ABOUT THE TEAM

The First Person Cultural Trainer, sponsored by TRADOC G2, is a research project of the Arts and Technology (ATEC) program at the University of Texas at Dallas (UT Dallas). Arts and Technology, a joint program of the Arts and Humanities and Computer Science Schools, is one of the fastest growing majors at the University. ATEC has approximately 800 students including approximately 150 graduate students at both the master’s and Ph.D. level.

Skill sets on the team include project management, animation, 3-D modeling, computer game design, computer programming, behavioral modeling, interface design, experimental computer-based narrative development, and social science research. Several faculty members from the ATEC program as well as the Computer Science department as well as industry professionals work with undergraduate, master’s level and Ph.D. students on the First Person Cultural Trainer.

CONTACT INFORMATION

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ABSTRACT

The First Person Cultural Trainer (FPCT) is a high-fidelity, game-based simulation, which trains cross-cultural decision-making within a 3D representation of a Middle-Eastern society. FPCT is part of the Hybrid Irregular Warfare / Improvised Explosive Device Network-defeat Toolkit (HI²NT) sponsored by TRADOC G2 Intelligence Support Activity.

HI²NT is a federation of virtual, constructive and gaming models, providing a combat training center (CTC)-like experience for individuals through brigade-staff training audiences. HI²NT is in its second year of development. FPCT functions as a stand-alone cultural trainer, or as part of the HI²NT federation. Various data sets are available that provide information used in the cultural game. These include cooperation level, mood, golden nuggets (e.g., IED and IED Network related information), and other factors stored in these repositories.

These repositories are key because they integrate information created by subject matter experts (SMEs) into the game, they provide centrally vetted information, and they effectively allow game players to work with the data...for example trying to build rapport to change community mood...and put these data back into the repository to determine and investigate second- and third-order effects.
The First Person Cultural Trainer (FPCT) is a 3D interactive training simulation, sponsored by TRADOC G2 Intelligence Support Activity, which teaches the values and norms of a specific culture in order to facilitate intelligence missions. The game is currently focused on Iraq and Afghanistan and missions related to uncovering improvised explosive device (IED) network information. FPCT includes four clearly defined stages that lead to the successful completion of missions. The player is expected to rate moods and reliability, and gather information throughout four stages of gameplay, which follow the USAID Tactical Conflict Assessment Planning Framework (TCAPF) of See-Understand-Act-Measure.

- Step One: Establish a presence in the community
- Step Two: Understand community problems
- Step Three: Develop an action plan
- Step Four: Gather intelligence like information about IED networks.

The project has adopted an ongoing challenge to develop extremely high-fidelity representations to create an environment that serves as a cultural training tool before, or during, actual deployment. The game must act in a nonlinear way, as a Middle-Eastern geographic area would. Further, players must have the ability to read nonverbal communications of the non-player characters (NPCs) in the game. Figure 1 demonstrates NPC facial expressions.

Our game inserts the player into rural, semirural, and urban settings within Iraq and Afghanistan. The player’s goals are to explore the social and political settings through conversation, establish himself within the area, provide humanitarian aid, and eventually use the social status he has established to gather information about IEDs and the IED network.

In a high-fidelity simulated environment like FPCT offers, players can attempt to achieve realistic objectives in the context of accurate cultural representations. The technology is much more flexible than staged, full-scale model villages with live endemic actors — one way this type of training has been done to date. A high-fidelity simulation such as FPCT allows any number of players, who may be scattered around the globe, opportunities to quickly experience a wide variety of situations and specific cultures.

Conversation with the NPCs, otherwise known as virtual agents, is the primary method of interacting with the world. Tactfulness, emotional and cultural sensitivity, and problem resolution will bring respect among area inhabitants. Agents may become more comfortable with the player over time, and become increasingly willing to talk about issues in the area. The player is expected to rate moods and reliability, and gather information through each of the four stages described above. At the end of gameplay, the player is assessed based upon the accuracy of his ratings of the populace and the quality of information gathered. Figure 2 demonstrates a player conversation with an NPC.

To achieve these design requirements, the FPCT development team has developed a living-world construct to replicate in-theatre cognitive complexity. Param-
Development of the living-world architecture and the cultural models is ongoing. For this reason, the project strategy is to create a living-world architecture that is flexible and can accommodate new inputs, and is robust enough to create a representation of specific cultures now. Figure 3 illustrates this design strategy.

