FORTERRA SYSTEMS INC

OLIVE Medical Functionality Module[1]

Introduction

Forterra Systems provides a 3D, virtual world software platform called OLIVE™ (On-Line Interactive Virtual Environment). The combination of the OLIVE Medical Functionality Module with the OLIVE Medical Content Pack provides a complete medical training environment in a virtual world. It enables any healthcare organization to prepare medical practitioners to deal with a wide array of circumstances and patient conditions.

OLIVE is used by organizations to train, plan, and collaborate in ways not previously possible. It supports an array of capabilities to support a wide variety of interactive, virtual world operations. The baseline OLIVE platform includes fully-operational, realistic avatars, VOIP communications, distributed physics and networking, and a session record and playback capability. Figure 1 is a screen shot of a medical team treating of a virtual patient that has been exposed to a toxic chemical. Trauma and toxic gas exposure scenarios are available today, and as new physiology models are added over time, OLIVE will present trainees with a spectrum of conditions ranging from very rare events, such as a sarin gas attack, to common conditions, such as influenza.

Figure 1: Medical Team Practicing with OLIVE

Specific applications can be supported through the addition of optional Content Packs and Functionality Modules that extend the baseline capabilities of OLIVE, and that can be added to any OLIVE license purchase:

- **Functionality Modules** provide integrations or "plug-ins" to 3rd party business systems. The Medical Functionality Module integrates OLIVE with physiology models that add clinical realism to medical training scenarios.
- **Content Packs** are industry-specific collections of 3D art assets, including avatar costumes, interactive objects (such as gurneys and ambulances), scenes (such as a hospital) and simulations.

Medical Functionality Module Introduction

The OLIVE Medical Functionality Module provides a "plug-in" interface for physiology models that calculate the conditions, behaviors and responses of each patient avatar. It enables physiology models to calculate the results diagnostic procedures, to influence patient avatar behaviors, and to display data in real-time on virtual medical displays, such as the bedside monitor shown in Figure 2.

Physiology models provide realism and engagement for medical professionals. The patient's vital statistics and diagnostic results change in real-time as the result of the caregivers' interventions. Physicians and nurses can see the patients' pulse, blood oxygen, temperature, diastolic and systolic blood pressure level in readouts on the bedside monitor. They can perform examinations, order

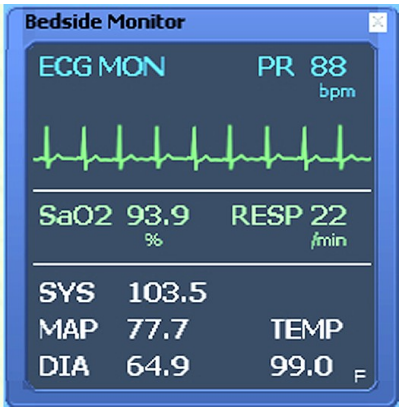

Figure 2: Virtual Bedside Monitor in OLIVE

[1] Development was sponsored in part by the US Army Telemedicine and Advanced Technologies Research Center (TATRC).

diagnostics and administer specific treatments. If the conditions worsen, and interventions are not applied, a sick patient avatar can even die.

In addition to enabling the practice of responding to of individual patient cases, OLIVE's physiology model plug-in supports scenarios that involve multiple patients being cared for simultaneously. Originally designed to support mass casualty drills in virtual hospitals, this feature enables organizations to practice the operations of clinics, multi-bed hospital rooms or entire departments.

OLIVE's built-in session replay capability is an invaluable tool for debriefing and performance assessment. The playback feature enables instructors and participants to review in 3D all of the discussions conducted and actions taken by the healthcare team during the session. Each session can be played back from any viewpoint, and every event can be reviewed in detail. Instructors can use the replay to provide mentoring and corrective action on the basis of session reviews, so that the participants learn from their mistakes, as well as their correct actions. Learners can repeatedly practice a variety of medical conditions with the interactive, simulated patients until their interventions are successful.

Physiology Model Implementation

The Medical Functionality Module enables developers to add physiology models that either run externally to OLIVE on a separate server (through co-simulation), or that run internally within OLIVE, in a hierarchical finite state machine (HFSM). A co-simulated model can be programmed in any language; medical models for the HFSM are coded in XML.

The first examples of the HSFM-based medical modules were developed in partnership with the Stanford Medical School — conceived by Dr. LeRoy Heinrichs and Dr. Parvati Dev, two of the world's authorities on applying virtual technologies towards advanced medical training practices, who are now the principals of Innovation in Learning (http://www.innovationinlearning.com/). Each model is a rule-base that represents the patients' initial conditions, and how their bodies respond to stimuli, such as injury and drug treatment, over time.

The HFSM is a feature of the OLIVE runtime system. In general, a state machine is a model of behavior composed of a finite number of states, transitions between those states, and actions. Figure 3 below represents a state machine in the form of a table. In this example, if the patient is in State B when Event Y occurs, then the patient will transition to State C. This could represent a transition from being in extreme pain (State B) to moderate pain (State C) after morpheme drip is applied (Event Y).

Current State -> Condition	State A	State B	State C
Event X	...	...	...
Event Y	...	State C	...
Event Z	...	...	...

Figure 3: State Transition Table

The originally models developed by SUMMIT represent mass trauma and sarin gas exposure cases. However, the OLIVE HFSM can be tailored and expanded to handle different medical cases such as MRSA reactions, or the flu. To create new models, developers design a set of patient cases that have pedagogical value, and then design the transition rules that progress those cases from onset through the end of a scenario. Once that design is complete, the HSFM can be programmed using XML. For customers wanting assistance with either designing medical models or programming with XML scripts, IIL and Forterra provide consulting services to support your development efforts.

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