

REENACT: Learning about Historical Battles and Wars through Augmented Reality and Role Playing

An EXPERIMEDIA Experiment

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Keywords: Future Internet Research and Experimentation, Technology-enhanced Learning, Augmented Reality.

Abstract: This paper presents one proposal to engage groups of people into immersive collective experiences to learn about a certain historical battle or war, from the point of view of reenactors and historians. The participants will be equipped with tactile mobile devices that interact with an augmented reality platform and an online environment for the orchestration of distributed live games, provided by the technological facility that is being developed within the EXPERIMEDIA FP7 project. We describe the implementation and experimentation plans, including a discussion of the indicators we will be measuring to assess *Quality of Service*, *Quality of Experience* and *Quality of Community*.

1 INTRODUCTION

Human History has been shaped by the outcomes of countless battles and wars. Unfortunately, the classical pedagogy of these events puts them down as occasional events that just happen, that involve two sides (often appearing as the good and the evil forces) and that apparently end fortuitously, as by tossing a coin. This approach neglects many facts about the reasons for the battles, alliances and supporters, why things went on the way they did, what were the winning or losing choices, what were the consequences in the short, medium and long terms, etc. As a result, the general awareness of History in our society is rather partial and deficient, and the students end up with little more than a collection of dates and a vague idea of who defeated who.

Novel technologies provide powerful means to make things better and more interesting. Smartphones and tablets have already been around for some time (Moon et al., 2010; Akkerman et al., 2009; Sala et al., 2011; Lohr, 2011), just like social networking (Arends et al., 2012; Agarwala et al., 2012; Díaz et al., 2012), videogames for learning (Charsky and Ressler, 2011; Watson et al., 2011; Froschauer et al., 2012) and even location-based and virtual reality educational tools (Tosatto and Gribaudo, 2009; Jacob-

son et al., 2009). Combining these elements and going one step further, we present in this paper a new approach (called REENACT) that brings augmented reality (AR) technologies into History learning. The aim is to engage groups of people into immersive collective experiences that will make them learn about the prelude, the course and the aftermath of battles and wars with the aid of tactile mobile devices, repositories of multimedia contents, an advanced technological facility and remote experts. We present the details of the proposal in Section 2, followed by a description of the implementation plan in Section 3. The experimentation plan is presented in Section 4, including a discussion of the indicators we will be measuring to evaluate *Quality of Service* (QoS), *Quality of Experience* (QoE) and *Quality of Community* (QoC). Conclusions about the potential value of the proposal for different stakeholders are given in Section 5.

2 THE REENACT APPROACH

The REENACT experiences will be organised in three stages, that give the participants the possibilities of learning about one event from inside, as reenactors, and from outside, as historians. Next, we will briefly

explain these stages with examples borrowed from the scenario of the Battle of Thermopylae, which is the first event we will experiment with. This event is quite popular as a symbol of courage against overwhelming odds, but it is not really well understood due to non-rigorous treatment in movies and comics. Fortunately, the details reported by Herodotus and other historians provide sufficient scenes to yield both a didactic and enlightening experience to explain such facts as the advantages of training, equipment, and good use of terrain as force multipliers.

2.1 The Reenactment Stage

Stage 1 is about involving groups of people in the reenactment of battles. They will be moving around in a room with a number of QR codes on the floor or on the walls, where they will spend 15–20 minutes immersed in a multiplayer role-playing game with an AR vision provided by tactile mobile devices. The QR codes serve to identify zones in the reenactment space, as needed to enable different actions at different places over time. Figure 1 depicts the zones defined for the Battle of Thermopylae over a distorted map of Greece, including Asia Minor (where the Persians came from to conquer the Greek city-states), Sparta and Thessaly (home of some of the main characters), the settlements of the Persian and Greek armies at Thermopylae, the sky of Elysium (for the Greeks who die and do not get new roles), the Tartarus (the Greek underworld) and the Garothman (the heaven of Zoroastrianism).



Figure 1: Zones for the reenactment room of the Battle of Thermopylae.

After watching a brief projection explaining the

historical context of the conflict, the participants will be lent one tablet, take up one role in the battle and start playing. Using the tablet, each participant will be able to visualise his/her position in the scenery, mapping the zones to real locations on a satellite view that may be overlaid with historical maps as in Figure 2. Additionally, the tablet will be offering the actions each participant may make at any given moment: to advance on a certain stand, to retreat, to fight one way or another, to surrender or not, etc. The choice of possible actions will be a function of each individual's choices, choices made by other characters in the past or decisions made collectively by voting, as determined by a script of the event.