**INTEGRATION WITH HFNT**

FPCT serves as a stand-alone trainer, but also functions as a highly immersive interface for other types of models that bring veracity to the virtual environment using real-world data. In its current development, FPCT is the cultural interface of the Hybrid Irregular Warfare / Improvised Explosive Device Network-defeat Toolkit (HFNT) sponsored by TRADOC. HFNT is a federation of virtual, constructive and gaming models, providing a synthetic corollary to a combat training center (CTC) experience for individual through brigade-staff training audiences.

The federation facilitates collective, multi-echelon training within the COIN environment for fire team, squad, and platoon leaders at one end and brigade and battalion staffs at the other. The federation incorporates data from OneSAF and the Joint Non-kinetic Effects Model (JNEM) into FPCT. Players in FPCT can work with the data – for example, they can try to build rapport to change community mood and cooperation – and then put data back into the federation’s repository to determine and investigate second- and third-order effects (Jordan, et al., 2010).

**FPCT – DESCRIPTION OF DEVELOPMENT MAKING CULTURE**

Our model uses visual, auditory, cultural, and behavioral components for immersive cultural training using the living-world construct. Living worlds offer nonlinear, unscripted processes for experiencing and safely learning the cognitive complexity and nuance of culture through emergent high-fidelity simulation (Zielke, Evans, Dufour et al. 2009).

We will emulate the definition of the cultural framework outlined above to achieve the living-world construct and create a realistic and believable synthetic training experience. Since the exact situation that must be modeled at any given time is unknown, the simulated environment must be adaptable. For this reason, we have created a living-world architecture that models psychology, culture, emotion and behavior. Part of the ongoing research is to create tools that can be used by subject matter experts who understand the cultural nuances of the mission environments.

In FPCT, the NPCs that populate the villages and towns the player visits are not static characters, locked into specific behaviors. Rather, they influence and are influenced by the environment around them, which affects how they interact with other NPCs and the player. Each NPC carries within it a complex emotional model which directly influences its behavior. This emotional model is influenced by many factors, among which are previous events (as outlined in the beginning of each mission through prologues), ethnic background and psychological models, gender, age, and how they have been treated in-game. Figure 4 illustrates this concept.

Figure 3. The on-going five-stage design process for FPCT.

Figure 4. The result of the FPCT design is a dynamic NPC personality that can remember conversations, express moods, and can choose to provide information to the player based on these internal variables.
Cultures act as a seed from which NPCs can be procedurally generated. Some components of our cultural model are based on the research of Martha Maznevski. Maznevski’s research has identified fourteen variables that define clear cultural parameters for belief and behavior (Maznevski, 2002). These dimensions allow for more specific behavioral definitions than are allowed by our emotional model, “filling in the gaps” of cultural nuance. For instance, the Maznevski dimension of “Can people change?” controls the flexibility of a virtual agent’s opinions toward others and how quickly those opinions solidify.

Perception, Decision Making and Behavior

In the context of our simulation, perception is defined as all inputs that influence how characters interpret themselves and the world around them. Perception is handled by our event model, which receives broadcasts of internal events (thoughts) and external events (interactions) and passes them into the agent’s mind for processing.

The interaction of cultural expectations, an agent’s schema, and an agent’s mental state makes up our personality system. This system is responsible for driving the decisions and behaviors of our characters via a rule-based contextual analysis of each of these factors.

Determining how to respond to perceptions is the primary form of decision making. Responses include: modification and queries to the schema, emotional change, and prioritization of an errand. Culture drives our list of possible errands. This currently includes, for example, eating, farming, playing, cleaning, and conversing.

Table 1. Psychological Motivators with Relevant Emotions

<table>
<thead>
<tr>
<th>Psychological Motivator</th>
<th>Emotion</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Strong Negative</td>
</tr>
<tr>
<td>Survival</td>
<td>Fear</td>
</tr>
<tr>
<td>Ego</td>
<td>Anger</td>
</tr>
<tr>
<td>Reason</td>
<td>Interest</td>
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<tr>
<td>Morality</td>
<td>Sorrow</td>
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</tbody>
</table>

The schema is another component of building psychology. A schema defines mental representations of the world. For our purposes, a schema is the experiential memory of our NPCs that can be revised, refined, or falsified and includes all beliefs about the world. Our schema maps gamesworld objects to schema nodes, where each schema node contains a list of properties that the character assigns to that object. For instance, if an agent perceives a particular coffee shop, his schema contains a list of everything he believes about that coffee shop. Relational schemata could also be developed to build associations between schema nodes, and the complexity and accuracy of the schema could be controlled by character personality or age as referenced in Figure 5.

