues: firing, observation, formation and movement. The assessment of *tactical* and *strategic* skills is implemented using a knowledge-based approach. Beyond the collection of expertise and modelling, a Knowledge-Based System (KBS) was developped.

But producing assessment results as exercise progresses is not enough for preparing the synthesis of the AAR: justifying the evaluations by linking them together with the present or past events or situations is necessary, and the produced evaluations must be sorted out using the instructors' criteria. To answer these needs, we suggest generating an interactive AAR report offering a synthetic view of how the exercise progressed as well as navigation means based on the expertise of the domain, while preserving the temporal navigation that gives all its sense to the simulation exercise.

PRESENTING PPTS ON-LINE

The general architecture of PPTS on-line comprises three levels, thus following instructors' assessment approach. The *Monitors* constitute the first level, the one of the *technical skills*.
The Monitors operate practically in real-time. When an interesting state is detected, the Monitor immediately points it out to the instructor and generates a set of facts in a working

memory made available to the Analysts. The Monitors have been implemented in the *ALARME* software (Joab et al 2002). The *Analysts* constitute the second level of the evaluation, the one of the *tactical skills*. The knowledge arise from the expertise collected with the instructors. Every Analyst (aggressive behaviour Analyst, protection Analyst, movement Analyst) uses a knowledge base, the base of facts of which is supplied by the Monitors. Figure 1 presents an example of a rule used by the aggressive behaviour Analyst. Some rules assess the level of priority and threat of the enemy according to the kind of enemy, its distance between the platoon, its speed … The Monitors supply intervisibility data, distances, aims, in order to validate the premises calculated from the PDUs. The KBS updates its knowledge base every second when new information occur. In order to deal with the rule in fig.1., the KBS waits for a fire during 20 seconds (a special fact is created for this purpose). When the time is over, the rule activates. To avoid multiple activations of the same rule in closely following contexts, the rule is inhibited for a short time.

The rule conclusions are posted to the instructor during the exercise and backed up in an XML file which is used at the end of the exercise by the AAR interactive report generation module. The XML file records for each activation of a waiting rule, its date, the enemy context, the starting date of the waiting period and the conclusions.

The global evaluation of the mission constitutes the third level of PPTS. This level, which shall assess how the exercise progressed at the strategic level, has not been studied yet. In a similar domain, Marsella and Johnson (1998) use the situation assessment and the decision making capabilities of the synthetic entities to assess the trainee's performance. AETS (Advanced Embedded Training System) has been developed for tactical team training (Zachary et al 1999). AETS processes high level actions from a large amount of data and builds an automated performance assessment and a cognitive diagnosis.

If the platoon is able to aim an enemy
If the enemy does not fire at the platoon
If the enemy has a priority level of 1
If the platoon does not fire at the enemy after 20 s
Then the platoon should have fired at the enemy

Fig.1. An example of a rule used by the aggressive behaviour Analyst

PPTS OFF-LINE : INTERACTIVE AAR REPORT DESIGN

When the instructor prepares the AAR, he has to be able to browse quickly the results of the evaluation, associating these results to their justifications, tracking down the key situations, processing the outstanding events and quickly finding a given situation. The temporal presentation of the information must remain homogeneous.

The temporal navigation

The instructor moves around the exercise and uses a key strip to select the time interval which will be examined. The time unit is the second. A reference interval lasts 6 seconds. Every second corresponds to an inference cycle for the KBS which can produce one or several assessment results. An assessment result contains a conclusion (text), main premises, and when made available a 2D map.

We represent:

- assessment results addressing an event or a situation in the current time interval (fig. 2),

- assessment results addressing several events or situations in the current interval (fig.3),
- assessment results addressing an event or a situation in the current time interval, justified by several past events or situations. (fig. 4).

By analogy with a wading bird, we will designate the legs of the graphic object representing an assessment result. The third type wading bird legs are hyperlinks allowing to switch from one date to another one.