At certain points, the participants will enjoy 360° views of the scenery and 3D contents linked to the markers laid on the floor or on the walls. Likewise, to enhance the feeling of a collective experience, one laptop can be put to use any big screens or projection boards available in the reenactment room to display the visualisation of the scenario of the battle, along with video footage that may serve to illustrate what is going on, and even pictures or textual comments coming from the reenactors' devices. If available, loudspeakers will play accompaniment music and sound effects for further immersion. These features may enhance the educational aspect too, as proved in (Fassbender et al., 2012). We will also exploit the tablets to make the reenactment a playful experience, for example, to play sounds when the device becomes a sword or to allow shooting arrows by dragging a slingshot.

2.2 The Replay Stage

Once the recreation of the battle has finished, the participants will be taken to a projection room to analyse what has been happening. They have already lived the battle from inside, with a very partial vision, and now it is turn to learn more by watching things from outside, and to see how their recreation compares to the real historic events. This second stage of the REENACT experiences will be driven by one expert, who may be physically present at the projection room or appearing on the screen from a remote location. The expert will rely on a record of the movements and actions of each participant during the reenactment. Combining this record with the script of the battle, the expert will be able to identify specific situations lived by the reenactors that could serve to explain important facts about the course of the fights (e.g. to illustrate the technological superiority of one of the opponents, the war tactics employed, etc).

The important point of the replay stage is to relate the reenactors' experiences with the historical

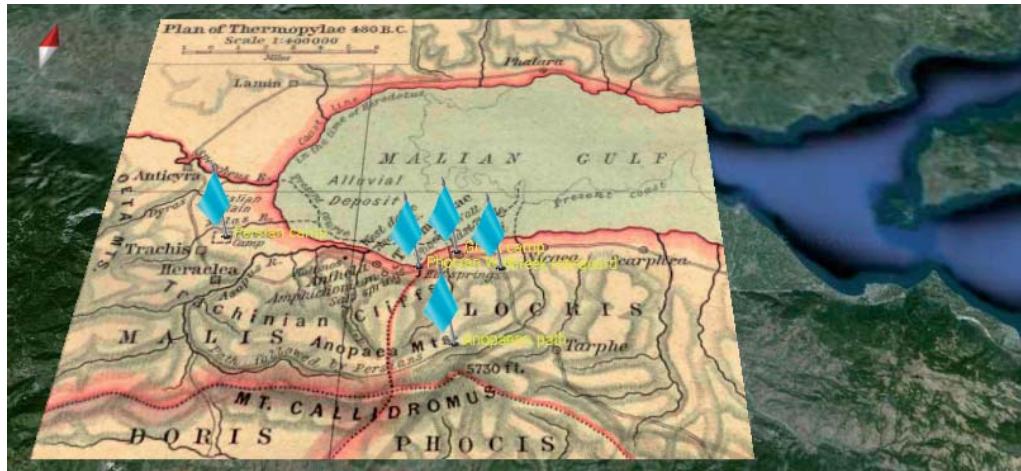


Figure 2: A view of the Thermopylae area with a historical map overlaid.

facts, which should help them to realise and memorise facts that usually go unnoticed in traditional History teaching. Therefore, the expert must devote some time to explaining what aspects of the reenactment diverge from the real facts, either because the scripts make some allowances or because the participants have made the opposite of the real characters' decisions. Also, the expert may choose to run a collective quiz game with multiple-choice questions about the prelude and the course of the event. This may be a qualifying game (the one who misses an answer is eliminated) or a cumulative one (the one who gets the greatest number of correct answers, wins). Typically, there will be only one correct answer, while at least one other option could make sense and at least one would be ridiculous, like in the following example:

- *What type of bridge did the Persians build to cross the Hellespont?*

 1. Two 1.3 km pontoon bridges. (TRUE)
 2. A Roman stone bridge. (FALSE)
 3. A double-decked cast iron bridge. (FALSE)
 4. A suspension bridge. (FALSE)

There will also be questions in which all the answers are correct, just seeing one fact from different perspectives, like:

- *What was the year of the Battle of Thermopylae?*

 1. The 4th year of the 74th Olympiad by the Attic calendar. (TRUE)
 2. Year 274 ab urbe condita. (TRUE)
 3. Year 2157 by the Chinese calendar. (TRUE)
 4. Year 23 by the Achaemenid calendar. (TRUE)

Finally, there may be features for pure entertainment like awards to the best soldiers, rankings of participants ordered by how long they have survived, galleries of user-generated pictures, etc.