Piaget (1972) suggests that schemata can acquire greater complexity by assimilation and accommodation through cognitive development.
DESIGN PHASE TWO: TOOLS FOR EXPERTS TO CREATE CULTURE

Our culture design tool allows subject matter experts to build and maintain subculture hierarchy and define properties. Cultural properties include animation data for gestures, Maznevski cultural variables, and the extent of the culture’s influence on a person. Each culture has a collection of roles that define influences and group expectations. Cultural role properties include acceptable wardrobes, baseline personality, and control variables for defining ages, genders and behaviors. Characters are generated from these cultural roles and deviate depending on the cultural influence on that person. The subculture hierarchy allows cultures to “inherit” properties from parent cultures. Subcultures are by default similar to parent cultures, but may be refined as desired. Parent cultures can be modified, automatically updating each of the child cultures. Figure 8 illustrates the tool’s slider interface.

Prologues

Prologues are pseudo-cultural entities that represent environmental and psychological influences from recent events in an area. Each environment used by our game has a prologue that changes behavior and personality for that area only. These prologue definitions include information for randomizing population and objects in the world, a situational personality that influences each character, and preset intelligence that will be disseminated by agents during conversation.

Figure 7 below illustrates the full conceptual psychological, emotional, behavioral and cultural model.

Figure 7. The full conceptual psychological, emotional, behavioral and cultural model.

Figure 8. The culture design tool was created to allow experts to construct culture. This image represents a small subset of the tool.

DESIGN PHASE THREE: DEVELOP VISUAL, AUDITORY, AND BEHAVIORAL REPRESENTATIONS FROM EXPERT CULTURAL DESIGN

We use the constructs described above to make NPCs. Each emotion is associated with a pool of facial and body motion capture data. Blended animations between these extremes produce the final, nuanced animation. The animation associated with a character becomes the weighted average of the corresponding animations.
Virtual Humans

Visually, a given NPC manifests its emotions through motion-captured postures, gestures and facial expressions which were performed by highly-specialized Afghan and Iraqi actors. The NPC can use that motion capture data to express a wide variety of emotions including mourning, happiness, and anger. When combined with body movement, NPCs are rendered realistically and naturally.

Character Generation Model

The Character Generation Model is a series of tools that allow us to easily generate large numbers of culturally accurate wardrobes. Our model of human wardrobes is essentially a hierarchical boolean logic system. Each wardrobe is represented as a conjunction or disjunction of wardrobes for nuances like “don’t wear this shirt with this hat.” These wardrobes have an artist-defined system for randomization while allowing us to easily generate large numbers of outfits. To construct an outfit, the program starts at the root of a wardrobe tree and descends recursively. If the wardrobe is conjunctive, then all sub-wardrobes are traversed. Figure 9 illustrates this process.

This tool also allows artists to see and modify their characters and wardrobes with a real-time view of the results.

Environments

Our environmental design process starts with research of a given geographic area. We use tools such as Google Earth and Google Images, as well as reference photography from subject matter experts, to gather a pool of source materials. We then synthesize our references into a fictitious environment, based on geographic parameters provided from scenario prologues. Our production strategy involves initial development of a basic structural layout using design tools within Unreal Engine 3. We then begin enhancing the environment with the addition of meshes modeled in 3D design programs. Details are added with additional textures and advanced particle emitters that simulate effects such as dirt, dust, and smoke. The environments are finalized by adjusting lighting models to simulate realistic lighting and shadow through the use of radiosity and ambient occlusion, features of the recently updated Unreal Engine 3. The high-fidelity quality that this process produces is illustrated in Figure 10.

Sound

Sound in FPCT is mainly designed to ensure the level of complexity and realism necessary for successful immersion in the environment. The sound in the environment will allow for the same type of perceptions as sounds in real life and fulfill four levels of listening (Schaeffer, 1966).

The first level is the indexical level of listening. This means each of the sounds in the environment is related to a visible or plausible physical cause. This level answers the question: “What do I hear?”

The second level pertains to the reception of this sound in regard to the overall acoustical context and to the situation of the listener in this environment. This level answers the questions: “Where am I in this environment?” and “Where does this sound come from?”

The third level is defined as the iconic level of listening because it relates to the purely sonic qualities of the sound. This level is uniquely activated when a sound whose cause has not been defined by the first level is perceived. Qualities of the sound such as gait, variations of harmon-
ic content, variations of intensity, and timbre are used to form an image of the cause of the sound. This level is also activated when semantic information from the fourth level is not available. For example, players can hear a voice speaking in a foreign language and understand the emotions and intentions of the speaker by analyzing qualities of the sound such as variations of intensity and pitch.

