Publishable Executive Summary

Project summary

In the project a focused consortia of four leading European organisations provide complementary competencies to develop a next generation holographic 3D display that overcomes the limitations of the current 3D visualisation. It will be able to present realistic 3D images to number of simultaneous viewers in a wide field of view, without any common restrictions. Moreover it will answer today's expectations with regard to resolution, brightness, colour, contrast, size (with a hologram screen over 50" diagonal), and will in fact satisfy end-user requirements in professional use.

It will be based on the proven holographic principle enhanced with novel temporal multiplexing. Emerging technologies will be used, like LCOS microdisplays with fast switching speed in single panel configuration with unique polarization method, solid-state technology in the illumination based on high brightness LED-chips of six colours providing the highest possible colour-fidelity, special micro-optical components, plastic aspheric & diffractive optical elements, a redesigned holographic screen. High speed control electronics, backed by a render cluster with proper 3D software solutions and 3D formats based on 3D compression algorithms will provide the real-time dynamic feature allowing to integrate the 3D display to variety of IT systems.

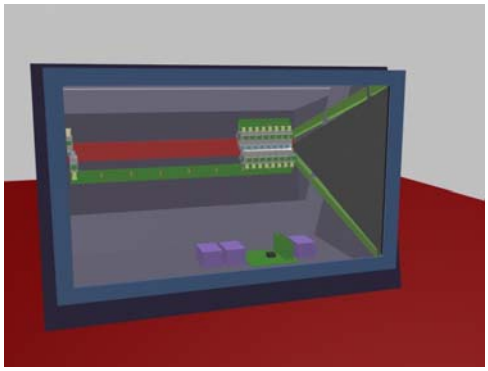
The project work plan includes continuous end-user involvement in the system definition, validation and demonstration activities. As one of the potential applications, a terrain visualisation prototype will be developed, which supports collaborative decision making for 3D environments. The appreciation and understanding of the terrain data will be compared with alternative visualisation using conventional and stereoscopic displays.

The project will target not only challenging final deliverables, but also decisive outcomes beyond the prototype phase, to enable this technology to be among the potential displaying solutions for the future 3DTV.

Summary of project objective(s)

Looking at the major trends in the display technologies and television (B/W, Colour, HD) it is evident that the next step is the 3D. Even though the numerous developments in display technologies recently, even though the lot of improvements in the image quality, resolution, colour, contrast, etc., the view still looks artificial. The difference is the missing third dimension. Viewers should see a 3D image on the screen, as they would see in reality. There was a boom in using and manipulating 3D data in IT systems; still the weakest chain in the information flow remained the displaying that has not yet been solved properly up to now. 3D displays should provide the same level of functionality and freedom that current 2D displays offer while exceeding their capabilities. Systems that cause any optical discomfort or restrain the viewer will not be broadly accepted on the long term. The proposed system is based on well-proved hologram geometry principles and represents a high-end approach in the 3D displaying. Not limited by roadblocks in the principle and with the continuous technology development it has the potential to reach even the hologram quality displaying. When hanging on the wall, future displays should look like a real window, undistinguishable, except the technology working behind. The technology is here, and true 3D can be the most important development, a paradigm shift, in display technologies for the coming years.

The objective of HOLOVISION project is to develop a next generation holographic 3D display that overcomes the limitations of the current 3D displays, reconstructing natural 3D images to number of viewers in a reasonable field of view, with walk-around possibility without any restrictions. Moreover it will answer today's expectations with regard of resolution, brightness, contrast, highest possible fidelity-fidelity, good depth resolution and size.



The display will have a 16:9 aspect hologram screen with at least 50" diagonal. More than 125 million pixels will be controlled to build up a high-resolution 3D image. To form an idea about this value, however there are no standard terms accepted up to now for defining 3D resolution, it is important to emphasize that the number of addressable voxels (volume pixels) is orders of magnitude higher than the number of pixels since various combinations of 125 million pixels address different voxels. Due to the hologram geometry principles, where 2D is a special subset of 3D, the display will be fully compatible with 2D displays, able to show 2D images without the necessity of any switchover. With 2D terms the targeted image resolution is 1024 x 1920. This target is foreseen as a common longer standing value matching HDTV resolution or those equivalents to WSXGA. This will enable this technology to be among the candidates of potential display technologies for future 3DTV.

