

# Game-Based Training in an Interactive Environment by means of OpenCrimeScene

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## Abstract

*This paper presents a novel approach towards training with game elements in an interactive environment by means of OpenCrimeScene, a virtual 3D training system for crime scene investigation (CSI). The application is designed to supplement the curriculum for self-study and as a basis for group discussion. To facilitate curriculum integration, the interactive environment has been made suitable for distinct audience groups (i. e. teachers and students). Different interaction techniques for each group have been developed respectively. The application consists of three main components which are called authoring, training, and reviewing. The underlying application framework follows a generic approach and can also be adapted to training fields other than CSI.*

Categories and Subject Descriptors (according to ACM CCS): D.2.6 [Software Engineering]: Interactive Environments

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## 1. Introduction

Current trends in developing interactive environments for training continuously move towards game-based applications like, e. g. serious games. By exploring the interactive environment and actually *playing* the game the user can take up a context-dependent role which stimulates the learning process more effectively [vE06]. Also, as game-based interfaces are commonly well known they facilitate the first contact and ongoing usage of the system [DS01]. However, current applications used for game-based training are often hard to integrate into a curriculum [EN05].

In this paper we present a novel approach for the design of interactive environments for game-based training. *OpenCrimeScene* addresses not only the student as game player but also the teacher. A game for crime scene investigation facilitates the casting insofar as the teacher can act as an offender whereas the student has to act as the officer. This way the system encourages both audience groups to participate in the game play and, thus, in the training process.

The system has been split into three components, namely authoring, training, and reviewing. The authoring component addresses the teacher as main user. It allows for a generic and interactive scenario creation. The training component addresses the student as main user. At present, basic investi-

gation procedures like, e. g. taking pictures of the crime scene are covered [BPS08]. Interrogations will be added, too, in order to ensure that the student can interlink and internalise practical and theoretical issues. Finally, the reviewing component will serve as a basis for discussion by generating visual reviews of the training session [BSS07]. The underlying framework connects all three components in one interactive environment.

## 2. Related Work

Serious research on interactive environments for training with game play elements has been pursued for about ten years now. Several studies on using computer game play in education have yielded that motivation and interest of the participants had been high throughout the evaluation tests, e. g. [MSS04]. The evaluation tests also revealed that teachers could hardly adapt the software to the curriculum. This was mainly due to inappropriate contents, tight curricular schedules, and rigid application frameworks [EN05]. Research currently seems to got stuck on how to proceed and many researchers call for more suitable application frameworks [vE06].

Interactive environments for (game-based) training usually rely on game design patterns and follow a single-player-centered approach by addressing the student only [MC06].

The teacher's role is generally neglected in this scenario. At most, training systems are designated for tutor or guide integration [dARIM05, HHP\*00]. A reason for the disregard of content creation might be the complexity of authoring systems. These are rarely applicable for non-professional computer users and, thus, require professional authors [KHG\*07].

There exist only a few academic solutions for virtual CSI training. Most work has been put into realistic crime scene reconstruction tools for professional investigators [GH00, DMG04]. The *SGTAI* project, however, has engaged with the development of a serious game for traffic accident investigation training called [BMR08]. The application resembles the *OpenCrimeScene* training component. The user also has to train scene assessment procedures. *SGTAI* also provides for a simple after-action-review which contains a list of recorded user interactions and a score sheet. In contrast to *OpenCrimeScene*, however, scenario creation is neglected. Moreover, none of the tools provided has been turned into a realistic application like, for example, *OpenCrimeScene*'s virtual SLR camera *vSLRcam* [BPS08].

### 3. Challenges

Education is basically a threefold relationship between the teacher, the student, and the curriculum and in this regard has to provide means for explanation and discussion. However, most interactive environments for training leave sparse room for active teacher participation or debate. Also, the design and implementation of interactive environments primarily is subject to the developer's point of view and often lacks comprehension of the user demands, cf. [Tay03]. This makes it hard to integrate the applications into the curriculum. Instead, they are often designed as an alternative to the curriculum or request the teacher to completely change his or her teaching method to make use of the applications [EN05]. If interactive environments for training are to become more suitable to educational settings they have to

- serve as a generic supplement giving more creative freedom to the user and not serving as an alternative to the curriculum,
- attend to the teacher's role, e. g., in terms of content creation and in the same appealing way as for the students,
- offer means to the students to internalise procedures from practical training and to link them with theoretical background and finally
- review the student's training session with the help of visual feedback to serve as a basis for discussion.

