

<b>Title</b>	INTEGRATED MONITORING SYSTEM BASED ON UBIQUOUS COMPUTING AND AUGMENTED REALITY
<b>Acronym</b>	SICURA
<b>Call</b>	MITYC
<b>Duration</b>	2008-2010
<b>Partners and Collaborators</b>	DRAGADOS, Herrenknech, University of Valencia
<b>Specialty</b>	Construction Processes
<b>Application to work sites</b>	Construction of 112 houses and storerooms in Las Tablas Parking of Manises Airport (Valencia) Machinery Depot of Levante

### PROJECT OBJECTIVE

The purpose of SICURA is the application of Augmented Reality (AR) to construction activities. Within the multiple possibilities offered by this technology, the two applications developed in the project are focused on supporting the company's technical team in two specific processes, the control and monitoring of project work execution and the maintenance of the machinery used on site.

### DESCRIPTION

The SICURA project is co-financed by the MITYC, led by DRAGADOS and undertaken together with Herrenknech and the University of Valencia. From a general perspective, AR allows real information (for example, an image from a camera) to be merged with information generated by a computer to provide the user with additional information in text, sound or image formats. The devices that can be used to take advantage of this technology may range from a smart phone, PDA or tablet PC (for use on site) to a conventional PC (desktop application for remote use).

#### Application of augmented reality as an aid to control and monitoring of project progress

The first application developed in the SICURA project supports the site technical team in tasks such as checking the layout or the project execution, placing of reinforcement, help in generating as-built drawings, taking measurements, etc.

The application overlays project plans (architecture, structure, installations, etc.) on an image of the work site, providing what is known as an augmented image or view. This enhanced view allows the differences between what was planned and what was carried out or is to be carried out to be checked visually and immediately.

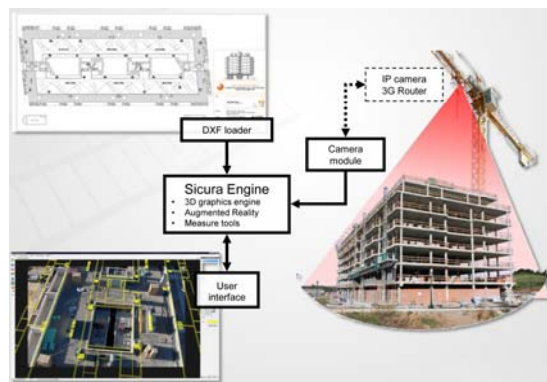


Image 1: Schematics of SICURA functional structure

This overlaying is possible through a simple process for calibrating project drawings and camera images so that the software adapts the layout on the drawing to match the real image of the project. The following details some aspects of the software's functionality:

- Operation with drawings: the application works with the standard formats and allows the multiple loading of drawings, change of measurement units, movement of drawings and the modification of the layers in the drawing (enabling, disabling, change of colour of lines, thicknesses, etc.).
- Image capture modes: to form the augmented views, the image sources can be a fixed image (the image loaded from an existing file in the PC), webcam (images in real time from a webcam or cameras built into laptops, tablets or UMPCs) or from an IP camera (images in real time from an IP camera using the MJPEG format). Currently, the orientation and zoom of the IP camera can be changed in real time with a precision of a few centimetres.
- Calibration: this process is needed to find the correct relationship between the drawings and the images.
- Measurement: various tools have been implemented for linear and area measurements both on the 2D plans and on the augmented view.

The application also allows the storage of photographs of the project taken from any device (camera, smartphone, etc.) and indexes them automatically in their position in the project drawings (once these places have been defined). Photographs can also be linked to comments such as incidents relating to what was photographed, actions to be carried out, etc. The photographs with pending incidents are marked with a red bar for easy identification. The application also keeps a log of the images taken of a given place on the site or of a given incident.

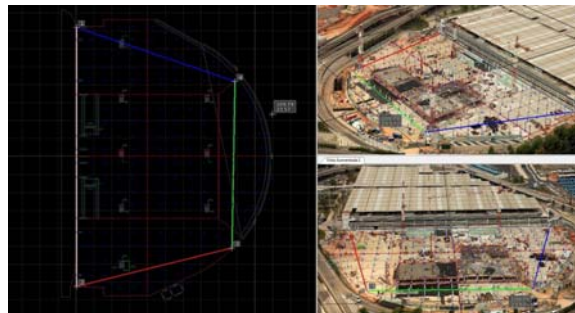


Image 2: Plan of structure projected on an image of the parking of Manises Airport

### Application of augmented reality to aid machine maintenance

In parallel within SICURA, another application has been developed in the field of machinery maintenance and repair processes that uses the advantages of augmented reality. The DRAGADOS R&D and Innovation and Machinery Directorates have collaborated in this project. The operation is similar to the project monitoring application but in this case augmented reality is used to give the worker information in real time on the working procedure scheduled for a specific maintenance action. This additional information can be in the form of 3-D elements, audio, video, text files, etc. as an aid to carrying out these tasks.

The fundamental innovation of this application is that a procedures editor has been created to allow a given maintenance procedure to be defined simply. This procedure is divided into steps (specific activities for each process, each shown in similar way as in a slide). Each step can be enhanced with all types of additional information.

A series of coded marks on the machine is used by SICURA to recognize the machine concerned and its maintenance procedures. SICURA then shows the mechanic the operations to be carried out, how to carry them out and what tools are needed in each step of the procedure. This system helps qualified staff without in-depth knowledge of the machine involved to repair it with maximum guarantees, and even simple

operations can be undertaken by persons with few qualifications or who are in training. This system was validated with mechanics in the Levante machinery depot.



Image 3: Procedures editor interface

**RESULTS ACHIEVED**

The two systems developed have been respectively validated in various building construction works and in one of the DRAGADOS machinery depots.