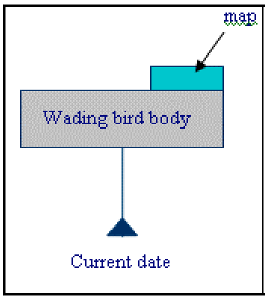

Fig 2.

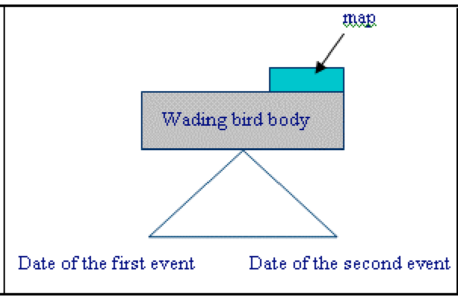

Fig. 3.

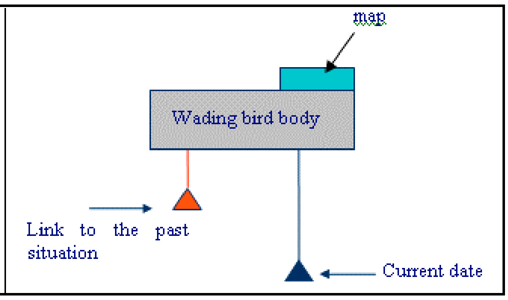

Fig. 4.

The temporal presentation of the information is then homogeneous. The activation of the left leg makes the current time interval a time interval centred on the past situation date.

