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**Proceedings of Emerging Tech Conference:
Edge Intelligence 2022****AI-assisted Serious Games: Interrogating an Avatar in Virtual Reality**

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Cutting-edge technologies such as Virtual Reality and Artificial Intelligence have helped elevate the digital storytelling and gaming experience. Consequently, serious games emerged as a powerful alternative to traditional classroom-based learning in various sectors including the law enforcement sector. In this context, the LAW-GAME project develops a social AI-powered VR game platform targeting specifically the training needs of Law Enforcement Agencies (LEAs). Focusing on one of the platform's gaming modes, namely the Police Interrogation, this paper explores the implications of implementing a realistic interactive dialogue among a human player (the police officer) and an AI-assisted non-player character (the suspect).

1. Introduction

In recent years the popularity of serious games has seen a rise especially for LAW Enforcement Agencies (LEAs) such as police forces, military and first responders. Serious games emerge as a powerful cost-effective alternative to classroom based learning that supports cognitive, behavioural, affective, motivational, physiological, and social learning outcomes [1]. Enhanced with cutting-edge technologies such as 3D constructed Virtual Reality (VR) worlds and Artificial Intelligence (AI) agents, serious games can offer training on realistic scenarios and complex situations that can be conducted collaboratively across geographical and professional boundaries.

2. The LAW-GAME project

LAW-GAME (<https://lawgame-project.eu/>) aims to train LEAs enhancing the transition between the theory and real-life practice through gamification technologies in a safe and controlled virtual environment. To achieve this, the project develops an intuitive, fully configurable, user-centred, social VR game engine enhanced with AI-assisted procedures and emotion recognition features. The project embeds four highly immersive and attractive “gaming modes” as follows:

- The CSI game. Police officers engage in a VR experience within a 3D incident scene using virtual instruments and virtual lab forensics toolkits following standard protocol actions. Trainees examine the crime scene, identify and visually analyse all kinds of evidence (human remains such as body fluids, firearm, bullet casings, bullet holes, fingerprints, etc.) in order to solve the case.

- The Police Interview game. Police officers engage in a VR role-playing experience within a police interrogation room or an external negotiation site. Trainees practice their interrogation and negotiation skills through conversational interaction with an artificial agent (AI-assisted 3D avatar) assuming the role of the suspect / perpetrator.
- The Terrorist Attack game. Police officers engage in a multi-player VR game where trainees attempt to predict terrorists' actions and terminate a critical situation. Trainees practice becoming better prepared in managing extreme, time-critical situations in a more effective and efficient manner, reducing, or preventing terrorist threats.
- The Car Accident game. Police officers engage in a VR experience at a 3D car accident site. Trainees use virtual instruments and virtual lab forensics toolkits following standard protocol actions. Trainees virtually collect scene's data (metal scraps, tire marks, scars alongside the road, debris, damage to fixed objects, vehicle rest position, etc.) in order to decipher what happened before, during and after the collision and to prepare a "true-to-life" accident report.

3. Interrogation game

Focusing on the Police Interview: Interrogation game, the game's basic elements are as follows:

- The game takes place inside a police interrogation room.
- There are three characters in the game: (a) the police officer who interrogates the suspect, i.e., the player's character in the game; (b) another police officer who observes as per formal police procedure, i.e., a non-player character (NPC) with minimal interaction; and (c) the suspect, i.e., an NPC controlled by the game's AI engine.
- The game has a specific storyline, i.e., a description of the incident and the reasons for the interrogation.
- Each game has a set of evidences, grouped under evidence categories, which were gathered by the police investigation team prior to the interrogation. For example, the category "vehicle" includes all gathered evidence relevant to the car used for getting to the crime scene, such as model, type, colour, licence plate, owner, camera captures, etc.
- The player may freely ask any question to the suspect, i.e., the game provides no guidance as to what to ask and when as the game leans more toward a realistic setting for testing the skills of a trainee rather than a learning tool.

4. Challenges in dialogue interaction

Implementing a realistic, interactive dialogue among a LEA officer (the player) and a suspect (AI-assisted NPC) brings us face to face with a number of challenges. First, the game engine that controls the suspect-NPC responses should be able to understand the police officer's questions, i.e., detect the intent of each question, and respond accordingly. Questions that are marginally relevant or even completely irrelevant to the storyline should also get a suitable response. Second, the game engine should be able to differentiate suspect's responses based on the

context of the dialogue, i.e., to unfold different interaction storylines depending on player's previous questions. For example, the suspect should be able to respond differently to the same question being asked twice (or more times); or to the same question being asked following another relevant question; or to the same question being asked after having admitted the truth of an evidence or having confessed the crime. Thus, imagining a continuum between absolute denial and full confession of an evidence or the crime, the game engine should be aware of the current state and produce relevant responses (Fig.1).

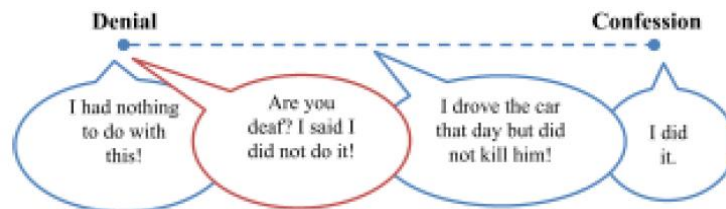


Figure 1: Variation of suspect responses to the same question depending on context and emotion

Finally, the game engine should be able to recognise and respond accordingly to different police officer's emotions. For example, the suspect should be able to respond differently to the same question being asked in an aggressive manner than in a calm manner (Fig.1).

5. Towards interrogating an AI-assisted 3D avatar

The proposed solution includes 4 mechanisms as follows:

- **Stage progression:** We divide the game into 3 distinct stages. The first is the Questioning stage, where the police officer asks questions relevant to the gathered evidence aiming to make the suspect admit involvement. Then comes the Confrontation stage, where the police officer asks the suspect to admit the crime; the suspect may or not confess depending on the progress made in the previous stage, i.e., depending on whether the police officer's questions were "good enough" to make the suspect admit most gathered evidence. Finally, and only if confrontation was successful, the Confession stage begins where the suspect now responds truthfully to all questions asked.
- **Questions' classification:** We classify relevant questions into evidence categories, e.g. "vehicle", "murder weapon". Questions within the same category can contextually influence responses of the same category and gradually progress the storyline towards admitting the truth. For example, when asked about using the car that specific day/time, the suspect initially denies using it. However, if asked again pointing out that the car was caught on camera 500 meters away from the crime scene, the suspect's response would be to admit having used the car. Obviously, responses' initial context should be to deny any involvement in the incident. However, as the game progresses and more key, contextual-relevant questions are asked, suspect responses move closer to the confession contextual state.
- **Dialogue management:** We combine two different AI approaches in order to build an Interactive Storytelling Engine (ISE) able to understand what the player says and drive the story forward. As far as understanding the messages of the police officer's

questions is concerned, we rely on recent work in text classification using transformersbased language models [2] to classify each message into the relevant evidence questions. For managing the unfolding of the storyline, we rely on an action-driven framework where every interaction may affect the next interactions by means of pre-conditions and postconditions inspired by work in automated planning [3].

- Emotion loading: We regard emotion as an additional dimension in our action-driven framework that manages the storyline. However, emotion does not affect the context of the response, just the way the response is formulated (e.g. impolite answer) or expressed (e.g. angry avatar face).

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