The fourth level corresponds to the semantic activity of listening and enables the understanding of the content conveyed by the sound. This level answers the question, “What does this mean?” The answer depends on the knowledge of the listener and the code by which the sound relates to a meaning. The syllables of the phrase, “Sabaah al- khayr,” can mean “good morning” to only some listeners.

Using this approach, we defined four streams of sound used to synthesize any complex environment and to immerse the user into a meaningful auditory context:

- Global stream: the background sound of the environment
- Regional stream: the background sound of a section of this environment
- Local stream: the sounds attached to the visible agents
- Conversation: the voices of the agents in face-to-face conversation.

These streams are also defined by their degree and mode of variation or their dependence on other parameters of the program. Figure 11 illustrates, these four streams of sound as they relate to the game environment.

### DESIGN PHASE FOUR: GAMEPLAY

In FPCT, the player is presented with a prologue that outlines the situation (i.e., general perception of the player by the populace, recent violence, unrest, etc.), and then is given a list of goals to meet. The goals are separated into the four stages referenced in the introduction, with each stage having its own discrete set. The player decides when he or she has met the goals of the stage and can advance to the next by selecting the option for his journal. When FPCT is used in the HFNT federate mood and cooperation level comes from JNEM and is parsed back into JNEM after gameplay.

Once a player has signaled that he wants to advance to the next stage, he is graded on completeness and on his success in interacting with the population. This between-stage grade will factor into the final assessment at the end of the game. By completing the assigned goals, communicating well with the populace, and discovering and documenting important information, the player will advance through the game and ultimately receive an assessment for that level. The player can then move on to a different environment level, or replay the current environment with a different prologue shaping the events. Important elements of our game design are discussed below.

### DESIGN PHASE FIVE: ASSESSMENT

Current development utilizes During Action Review (DAR) and After Action Review (AAR) for play session assessment. As a means of increasing, enhancing, and integrating the benefits of DAR/AAR into gameplay, FPCT introduces the player journal. The journal interface has been designed to elicit a higher level of observation and documentation from the player, while the enhancements to the journal functionality seek to add interest and viability to the simulation. The journal includes most of the DAR/AAR UI elements designed to enhance gameplay as well as after action review information. Example events that could be collected include:

- Noting the name of a community leader
- Tracking the culture and social network of an agent
- Identifying and recording Golden Nuggets

![Figure 11: Sound is represented in FPCT by four streams: global, regional, local and conversational.](image-url)
In contrast, the difficult mode requires the player to record objectives as they are completed. The player’s observational skills and ability to complete the static missions will be calculated and displayed in the AAR after each stage.

Figure 13 provides an example of the log tab. The log tab allows the player to document an NPC’s name, culture, and important conversations. Within the log, the player can save excerpts of conversations that may be of particular importance. Players can also pick up and save physical items they have identified during the simulation as valuable. As with other elements, the player will be prompted to document this information in the easy mode of play, and will be penalized for not recording information in difficult mode.

Assessment UI Breakdown

With the journal as a repository, assessment features can be brought up and reviewed during gameplay. The player’s journal is divided into four stage tabs, with each tab representing one of the four stages of gameplay. Only the tab that corresponds to the current stage of gameplay will be available to the player. Within each stage tab, the player will have several subheading tabs that activate different DAR/AAR functionalities. These sub-tabs will allow the player to choose the following views:

- Objectives
- Log
- Review (Only activated upon completion of a stage of gameplay)

Figure 12. The objectives tab of the journal houses information regarding player specific tasks for each gameplay stage.

In difficult mode, the player’s journal entries are reviewed and assessed after the completion of a gameplay stage. As demonstrated in Figure 14, the review tab provides a summary of the play session data generated. In the review tab, player effectiveness is assessed through measurements of player-collected data.

Figure 14. The review tab provides the player with a final performance evaluation for each stage of gameplay.
Game Assets are anything a game engine needs to run a game. These assets can be almost anything the game uses besides core game engine code. Examples include mesh files for the graphics, animation data to make the meshes move, sound files to provide the aural experience or script files for game-specific logic. This list is by no means exhaustive, and new types of assets can be envisioned for specific domains. For example, personality data sheets might be needed by a personality modeling library.

A middleware solution that isolates a virtual cultural trainer’s game logic in one section, its core emotional model in another section, and vetted assets in a central repository best facilitates development across multiple platforms. The game logic can be isolated from the game engine itself. Connectors can be written into almost every game engine that provides integration: either through direct source code access or through wrapping data structures into language extensions for the scripting language that the engine uses. For example, if the game logic were isolated into a C++ library for efficiency, an API can be provided so that to use the virtual cultural simulator on a game engine, the same functions are called, and they are the same regardless from where they are called. The same could be developed for a cloud computing platform.