The *OpenCrimeScene* training system meets these challenges by corresponding more closely to the traditional setting in education. During the design phase, thus, emphasis was put on the audience groups, the system components, and the game elements:

**Audience Groups:** In every educational situation the teacher and the student reside on opposite positions. The teacher ex-

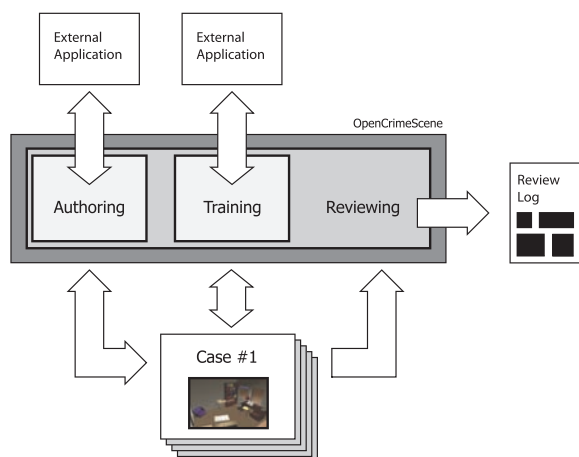
plains theories, conveys information, and prepares the lessons. The student takes up the theories, deals with information, and applies them to new situations. For CSI training the teacher has to prepare the crime scene and the student has to practice initial response and scene assessment procedures. To adapt this to an interactive training system both teacher and student have to be addressed by the system. This might facilitate a curriculum integration.

**Components:** Educational content creation, training, and discussion do not have to occur at the same time. To address two different audience groups and to review training sessions, the *OpenCrimeScene* training system is composed of three distinct components. *The Authoring Component* addresses the teacher as the main user and offers means for content creation. For CSI training the component has to allow for preparing the interactive environment to conform to a crime scene. Also, in order to transfer theoretical issues to the interactive environment, the authoring component has to provide for interfaces to construct interrogations or instructions and to import existing materials. *The Training Component* addresses the student as primary user. Again, for CSI training the component has to provide means for protecting the crime scene. Furthermore, interfaces have to be added by which the users can respond to questions the teacher might have posed. *The Reviewing Component* is intended to bring both parties together in terms of discussing the training session, e. g., in class. Therefore, all user interactions made by the teacher and by the student have to be logged and analysed. Finally, a visual review will have to assemble significant events either in an overview or a sequential image to serve as a basis for discussion.

**Game Elements:** The last challenge is *how* the audience groups can engage with the system. The *OpenCrimeScene* training system applies game elements for this. These have to involve the audience groups into the game universe. For *OpenCrimeScene* the universe clearly revolves around crime scene investigation. Consequently, the audience groups can be split into offender (teacher who prepares the crime) and officer (student who has to protect the crime scene). This universe determines how the user interfaces and interaction techniques are presented. Moreover, the application has to believably situate the game elements within an educational frame and, thus, enable the users to draw up relations between them and the educational context.

### 4. The OpenCrimeScene Training System

According to the challenges, the *OpenCrimeScene* system is split into three components, each addressing a different user or generating a visual training session review. The underlying framework of the *OpenCrimeScene* training system is illustrated in Figure 1. The components allow for accessing external applications in order to improve exchange with existing materials and review log generation. Internally, the



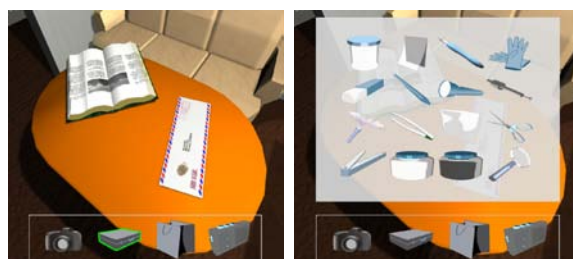
**Figure 1:** The overall framework of the OpenCrimeScene training system. The framework is designed as an intermediate between basic game levels and interfaces to office applications which are expected to be frequently used by teaching personnel.

system logs crime scene modification in the game levels. Each game level conforms to a case that has to be solved.