The view of the domain

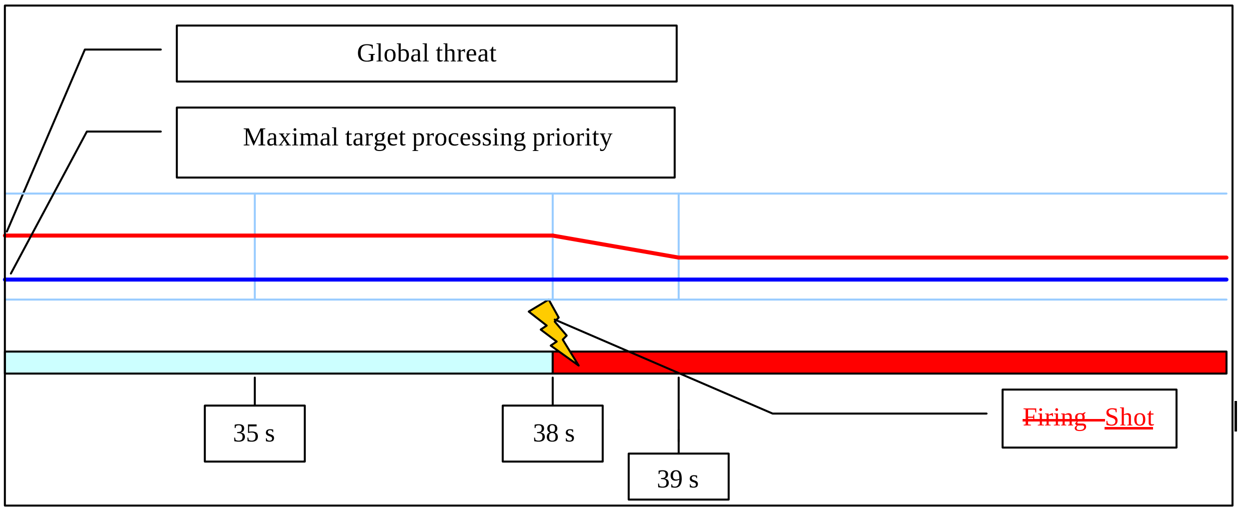

Fig. 5. A synthetic view of an exercise

The expertise of the domain pointed out the importance of detecting the phases (speed, observation, fight…) in an exercise, because the expected platoon behaviour depends on the current phase. To underline the nature of each phase, a colour code has been used (fig. 5). The tactical evaluation relies on the analysis of the enemy context (the ennemy presence, its dangerousness, the target processing priority). Two curves at the bottom of the screen represent the continuous evolution of the global threat (in red) and of the maximal target processing priority (in blue). The instructor then gets a synthetic view of the enemy context and can access a detailed context at every point of both curves. The shots and the adopted formations play an important role in the identification of the key situations. They are represented by means of icons. The instructor accesses the details of a shot through its corresponding icon. The expertise revealed several assessment criteria. If the instructor chooses as an option to point out these criteria, every wading bird associated to an assessment result receives a specific colour. The active wading birds are those that match the selected criteria, the others are inactive. This interface allows to combine the temporal navigation and a thematic evaluation. A similar approach is used to explore visually temporal object databases. A temporal object has at least one temporal property. The point-wise temporal object browser enables to navigate through the time dimension and through object relationships (Daassi et al 2000;Dumas et al 2000).

THE USER INTERFACE

On figure 6, a twoleg wading bird points out an assessment result of the aggressive behaviour of the platoon. At the date 12 min 39, the system concludes: "the platoon should have fired at the enemy n°5 for 6 minutes". Over this conclusion, we note the related justification: "the platoon could have tracked down the enemy. The enemy did not fire at the platoon". The wading bird refers to the date 6 min 39, from which the platoon should have reacted. By activating the left leg, the user jumps to the date 6 min 39: the wading bird passes from one leg to the other one. If we activate the right leg, we return to the figure 6.

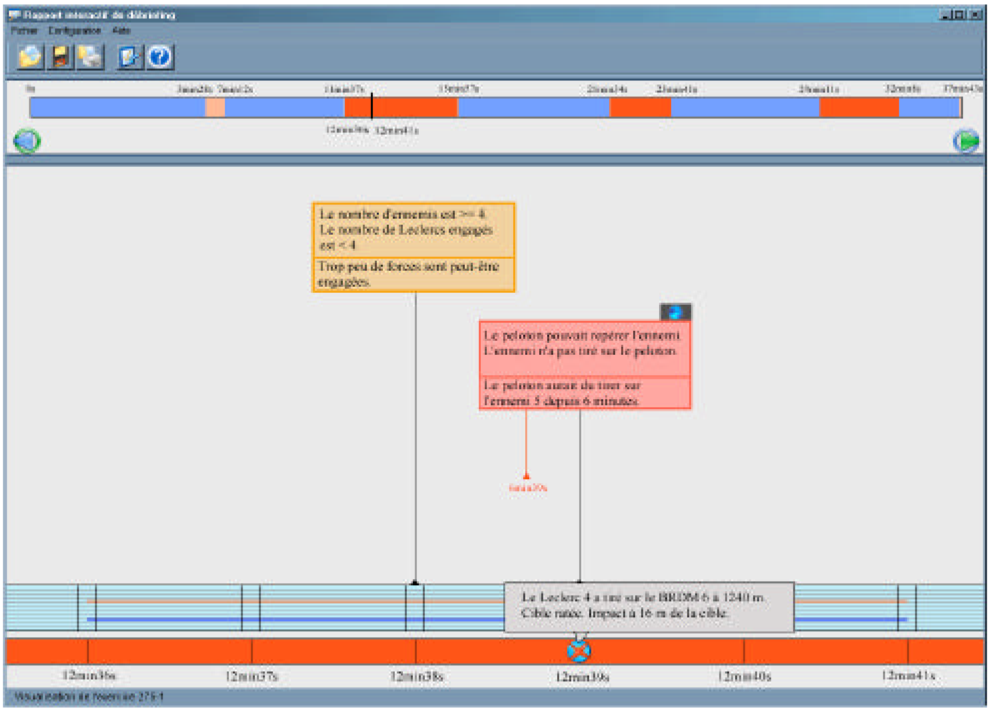

Figure 6 : a two legs wading bird at the date 12 min 39

IMPLEMENTING THE INTERACTIVE AAR REPORT GENERATOR

The interactive AAR report generator software is composed of two Java modules: the Assessment Synthesis module and the User Interface module. The Assessment Synthesis module aims at parsing the data generated by the on-line part of PPTS in an XML file. A DOM parser (the Xerces 2.4.0 parser from the Apache foundation Software) builds a treelike representation of all source tags contained in the XML file. From this treelike representation, stored in RAM, we generate all synthesis elements. When the analysis of the treelike representation ends, the generated objects are serialised.