Assets could be ported from one platform or engine to another through a central repository. Different versions of assets, such as low polygon count art assets for mobile and high polygon count for desktop, could be stored and retrieved as appropriate. These assets could be stored in an independent form and translated as necessary. Keeping assets in this independent repository would also save space, although art fidelity may be sacrificed in the end product.

Figure 15 illustrates that a middleware solution with a central repository maximizes the code and art reuse, while optimizing the amount of “architecting” of generic code required.
Due to the composable nature of the FPCT development, the team was able to prepare for the experiment in a few days with an appropriate synthetic environment that corresponded to study objectives. Overall, the experiment illustrated the potential of a game-based simulation like FPCT for effective non-kinetic training. Four groups were involved in the experiment. During the experiment, two groups received FPCT training first, then participated in training with live actors. The other two groups trained with live actors first, and then underwent the FPCT exercise.

All participants received eight hours of classroom pre-deployment training from the TRADOC Culture Center one week prior to the experiment. Each team chose a team leader and was given their Operations Order (OPORD) to review prior to the experiment. The mission was the same for all four groups, and involved running through four critical events: meeting their new interpreter, traveling through the village and encountering members of the Afghan National Police and local villagers, meeting with the village elder, and meeting with the schoolmaster. The overall goal was to build a relationship with the village elder and the schoolmaster, who would try to push the team leader to commit time and resources to the village.

Based on observer ratings, groups that received FPCT training prior to the role-play scenario performed much better than the others. In addition to observer ratings, self-report feedback by experiment participants was gathered regarding the usefulness of the cultural training. All participants felt FPCT was useful; those who received the training prior to the live role-play exercise felt the additional training positively influenced their performance, and those who did not receive the FPCT training up front felt it would have helped improve their performance. All participants agreed that FPCT was an effective training tool beyond classroom training.

**FPCT FIELD IMPLEMENTATION**

The FPCT team is committed to developing research that analyzes the effectiveness of game-based simulations for cultural training. To this end, the team participated in an October 2010 experiment with cadets from the University of Central Florida Reserve Officers’ Training Corps (ROTC) at the Camp Blanding Military Operations Urban Training (MOUT) Site in Florida. The experiment was designed to assess the effectiveness of computer-based cultural trainers such as FPCT as an enhancement to classroom-delivered pre-deployment training. FPCT was selected from a half-dozen other Cultural Computer-Based Training (CCT) simulations for use in the experiment by the observers from the Defense Equal Opportunity Management Institute who participated in the MOUT experiment. The observers selected FPCT because it combined multiple training characteristics that they found singularly in other CCT simulations. These training characteristics are, composability, feedback tools, and high-fidelity representation of the decision-making effects on the virtual populus.

**Figure 15.** In this middleware structure, raw data flows out of sources like a digital content creation suite (Maya) or a HF2NT federate and is preconditioned so that it exists in a platform independent state.

**Figure 16.** Cadets using FPCT for training during Camp Blanding CCT experiment.
SUMMARY

FPCT’s enhanced characteristics – its composability, feedback tools, and high-fidelity representation of the decision-making effects on the virtual populace – make it an innovative simulation for computer-based cultural training. As well, FPCT’s capability to incorporate HI2NT federation data brings a real-world veracity to the synthetic training environment that is essential in training the general force as a whole.

REFERENCES


Overall the experiment was successful, as the main objective was to determine the effectiveness of CCT simulations such as FPCT as an enhancement to classroom pre-deployment training. By showing the utility of CCT simulations like FPCT, more soldiers may have the opportunity to train in an interactive manner prior to deployment, increasing their chance of success in theater, thus enabling a more available method of cultural training over traditional methods. TRADOC G2 will co-sponsor additional experimentation with PM TRADE in the future.

AWARDS

FPCT won the 2010 award from the National Training and Simulation Association (NTSA) for Outstanding Achievement in Cross Function Development. The development was also a top-ten finalist for the Governor’s Cup at the Interservice/Industry Simulation and Education Conference (IITSEC) in Orlando in 2009 and was also nominated again in 2010.

FURTHER RESEARCH – LOOKING FORWARD TO SPIRAL THREE

In FPCT Spiral Three we are exploring a variety of enhancements to the cultural training platform. These include integration into a virtual world platform, multiplayer, integration of Combat Hunter methodology and further research into microexpressions of NPCs.

Figure 17. Cadets using FPCT for training during Camp Blanding CCT experiment.