2.3 The Debate Stage

Finally, in stage 3 (debate), the expert will drive a collective brainstorming about the consequences of the conflict in the short, medium and long terms, wondering what might have been different in History if things had happened differently. For example, considering the Battle of Thermopylae (which was not really decisive in the broader context of the Greco-Persian wars), the topics for debate will include the following:

- *Would there be fewer ruins in Athens today if King Leonidas had stopped the Persians' advance? Would the Parthenon ever have been built?*
- *Would the Persians have conquered the whole of Europe? And what else? Who would have stopped them: the Macedons led by Alexander the Great the next century, the Carthaginians a little bit later, the Celts, the Vikings, ...?*
- *Would science have developed better or worse? Would the Middle Ages still occur? And the industrial revolution?*
- *Would the Europeans have discovered America, or someone from America have crossed the Atlantic Ocean the other way before? If so, who?*
- *What would our languages sound like? What about sports and music?*
- *Would Zoroastrianism get to be the predominant religion in the world? Would we ever have heard of Christianity or Islam?*

During the debate stage, the projection screen will become a dynamic big board to display comments posted by the visitors, which can be rearranged by the expert. At any time, the expert will be able to choose

multimedia contents to illustrate the different points that are raised. Participants will type their comments using the tactile mobile devices, and, if chosen by the expert, they will have the possibility to explain their ideas or viewpoints to the whole audience in an audio- or video-call. Some arguments can be voted upon, or socially rated as “possible” or “impossible”, “likely” or “not likely”, “interesting”, “absurd”, “original”, so that the most active visitors get some kind of recognition. Again, there may be quiz games to appraise the participants’ understanding of the importance and impact of the battle.

3 IMPLEMENTATION PLAN

The REENACT proposal is being developed on top of the Future Media Internet (FMI) technological facility provided by the EXPERIMEDIA FP7 project¹. As explained in (Salama et al., 2012), the technologies that reside in the EXPERIMEDIA facility have been encapsulated into four components under common type of content:

- The *Experiment Content Component* (ECC) monitors, derives experimental data from, and manages the other components, taking control of installation, deployment at the experimentation venues, running and termination.
- The *Social Content Component* (SCC) gathers and manages data that is generated on social networking sites during the course of an experiment. Internally, it provides access to different social networks (giving read access and publishing capabilities) and also communicates social network monitoring metrics to the ECC.
- The *AudioVisual Content Component* (AVCC) provides services related to the management and delivery of audiovisual contents, including acquisition from a media producer, adaptation and distribution to different platforms, live edition and realisation, and data and metadata synchronization.
- The *Pervasive Content Component* (PCC) provides means to track the users’ locations as a means by which AR content can be selected for delivery and user-generated data can be mapped to a spatial location. It also hosts an augmented reality platform and an online environment for the orchestration of distributed live games.

The REENACT experiences will be delivered by a software system comprising one server and three main interfaces:

¹<http://www.experimedia.eu/>

• The *REENACT server* will centralise access to pre-recorded contents and live streaming through the AVCC, to store the records of events raised during the reenactments and to control what is displayed on the different areas of the projection screen during the replay and debate stages. Besides, it will provide a repository to store the static images and the text documents that may be used for illustration purposes at any time.

- The *reenactors’ front-end* will be provided by an Android application that delivers the interactions envisaged for the participants during the reenactment, replay and debate stages. This application relies on the PCC to render the AR vision of the reenactments on the participants’ devices, and on the SCC to support messaging, ratings and so on during the replay and debate. It also interacts with the AVCC to control the flows of text, images and audio entering and leaving each device.
- The *expert’s front-end* will be a web application providing the controls needed to conduct the replay and debate stages. The application will interact with the AVCC to allow the expert to join from a remote location and to browse multimedia contents. His/her participation will be realised through the SCC as for the other participants, though including means to manage the arguments raised during the debate, including features of real-time parsing (e.g. to highlight key words) and filtering of text messages in cases of foul language or disrespectful/offending comments.
- Finally, the *administrator’s front-end* will provide the interfaces needed to supervise the operation of the rest of the elements during the REENACT experiences, including manual control over the orchestration of events during the reenactment stage and the gathering of information for later evaluation in cooperation with the ECC.

4 EXPERIMENTATION PLAN

The scenario of the Battle of Thermopylae is being developed in collaboration with the Foundation of the Hellenic World (henceforth, FHW), a not-for-profit cultural institution based in Athens that boasts a unique technological infrastructure, including a dome-shaped room that displays 3D contents rendered in real time. The FHW is providing support from expert historians to develop historically rigorous scripts for the reenactments and sets of questions and topics for replays and debates. Besides, their virtual reality department is contributing 3D models for the

AR features as well as some pictures and audio/video footage to put into the content repositories.