CONCLUSION AND PERSPECTIVES

The PPTS on-line system has been developed up to the technical (Monitors) and tactical (Analysts) levels. The third level (strategic evaluation) has not been studied yet. At the first level, the Monitors raise all the relevant technical information for the evaluation. At the second level, the analysts produce the XML file resulting from both technical and tactical evaluations. On-line PPTS has been validated by the instructors from the Training Centre of Saumur. With respect to off-line PPTS, the interactive AAR report generator has been implemented. Resulting AAR documents will soon be discussed with the instructors. One of the major assets of PPTS is to point out expert knowledge supported assessment results. We can find this feature in the interactive AAR report. This report comprises markers based on the expertise of the domain. Icons, colour code, curves make sense. Detailed information relating to icons and curves are particularly useful for the AAR. Assessment graphic representation (the wading birds) allows representing in a similar way sporadic evaluations and distant dependences.

Guiding the AAR through the assessment criteria enables the instructor to compare to the behaviour of the platoon during scattered situations. Therefore, further use of the AAR report will allow facilitating the indentification of erroneous and regular behaviours. The design of off-line PPTS is generic. Off-line PPTS could furthermore be disconnected from any domain of expertise. The graphic classes modelling within the user interface module does not refer to the domain.

REFERENCES

DAASSI , C., DUMAS, M., FAUVET, M.-C., NIGAY, L., SCHOLL, P.-C. (2000). Visual exploration of temporal object databases, *BDA 2000*, Blois, France, p. 159-178.

DUMAS, M., DAASSI, C., Fauvet, M.-C., Nigay, L., Scholl , P.-C. (2000). Pointwise temporal object database browsing, *Symposium on Objects and Databases (ECOOP)*, Sophia Antipolis and Cannes, France.

GECSEI, J., FRASSON, C. (1994). SAFARI: an environment for creating tutoring systems in industrial training, *Educational Multimedia and Hypermedia, 1994. Proceedings of ED-MEDIA 94. Assoc. Adv. Comput. Educ, Charlottesville, VA, USA*. p. 15-20.

JOAB, M., AUZENDE, O., FUTTESACK, M., BONNET, B., LE LEYDOUR, P. (2002). Computer Aided Evaluation of Trainee Skills on a Simulator Network, *Intelligent Tutoring Systems 2002, ITS 2002*, Biarritz, France, Springer-Verlag, p. 521-530.

MARSELLA, S.C., JOHNSON, W.L. (1998). An instructor's assistant for team training in dynamic multi agent virtual worlds, *Intelligent Tutoring Systems. 4th International Conference, ITS '98. Proceedings. Springer-Verlag, Berlin, Germany*. p. 464-73.

RICHARD, L., GOUARDERES, G. (1999). An Agent-operated Simulation-based Training System, *Artificial Intelligence in education (AI & ED 99)*, IOS Press, p. 343-351.

STOTTLER, R., JENSEN, R. (2002). Adding an Intelligent Tutoring System to an Existing Training Simulation, *the Industry/Interservice, Training, Simulation & Education Conference (I/ITSEC 2002)*

ZACHARY, W., Cannon Bowers, J., Bilazarian, P., Krecker, D., Lardieri, P., Burns, J. (1999). The advanced embedded training system (AETS): An Intelligent Embedded Tutoring System for tactical team training. International Journal of Artificial Intelligence-in-Education, 10, n° 3-4: 257-277.