**Authoring Component:** The authoring component addresses the teachers as content creator during crime scene preparation. The component applies game-based interfaces and does not resemble a traditional authoring system editor. Since game-based interfaces are intuitive and popular non-professional users are supported in authoring and interacting with the application. The virtual crime scene can either be prepared implicitly by playing the offender or explicitly by accessing a trace editor. Navigation is accomplished in an first-person-shooter game manner. Currently the offender can interact with the scenario by selecting scene inventory and move or remove it into the thief bag. Moreover, the offender can position items like fingerprints, shoeprints or bloodstains to the scene. The traces are placed in the scene automatically while the offender walks around or selects scene inventory. For explicit positioning, the authoring component offers access to the trace via a graphical user interface, cf. Figure 2.



**Figure 2:** The offender can leave footprints on the floor while walking through it (left). Also, he can leave fingerprints on the inventory when selecting it (right).



**Figure 3:** The officer's GUI grants access to several tools (left). The tool bag contains several tools for collecting items like, e. g., powder, brushes, gloves, etc. (right).

**Training Component:** Scene assessment can be practised when logging into the training component. Here, the user will act as the officer in order to protect the crime scene. The officer can access tools like, e. g., an SLR camera, a tool bag, an item bag, or a microphone to capture audio notes, cf. Figure 3. Generally, the officer can apply the same interaction techniques as the offender. The officer can also leave traces in the scene. This resembles reality and serves to train the prevention of self-inflicted contamination of the crime scene. Also, the officer can take pictures of the traces with the vSLR-camera [BPS08]. This is a virtual SLR camera that simulates a real camera which is used during scene assessment.

**Reviewing Component:** The reviewing component is intended to trace back the sequences of scene assessment and to generate a visual review. This review shall be visualised as a storyboard-like sequence of events or as an instant overview on scene assessment as described in [BSS07]. A first visualisation has engaged with merging character positions over time, cf. Figure 4.

**Game Elements:** As has been hinted at in the last paragraphs the major game elements are the offender and the officer. Whenever a user logs into the system he or she has to decide whether to play the offender (evoke the authoring component) or the officer (evoke the training component). The training system uses game levels to represent different cases. Initially, these levels consist of indoor crime scenes — 3D rooms with furniture, cf. Figure 5. Additional information added during crime scene preparation like, e. g., fingerprints or bloodstains, and scene assessment like, e. g., labels or photographs, will be stored in these levels. The offender commits a crime (the teacher can prepare the crime scene) and stores it to the case so that the officer can access it and assess the scene (train CSI). Moreover, the levels serve as input data to the reviewing component.

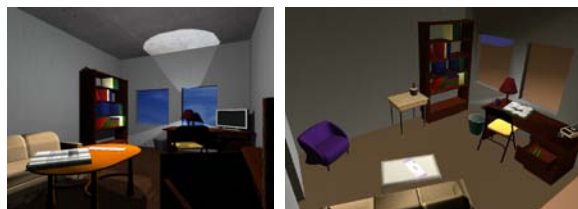
## 5. Summary & Future Work

The *OpenCrimeScene* training system is part of a collaboration project between the University of Magdeburg and the Police University of Applied Sciences Saxony-Anhalt. The project aims at developing an interactive environment for



**Figure 4:** The reviewing component is intended to generate training session summaries, e. g., like an instant overview of character positions over time to start with [BSS07].

virtual CSI training with game elements and to integrate it to the Police University's curriculum. Currently, the system is in prototypical state and offers basic means for committing a crime as well as for scene assessment. To facilitate curriculum integration, the training system addresses both teacher and student as participating users. The system offers a broad application framework with manageable functionality and targets virtual CSI. Further tasks have to be accomplished. Especially, the realistic rendering of traces or the CSI interaction techniques have to be improved. For example, a realistic fingerprint visualisation depends on the material, the incident light, and on the viewing direction. This has to be implemented. Furthermore, the offender has to be able to break into the scene and, e. g., to destroy windows or scene inventory. The officer, on the other hand, has to be able to sequentially collect traces by interacting with the appropriate tools. In order to import external materials certain wrapper interface still have to be realised. Finally, the reviewing component lacks further visualisation forms so far.



**Figure 5:** The current crime scene accords to a standard living room. Furniture can be added easily by an external editor.

## Acknowledgement

We would like to our colleagues from the Police University of Applied Sciences Saxony-Anhalt and several students from the University of Magdeburg and the University of Applied Sciences Magdeburg-Stendal who have contributed to *OpenCrimeScene*.

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