FIRST PROJECT PROGRESS REPORT

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TRAINING AUGMENTED REALITY GENERALISED ENVIRONMENT TOOLKIT

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INTRODUCTION

PROJECT CONTEXT

SCAs (Security Critical Agents) require a range of competencies, knowledge and practical experience to cope with a complex and rapidly changing world. The diversity and relative rarity of situations creates unprecedented challenges for effective SCA training. In addition, due to the increasing visibility of emergency services owing to social media, societal pressures are imposing more expectations from technology, more accountability from emergency services, and less tolerance for errors.

TARGET aims at delivering a pan-European serious gaming platform featuring new tools, techniques and content for training and assessing skills and competencies of Security Critical Agents (SCA), such as counterterrorism units, border guards, first responders (police, firefighters, ambulance services civil security agencies, critical infrastructure operators). Mixed-Reality (MR) experiences will immerse trainees at operational, tactical and strategic command levels with scenarios such as tactical firearms events, asset protection, mass demonstrations, cyber-attacks and Chemical, biological, radiological and nuclear (CBRN) incidents. Trainees will use real / training weaponry, radio equipment, command & control software, decision support tools, real command centres, vehicles. Social and ethical content will be pervasive. Unavailable real-source information will be substituted by AVR (Augmented / Virtual Reality - multimedia, synthetic role players). Near-real, all-encompassing and non-linear experiences will enable high degrees of dynamics and variability. The distributed Open TARGET Platform will provide extensible standards driven methods to integrate simulation techniques and AVR technology with existing SCA training equipment and be customisable to local languages, national legal contexts, organisational structures, established standard operational procedures and legacy IT systems. At key training points real-time benchmarking of individuals and teams will be instrumented. TARGET will support inter-agency SCA exercising across the EU and act as a serious gaming repository and brokerage facility for authorised agencies to share training material and maximise reuse and efficiency in delivering...
complex exercises. TARGET, combining training, content and technology expertise, will be co-led by users and technologists, mainly SMEs. 2 successively developed and trialed versions of the TARGET Solution will support user-technologist dialogue. The TARGET Market Place will enable sustainable impact, commercial uptake and synergies at EU level.

**PROJECT OBJECTIVES FOR THE PERIOD (MAY 2015 TO OCTOBER 2016)**

During the first reporting period the main objective of the project was to identify the training needs of SCA and then work towards developing the TARGET training platform to meet these requirements. The project identified where TARGET will lead to more immersive training experiences and better outcomes. Also where it will be able to deliver customisable scenarios, taking less time to develop and run, and at a lower cost. This led to the development of Mixed Reality (MR) technologies, a base platform, advanced drone technologies and geospatial systems, which when combined with the scenario editing tools and the advanced assessment engine will meet the needs of SCA across Europe.

**PROGRESS AND MAIN RESULTS ACHIEVED FROM MAY 2015 TO OCTOBER 2016**

Phase one of the project focused on requirements capture and the design of the Training Content (TC) scenarios, through the use of contextual enquiry and a training needs analysis. It was accompanied by a specification review process in order to maintain a focus on the end user requirements. The results were fed into the technical work packages to facilitate the development of Version 1 (V1) and future versions of the system.

![Figure 1: WP2 High-level Architecture of the overall TARGET Platform](image-url)
Six training content scenarios were developed and based on the requirements capture phase the key training objectives, MR components and injects were identified. Also taken into account were training issues, the number and roles of the people involved and their interaction and interconnection throughout the command structure. It also identified the real objects and tools required, training evaluation processes, social media injects and relations with the general public.

![Figure 2: Examples for (social) media triggers](image)

The system architecture is split into two subsystems: the TARGET Editor for creating scenarios and the TARGET Runtime for running the scenarios, as showcase hereafter.
The architecture also describes how the different components communicate with each other using Message-Oriented Middleware (MoM). The data storage solution for TARGET consists of multiple storages for different purposes and the separate components will be effectively decoupled from the technology used by the MoM and an access layer between the MoM and the storages. The modelling interfaces provide access to the modelling services. The routing service is already running on IVI’s TARGET server with test data. The current development version of the simulation engine already uses this routing service via the MoM. Other services have already been prepared and may be used in future. The modelling interface will support both internal and external interfaces thus allowing external data (3D object models, map data etc.) to be imported.
The TARGET assessment engine is already operational. The data used to produce performance indicators has been defined, and the editing of data in the performance reports for each TC has started.
A prototype of user interface (UI) for the TARGET system has been designed and mock up systems have been created as storyboards and relevant technical platforms evaluated. The interfaces are being redesigned to support the MobiKat System.

