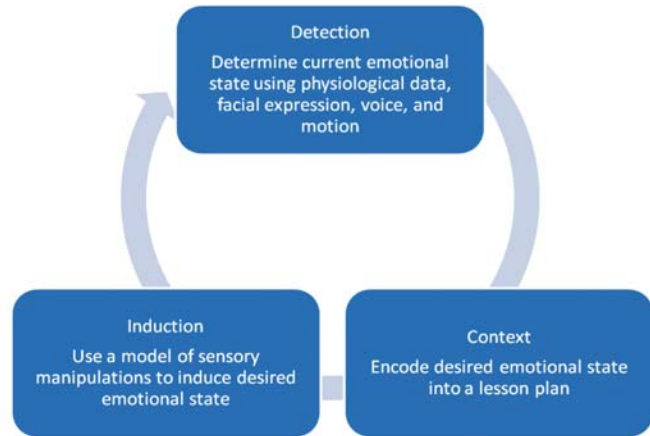


# A Framework for Incorporating Affective Learning in Virtual Training Environments

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## PROBLEM STATEMENT

Virtual Environment (VE) based immersive training systems are effective training alternatives to the costly and time-consuming live training exercises. They are especially necessary for frequent lengthy deployments for US military personnel in modern warfare. Current VE systems, however, exclusively on incorporating the psychomotor and cognitive aspects of learning. This may lead to decrements in learning outcomes due to the lack of an affective learning component in those systems. Inserting an affective component into training systems “will result in more effective training, which, in turn should lead to enhanced transfer of skills for Navy and Marine Warfighters while reducing the cost (time and money) to deliver this training.” (Solicitation N07-078<sup>1</sup>).

Recent findings, from a wide spectrum of science including neuroscience, psychology, and cognitive science, indicate that emotion plays a critical role in a user’s rational, functional, and intelligent behaviors (Picard, 1997<sup>2</sup>). If training systems are to be effective, they must therefore consider the user’s affective state as a key component in learning.

## WHO CAN BENEFIT?

Recognizing the above challenges, VRSONIC has developed a Real-time Affective state Detection and Induction System (RADIS) that incorporates

<sup>1</sup> Solicitation N07-078.

[http://www.dodsbir.net/SITIS/archives\\_display\\_topic.asp?Bookmark=29748](http://www.dodsbir.net/SITIS/archives_display_topic.asp?Bookmark=29748)

<sup>2</sup> Picard. R. (1997). *Affective Computing*. Cambridge, MA: MIT Press.

considerations of affective state and can be applied to any types of virtual environment based training systems that include warfighter training, medical crew training, and aviation training. Initial targets within the Navy/Department of Defense will be on the training commands (TECOM) and integrators who supply training systems.

## **BASELINE TECHNOLOGY**

There are three major detriments in current VE based training systems:

Firstly, current VE based training systems focus exclusively on incorporating the psychomotor and cognitive aspects of learning and trainee's affective state has not been considered. RADIS is a novel approach to incorporate affective learning capability into VE based training systems that enhances existing training simulation frameworks through the integration of affective state assessment and feedback mechanisms.

Secondly, current training using virtual reality systems are simulation based exercises where users go through the training with general mission objectives. For example, in a Military Operations on Urban Terrain (MOUT) training system, users might be instructed to clear an entire building by firing at all enemy units located therein. Nevertheless, typically the users have flexibility in terms of the order of tasks that they need to perform to complete the mission. To ensure training effectiveness, RADIS provides a capability to manage a lesson plan with specific targets that has been established for each training simulation.

Thirdly, current training systems do not generally track trainee performance so that task difficulty can be adjusted in order to implement a scaffolding strategy in the training system. The RADIS system includes a performance measurement component that monitors trainee performance and adjusts training difficulty in accordance with the trainee's capabilities.

## **TECHNOLOGY DESCRIPTION**

RADIS consists of several software components such as (1) affective state detection component, (2) structured lesson plan interpreter, (3) rule base, and (4) affective state induction component. RADIS dynamically monitors a trainee's affective state, compares that state to a target affective state encoded in the lesson plan for that training session, and then uses emotional state induction techniques to drive the trainee's emotional state towards the target emotional state.

RADIS will be combined with the Affective Virtual Environment Training System (A-VETS) that Design Interactive, Inc. is developing and provide an end-to-end scenario design and runtime system for training. A Structured Lesson Plan (SLP) is a formal specification of training that will act as an interface between the A-VETS design tool and the RADIS runtime system. The SLP will be generated

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by training instructors using A-VETS and then implemented at runtime by the RADIS system.

<b>Feature</b>	<b>Advantage</b>	<b>Benefits</b>
Unobtrusiveness	Avoids discomfort and obstruction of trainee's actions.	Avoids decrement of training performance.
Multimodality	Provides a wealth of information about trainee's status.	Improves recognition accuracy.
Training Domain Independence	Provides data-driven design for interface with Lesson Plan Editor.	Allows applicability to any training domain.
VE System Independence	Provides a flexible interface with VE systems.	Allows applicability to any VE training systems.
System Robustness	Results in higher recognition accuracy.	Increases system reliability.
Structured Lesson Plan	Guarantees training outcomes.	Ensures that warfighters are receiving the training they need to be effective in field. This reduces training time, improves mission effectiveness, and provides higher Return on Investment from training systems.
Affective state induction	Improves training effectiveness.	More effective training means that warfighters are better prepared. This will result in higher mission success, enhanced safety, and reduced collateral damage.

### CURRENT STATE OF DEVELOPMENT

Currently, the RADIS system is at the Technology Demonstration stage, Technology Readiness Level 6. Some components of the system are still in development (TRL 5) while others are at TRL 7 as outlined in the table below.

<b>Task</b>	<b>TRL</b>	<b>Due Date</b>	<b>Description</b>
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Affective State Induction	5	Oct. 2009	A strategy for affective state induction capability has been developed.
Structured Lesson Plan Interpreter	7	March 2010	Structured Lesson Plan (SLP) Specification has been developed and the first version of SLP Interpreter system has been also developed.
Rule Base System	7	March 2010	The first version of Rule Base System has been developed.
Affective State Detection	7	May 2010	Affective state detection systems using speech and facial expression are currently under development.

## REFERENCES

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## ABOUT THE COMPANY

VRSONIC, Inc. was incorporated in 1999 in order to develop new technology in spatial audio systems for VE. VRSONIC engineers have extensive experience in commercial and government software production. VRSONIC's founder, Dr. Fouad, is pioneer in the field of spatial audio and real-time systems and has written extensively on those topics. The company has delivered working systems to many government and commercial customers including the Naval Research Laboratory (NRL) audio lab, the NRL VE lab, the Institute for Defense Analysis, the Office of Naval Research, the Lockheed Martin Corporation, and Plymouth University in the United Kingdom. VRSONIC has a number of strategic partners including Design Interactive, Sennheiser, Klipsch, and Global Immersion that enable it to deliver comprehensive solutions to its customers. VRSONIC is a Virginia corporation qualifying as a small business. There are currently seven employees and we anticipate that number to grow substantially over the next year.