Participants' list

Participant role*	Participant no.	Participant name	Participant short name	Country	Date enter project	Date exit project
CO	1	HOLOGRAFIKA Kft.	HOL	H	M1	M30
CR	3	STOCKERYALE (IRL) LTD	STY	IRL	M1	M30
CR	4	BAE SYSTEMS (OPERATIONS) LIMITED	BAE	UK	M1	M30
CR	5	Insyte	INS	UK	M3	M30
CR	6	VIDEOTON	VID	H	M2	M30

*CO = Coordinator
CR = Contractor

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Summary of achieved results

The HOLOVISION project started in November 2004. After having set up the project management structure, the Consortia commenced to perform the project plan.

The first half of the project year was a conceptual phase, the basic principles of the Holovision display was identified to meet the initial user requirements. The main goal in the Holovision project is to create new generation 3D display that surpasses the limitations of other 3D displays while no additional equipment is required for the user to experience the 3D vision. Therefore, from the beginning strong emphasize was laid on end-user involvement. An extensive evaluation process was carried out on the state of the art, as well. Based on these inputs the architecture of the system was defined that supports the desired functionality. The preliminary conceptual planning was already set off in parallel with the system specification to iteratively check any potential roadblocks for the later development stages.

In the second 6 month the actual development has begun in every area.

One of the major components of the Holovision 3D display is obviously the **optical system**. The optical design has progressed with the following main steps in the first period of the project. After having modelled the optical system the geometrical configuration of the desired key elements was defined. As of the next phase the development of the special imaging and illumination optics started. The optical design is performed with the help of optical designer CAD software. Being a very complex optical system, the modelling of the system, the design and the optimization of the optics, the thermal analysis of the lenses, etc., are very computation intensive tasks. The other key element in the optical system is the screen. Several screen samples were tested and measurements were carried out to find the most adequate one for the HOLOVISION display.

The other main development area of the Holovision display is the **illumination module** development. Currently the Alpha prototype of the LED-based illuminator is under development. Several LED chips available on the market were investigated and tested to select the most effective chips that can fulfil the desired optical requirements. The LED substrate is already in the prototyping phase, while the design of the necessary driver electronics is in progress. Based on the expertise gained in course of the development of the alpha prototype, a final illuminator module will be prepared in the following period.

After the basis of the system architecture is specified the **microdisplay driver module** development has started. An FPGA based LCOS evaluation board has been designed and manufactured that will enable us to carry out initial display tests and measurements in the following period. In the Holovision display a large number of pixels, over **125 million**, have to be managed, which means a massive bandwidth requirement that has to be fulfilled. Today's displaying technologies are using DVI (Digital Video Interface) that provides a relatively broad bandwidth for data transfers. Since high data throughput is addressed in this project, high-speed electronic devices will be utilized to exploit the maximum bandwidth possible.

The **mechanical design** was started on the basis of the optical layouts and dimensions. Mechanical CAD software is used to model the system and also to optimise the final physical measures of the display. Emphasis was mainly laid on reducing the physical sizes, to meet today's requirements in terms of the device dimensions. This requires a strong co-operation with optical design, since the optical path determines the mechanical size. As a result of this the final mechanical system will be developed on the basis of the final optical arrangement.

Apart from the actual display development the development of a **visual application** started in the addressed period as well. A first prototype of the terrain visualising application has been prepared, which is based on OpenGL and provides a fully configurable solution. The planned application will be controllable via not only the standard computer peripherals as keyboard or mouse but also with special game-pad devices to provide the user maximum freedom in terms of handling and controlling the application.

Beside preparing a standalone application, in the course of the project a special software component will be developed that will offer compatibility between custom applications and the Holovision display.

Further to the technical developments strong emphasis was laid on **validation and preliminary dissemination** activities. Continuous end-user involvement was required to ensure iterative development process. Partners of the consortium attended several exhibitions and conferences and organized workshops to present the planned technology of the HOLOVISION display. A questionnaire has been designed and administered by BAE Systems to potential users at different internal workshops to gather user feedbacks and requirements for existing 3D displays in general and specifically for the future HOLOVISION technology. Beyond that the planned technology was also presented at different international exhibitions such as *European Research and Innovation Exhibition 2005* in Paris and *C+D 2005 - International Defence Forum*, Budapest. To further disseminate the first achievements and results of the Holovision project the Consortium has set up a public website (http://www.holovisionproject.org) that provides also general information on the project.