The core of our experimentation will be done during the summer of 2013 in the Hellenic Cosmos (the venue provided by the FHW in Athens), but this will be supplemented with trials in the University of Vigo, both *ex ante* (to get early feedback and fix defects in the software or in the experiment design) and *ex post* (to gather further evidence for the evaluation or to assess questions that remain unanswered). Participants will be recruited from among the communities of students, professors, researchers and other staff of the University of Peloponnese and the University of Vigo.

During the experimentation sessions, the REENACT software will be feeding data into the ECC, that will be processed later to evaluate a number of QoS, QoE and QoC parameters. To begin with, QoS data will consider aspects like the responsiveness of the communication with the different pieces of software lodged remotely in the EXPERIMEDIA facility, including the quality and the latency of the pre-recorded videos served to the tablets and the projection screen, the quality, latency and synchronization of the audio and video feeds from the expert's webcam, and the latencies in the communication with the "*Live games*" element of the PCC during the reenactment stage.

Regarding QoE, the REENACT system will keep track of all the movements and actions of the participants during the reenactments, and also of their interactions during the replay and debate stages (including stats about how and when the participants use the different features and interfaces). Additionally, the mobile application will provide brief questionnaires to gather opinions about the REENACT approach and to rate different features of the experience: educational value, level of entertainment, convenience of the interfaces, quality and completeness of the contents, preferences for certain types of contents, etc. Those ratings will be matched against anonymous information about the participants' educational background and interest in specific topics.

Halfway between quantitative and qualitative, the voting and quiz games offered during the replay and debate stages will be used as sources of information about the participants' level of engagement and learning about the historical events. As a research question, it will be checked whether any of the aforementioned parameters depends on the roles played by the participants during the reenactment stage, since it might happen that the QoE measurements are better for someone who has played a main role (say, King Xerxes in the Battle of Thermopylae) than for someone who has played a secondary role (e.g. a Persian infantryman), or maybe that differences appear be-

tween winning and losing sides.

Finally, QoC measurements will look at quantitative and qualitative aspects of the community of people that participate in a REENACT session. To this aim, we will primarily look at the interactions among the participants during the replay and debate stages, e.g. counting the number of ratings and analyzing the length, mood and depth of the comments they exchange using their tactile mobile devices. Special attention will be paid to what happens among people who did not know each other before, for which they will all be asked to tick out the nicknames of their acquaintances right before starting the reenactment stage. Thus, it will be possible to address questions like whether strangers keep distances during the reenactment, whether they comment on the others' arguments, or whether there is any apparent bias in the ratings given to acquaintances and strangers.

Some subjective input from the administrators will also be sought over the different experimentation sessions, to rate the general mood of the participants during the reenactment stage: *were they engaged? Were they apparently bored or having fun? Did they dare to talk aloud when required by their roles?*

5 CONCLUSIONS

Our experimentation is intended to appraise the value impact of the REENACT proposal for museums as well as primary and secondary schools. The data gathered about the aforementioned QoS metrics are mainly relevant to the construction of the EXPERIMEDIA facility, but the QoE and QoC data will be used to assess the truth of the following claims:

- Museum visitors or students will enjoy new entertainment experiences aimed at improving the understanding of historic events, with an opportunity of interacting with one another and with geographically distributed experts.
- Museum guides and educators will be able to participate in a new type of collective experience, supplementing the expertise and knowledge provided by the experts in replays and debates.
- Expert historians will be able to offer their services to collaborate in new pedagogical experiences, interacting more closely than ever before with people interested in knowing more about major historical events.
- Content creators/providers will find an additional outlet for the multimedia contents they produce, which will be usable to provide historically-meaningful explanations to the situations arisen

during the reenactments and to the arguments raised during the debates.

- Last but not least, the experimenters (ourselves) will draw useful conclusions about the ease of use of the game-like interfaces provided for the reenactment, the didactic value of the different stages, the interest of engaging in social discussions, etc. This valuable insight will serve to enhance our ongoing research activities in the area of information services, which deal with various flavours of technology-enhanced distance learning.

Commercial exploitation of the REENACT solution could happen through the selling of the technology, its implantation in the venues, training courses for educators, implementation of reenactment scripts and production of multimedia contents.

ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 287966 and from the Consellería de Educación e Ordenación Universitaria (Xunta de Galicia) incentives file CN 2011/023 (partly supported by FEDER funds).

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