NCPS: a new approach for serious pervasive games

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ABSTRACT
In this short paper, we describe elements and key features of ongoing research for serious cyber games, the next generation of serious pervasive games. Serious Cyber Games are based on the Networked Cyber Physical Systems (NCPS) framework provided by SRI International Menlo Park.

Keywords
Distributed knowledge sharing, pervasive games, networked cyber physical systems, serious games, cyber games

Analyzing our previous projects in a cultural context [AST 2011] showed us the importance of pervasivity for learning. As [GUS 2010] explained, pervasivity improves what classic learning theory calls “transfer”, that is: the application of abstract knowledge learned in everyday life. For these reasons, pervasive gaming [MON 2010] has been a starting point of our research work in serious games for cultural heritage. Last statement deals with Alternate Reality Games. It enforces engagement and allows better learning.

We have been deeply involved in different research projects related to pervasive games, and alternate reality games:

- Alternate Reality Games and Augmented Reality Environments: SoundPark [PEL 2010], Paris Overnight University (PLUG-POU) [AST 2011], Alterland [PLA 2011],
- Learning goals and content modelling for adaptive augmented reality based museum visits: ARTSENSE [ART 2013],
- Adaptive gaming, interactive learning and mobile gaming: POU-PLUG [AST 2011],
- Platforms for pervasive gaming: GASP/ubiquitousGASP [PEL 2010], player profile management [PEL 2009], adaptive and pervasive games [GRE 2011], Cloud Computing for MMO pervasive games in the context of the PLAY ONLINE project [PLA 2011],

More recently cyber physical games have been provided by the Networked Cyber-Physical Systems (NCPS) research team from SRI International Menlo Park [CHO 2013]. They offer a new paradigm to execute pervasive games. NCPS transcends Cyber Physical Systems initially proposed by Edward Lee [LEE xxxx]. They formally combine distributed execution to shared knowledge [KIM 2013]. They are based on partially ordered knowledge sharing, a higher paradigm than message passing or shared data based partially ordered distributed systems [RAY 2013].
NCPS are typically designed as a network of interacting nodes that sense and affect their environments. NCPS are the next generation of distributed embedded systems. They usually address swarms of drones or robots [KIM 2010].
The NCPS approach answers a real requirement of pervasive game research. Narration analysis is a common requirement for video research [BOS 2011]. But it is not sufficient. Game designers, and moreover serious game designers, need to formalize quests, puzzles, gameplay events, players' game progression, learning… Then new generation pervasive games need to integrate narratives, learning, players knowledge dynamic and execution monitoring at design time and runtime.

The design of a serious pervasive game has to take care of at least four dimensions:

1. The learning goal is the primary axis of the design. What do you want people bear into their mind. In the context of serious games for museums, learning goal is carried by mediation.
2. The game design and storytelling.
3. The execution platform features to be required to support goals 1 and 2.
4. Players/Visitors Experience evaluation, most people include this requirement as "Quality of Experience".

The balance between goals to be reached and gameplay is difficult. It is an iterative process of fine grain tuning; experimenting game sessions after game sessions, and studying feedback from qualitative and quantitative user experience studies. Most of these lessons have been learnt from the field in PLUG [AST 2011]. We could have done a better job with upper level monitoring tools.

We expect to be able to specify learning and gaming goals as NCPS knowledge statements that in game players/visitors can reach at their own pace. Previous works as [BOS 2011] could help. The key problems to solve are:

- Translate learning and gaming goals as knowledge statements that can be embedded in the NCPS framework
- Verify players/visitors behaviour against previous knowledge statements and detect achievements
- Report events and partial achievements to evaluate accuracy of game and mediation designs

As CNAM-CEDRIC we are users of the NCPS approach. Our research deals mostly with use cases and emerging applications of embedded distributed systems for interactive applications.

This research work is part of a wider project: the SERENDIPITY enabled CYBER GAMEs project, SeCG for short [GRE 2014]. It has been an initiative intended to help enrich research efforts using Augmented Reality Environments as described in the call UAREHERE [IAR 2013] from the US government. The aim of the project is to provide a framework based on cyber-games. SeCG is not currently funded.

The cyber game approach is also intented to be experimented in the context of the CULTE (Cultural Urban Learning Transmedia Experience) project funded by the ANR (National Research Agency from the French government) and labelled by the competitiveness clusters CAP DIGITAL and IMAGE & RESEAUX. The aim of the overall project is to provide an accurate gaming and learning environment for a more engaging and immersive visit. The cyber game approach is not part of this project. But we'd like to compare the cyber game approach with a traditional approach. Our goal is to evaluate how it can match

needs of learning and gaming design at runtime and how to glue it with real museum content for front end devices.

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