Implementation of TARGET Simulation Engine, using jMonkeyEngine, was started with a general simulation loop; Scripting to support complex scenarios; 3D support (collision detection); and Real-Time physics simulation. The first demonstrator is online, supporting simple movements. The first version of the routing server runs with test data and is accessible by other components via the MoM and Representational State Transfer (REST). Interface requirements have been defined by specifying the Structure Data Output PLY file. A structural diagram was developed describing the modelling components and their relations such as the live modelling input for the TARGET Game Engine, as well as the non-live modelling for the TARGET Geometry Store. There are over 130 2D/3D models ranging from people, weapons, vehicles and buildings to 2D toxic plumes.

![3D model of explosive blast wave due to car bomb](image_url)
The TARGET Photogrammetry Unmanned Aerial Vehicle (P-UAV) has been developed. The P-UAV provides innovative operational characteristics as compared to popular commercially available UAVs, such as a high resolution 36MP camera, mounted on carbon-fibre octocopter providing optimal photo quality due to three axis- stabilized camera gimble, and enabling defined P-UAV position with high accuracy. 3D image vectors for each photo are stored directly.
For the MR aspects, a technical requirements analysis, platform development and hardware selection have been undertaken.
Significant progress has been made on platform integration: a first version of the Geometry Store, and the MR editor, engine and runtime environment have been developed. Hardware options also been tested and evaluated.

Figure 10: TARGET Mixed Reality Hardware examples

Figure 11: TARGET Mixed Reality Engine and Runtime Environment
PROGRESS BEYOND THE STATE OF THE ART AND EXPECTED POTENTIAL IMPACT

The use of contextual enquiry approaches within security sensitive environments and an improved understanding of the costs, technical, ethical and ergonomic challenges that will be encountered was an advance. The findings point to the societal and economic impacts ranging from increased realism to reduction in the cost of training.

TARGET utilises a state of the art enterprise architectural design MoM using JSON based REST messages for communication. Modern encryption technologies and user authentication are used to grant fine-grained access rights and security. The programming-language-agnostic approach uses REST web services for communication; this allows for communication between TARGET components and legacy systems. Polyglot persistence, allows for the usage of various appropriate databases via an abstract layer. An import module supports different data formats. The imported data will be sent internally to the correct components / data stores; therefore allowing connections to legacy systems.

Development of the Platform UI has focused on the design and selection of the underlying frameworks., It is expected that the design of a complex MR training system will require significant advances. The use of real or emulation of real equipment will also be a significant advance and UI challenge.

The TARGET P-UAV provides photogrammetry, flight capability which exceeds commercially available options. As an innovation, Superior 3D models have been developed in a two-stage process, which are based on scientific-engineering calculations. The creation and use of higher resolution 3D models of persons, buildings and vehicles will significantly improve scenario realism. The TARGET P-UAV also provides an increased operational safety due to autonomous landing with an automatic parachute.

Advances in terms of mixed reality environments include integrating sensors and real equipment e.g. the detecting the firing of a real weapon inside a MR environment and the emulation of biohazard detectors/equipment. Blending realities e.g. the connection between command post and virtual/ augmented environments is another area of exploration. The mixing of reality coupled with the ability to create customizable, non-linear training scenarios (serious games) when combined with robust assessment approaches will provide a major advance over existing systems.
## GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation / Acronym</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>AVR</td>
<td>Augmented – Virtual Reality</td>
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<tr>
<td>CBRN</td>
<td>Chemical, Biological, Radiological and Nuclear</td>
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<tr>
<td>MoM</td>
<td>Message-Oriented Middleware</td>
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<td>MR</td>
<td>Mixed Reality (subsumes Virtual Reality and Augmented Reality)</td>
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<td>REST</td>
<td>Representational State Transfer</td>
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<td>P-UAV</td>
<td>Photogrammetry Unmanned Aerial Vehicle</td>
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<td>SCA</td>
<td>Security Critical Agents</td>
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<td>TC</td>
<td>Training Content</td>
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