1. The ART-SCENE Environment

ART-SCENE supports the systematic generation and walkthrough of scenarios that has been applied to specify 2 major air traffic management systems [1, 2]. Features include: (1) automatic generation of scenarios from use cases, (2) automatic generation of alternative courses, and (3) guided scenario walkthroughs.

Scenarios are generated in text-form for stakeholders to walk through using the web-enabled Scenario Presenter tool shown in Figure 1. Each scenario is in 2 main parts. The left side describes the normal course event sequence for the scenario. Each event describes the start or end of an action, thus enabling a scenario to describe concurrent actions in this text-list form. The right side describes generated alternative courses for each normal course event, presented in the form of 'what-if' questions. Different alternative courses are presented for different normal course events.

For each normal and alternative course event, the facilitator guides stakeholders to recognise whether requirements are specified in the requirement document to handle the event. If not, new requirements can be written.

So far ART-SCENE presents scenario normal and alternative courses in text form. Although effective [1], some scenario content might trigger stakeholders to recognise and discover requirements more effectively if represented in image, audio or video rather than text form. Examples include environmental factors, concurrent agent behaviour and tacit human knowledge. The use of multi-media representation in requirements tools is not new – AMORE [3] supported requirements acquisition with different multi-media formats while CREWS-EVE [4] represented scenario vignettes using video images. Our innovation was to integrate multi-media into ART-SCENE scenarios using multi-media authoring guidelines from multi-media design to support the discovery of requirements for new systems.

2. Multi-Media Authoring Guidelines

We adopted a principled approach to extending ART-SCENE with multi-media scenarios by implementing authoring guidelines reported in [5]. We extended these guidelines by linking their recommendations to ART-SCENE action, agent and object types and introducing information types into ART-SCENE. Depending on the action and agent types, a set of rules constrains the set of information types for an event, e.g.

\[
IF (ac1(type=cognitive) AND (ag1(type=*))) THEN (in1(type=causal) AND (in2(type=physical action)))
\]

which ensures that only causal and physical action (in1, in2) are displayed to a cognitive action (ac1), where the agent type (ag1) can be any type. Having specified the information type, a set of media selection rules are used to select the appropriate media resources which are best to represent the current event. These guidelines and rules are reported in full in [6].

3. ART-SCENE’s Architecture

The text-based Scenario Presenter was developed using Microsoft Visual InterDev supporting dynamic ASP pages on top of the Microsoft Access database, and runs on IE5.0 and above. This legacy architecture constrained development of the multi-media version. The multi-media version of ART-SCENE adopts the three-layer architecture shown in Figure 2. It has a presentation layer that defines the graphical user interface (GUI). The application layer defines system logic defined in the ASPs that generate the dynamic GUI and Visual Basic components where functions are grouped by application area. Its database layer stores all persistent data about scenarios.

A new separate application with its own presentation and application layer has been built, as shown in Figure 2 (right-hand side), and some existing components (left-hand side) have been changed. Both applications...
operate on the same database layer. However, the database layer has been extended to store multi-media documents of every event separately in the server’s file system.

Figure 2. ART-SCENE’s new architecture

4. The Multi-Media Implementation

The resulting multi-media implementation of ART-SCENE was demonstrated using one scenario that was generated originally to specify DMAN, a socio-technical system for sequencing and managing the departures of aircraft from major European airports such as Heathrow. The original scenario, which described how air traffic controllers give push back clearance to departing aircraft, was extended with multi-media artefacts made available from a film company who worked with UK National Air Traffic Services (NATS). The authoring guidelines were applied to extend 9 of the 18 scenario events with image, audio and video content. Examples of image extensions to the normal course event “The Ground ATCo looks at the aircraft and nearby traffic” are shown in Figure 3.

Figure 3. The multi-media ART-SCENE version, showing image extensions to the give pushback clearance scenario

ART-SCENE tightly couples scenario walkthroughs and storyboards. By integrating rich media, ART-SCENE provides more cues for recognizing and discovering new requirements. Furthermore a dynamic image gallery that describes the whole scenario enhances understanding by placing events in context, and new functions that show all video and audio documents offer great user freedom and flexibility to tailor scenario walkthroughs for local needs.

5. Evaluating Multi-Media ART-SCENE

We evaluated this multi-media ART-SCENE implementation using trials with 4 expert requirements engineers and one air traffic controller from Heathrow. Each evaluation was in two parts. Firstly, the engineer or controller walked through the text-based version of the scenario to undertake simple tasks such as discover requirements and document comments. Secondly, at a later date, the engineer or controller walked through the multi-media version of the same scenario and undertook the same tasks, observed by one of the authors who took notes and asked questions about the utility and usability of the multi-media version.

Most participants discovered new requirements using the multi-media representations, and most participants reported that the multi-media features contributed to a better understanding of the domain and system context.

6. Future Work

We are currently planning a larger-scale evaluation of the multi-media version of ART-SCENE on a new NATS project. We will use the generated scenarios and multi-media guidelines to direct the collection of multi-media material related to the new system. We look forward to reporting this future rollout of ART-SCENE in future work. More results are available in [6].

7. References