Augmented Reality as a Tool Supporting Design and Decision-Making Process in Landscape Architecture

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Extended Abstract

Within the framework of the project *Application of digital spatial models in landscape protection and shaping*[1] some experiments were carried out to examine the potential of the AR technology use for the needs of architecture as well landscaping. As a background for creating proper guidelines to conduct research, the author had examined a number of real world implementations of technology to identify the actual drawbacks of applied solutions[2].The research experiment was done in two variants corresponding to two different systems. The first was based on the generally accessible Layar system; the description as well as results of this experiment has been disregarded in this abstract. The other experiment, which is shortly described below, examined the author's pioneer solutions.

1 The MLBE V4 Experiment – The Aim of the Research

The objectives of the task were as follows:

- to create an AR tool free from the inconveniences of the already existing and examined solutions, which significantly affect the effectiveness of their application;
- to examine the limitations and difficulties that are entailed by implementation of an undertaking consisting in placing a virtual model of the designed object in its proposed location with the use of the AR technology;
- to interview a group of professionals from the field of architecture as well as non-professionals – in the form of public consultations on the potential investment project – on the question of reception and usefulness of such technology supporting the design and decision-making processes;

[1] The research has been financed by the National Science Centre within the framework of individual research and scientific project NCN 2001/01/N/HS2/02295: *Application of digital spatial models in landscape protection and shaping*, the project executor: Jacek Konopacki.

[2] Research has been made on basis of articles, visits on site as well individual interviews with researchers responsible for implementation of their own developed methods. 1. AR VTT system cooperation with Arkval Arkkitehdit OY, implementation site: Raseborg, Helsinki, research carried out by team of prof. Woodward, software used; MapStudio and the AROnsite VTT package. 2. Urban Augmented Realty, carried by NAi Rotterdam supervised by Marlies Den Hartogh, 3. The HIT Lab NZ Christchurch New Zealand, AR technology implementation by team of Prof. Gun Lee.

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- a side objective would also be to popularise the technology among designers by offering them the opportunity to learn about the tool's potential during the experiments and workshops.

The experiment held in Cracow, has been possible to be carried in cooperation with Prof. Gun Lee from HitLab NZ University of Canterbury who is the co-creator of the application operating in the Android system and at the same time the person responsible for the software part. System has been designed to meet the expectations of professionals in landscape planning and management. Main goal was to eliminate the deficiencies of the currently existing AR systems destined for visualisation of virtual objects in their planned location. Resulting system is a pioneer solution of this type . The results of the experiments gives satisfactory conclusions that can help to create efficient commercial solutions to support decision-making and project management in the field of landscape architecture.

The characteristic features of the MLBE V4 application which are of key importance for the usefulness of the AR technology in supporting design and decision-making processes in landscape architecture and urban design:

Four available ways of visualising the virtual object in its proposed real context:

1. The traditional method, the object is visualised as an overlay in the foreground.
2. Visualisation of the object together with virtual equivalents of real objects. This type of visualisation allows simulations of the designed object screened by real accompanying objects. Virtualised accompanying objects are represented in the form of opaque simplified spatial forms.
3. Visualisation of the object with virtual semi-transparent equivalents of real objects. This method is a modification of the one described above in the aspect of the accompanying objects display. Such semi-transparent spatial forms facilitate precise calibration of the model for persons with poorer spatial imagination.
4. Visualisation of the object in the form that represents its true impact, if in fact constructed at the site. Methods B and C – described above – allowed screening of the designed object by virtual equivalents of the objects actually existing in the real surroundings. In the case of the fourth method, these objects are not visible on the screen of the mobile device. They act like a mask and thus allow viewing the designed form screened by the simulated actual accompanying objects. This innovative method allows an exceptionally intuitive perception of the designed object by simulating precisely the real impact of the object in the existing spatial context.

Freely chosen by end user from two methods of the user location with key importance for the precision of locating the virtual object in its real context:

- The classic method using the satellite signal, offering satisfactory results as regards the precision of object location. Should not to be used in terms of professional decision making analysis. More to be useful in open landscape, as well as a tool to support public participation processes. Apparent (simulated) location.
- The author's method of fake location offering the possibility of very precise setting of virtual objects in their real surroundings. The application simulates the precise geographic coordinates of the pre-set location disregarding the satellite signal. The accu-

racy of this method oscillates within the range of a dozen or so centimetres, which is absolutely sufficient for professional use even in case of analysing impact of newly designed objects in street scape scale.

Survey evaluating the usefulness of the proposed MLBE V4 system as a tool supporting decision-making and assessment processes in landscape

The experimental in situ use of the application was combined with a survey and observation of the users. The respondents answered 9 questions to evaluate the AR technology usefulness; in the scale from 1 to 5, where 1 was a negative evaluation 3 – neutral, and 5 – the most positive, three questions where answer was Yes/NO. Last question number 12, was an open type asking about pointing out main drawbacks of proposed system. For purposes of the abstract, it has been chosen only those questions and answers expressing main goal of applying such AR system in field of professional practice of landscape designers, urban planners as well architects.

- *Is the fact that the new virtual object is screened by the existing buildings helpful in perceiving the real context of the proposed structure?*
  The users of the application evaluated this function as highly useful. The average evaluation was 4.52, where 60 % was grade 4, and the remaining 40 % grade 5.
- *Are the predefined locations from which the object may be viewed useful?*
  The experiment participants evaluated the opportunity of viewing the object from a predefined location for obtaining precise setting of the virtual object in the real context as useful. The average grade was 4.24, where 20 % was the neutral grade 3, 45 % − grade 4, and 35 % of the respondents evaluated this function as very useful and gave it 5.
- *How do you evaluate the usefulness of this technology as a tool supporting the procedures of public consultations in spatial issues?*
  The respondents evaluated the tool as highly useful for application in the procedures of public consultations. The average grade was 4.76, where 10 % evaluated it as neutral (3), 5 % as positive (4) and the remaining 85 % as highly useful (5).
- *How do you evaluate the usefulness of this technology as a tool supporting design – selection of form or scale?*
  The respondents evaluated the tool as fairly useful as a tool supporting the design process. The average grade was 3.45, where 5 % evaluated it as having little usefulness (2), 5 % as neutral (3), 25 % as positive (4) and the remaining 45 % as highly useful (5).
- *How do you evaluate the usefulness of this technology as a tool supporting the process of deciding upon location of an investment project?*
  The surveyed participants evaluated the solution as useful if applied to support the decision-making process on the location of the investment project. The average grade was 4.52, where 60 % of the respondents described it as useful (4), and the remaining 40 % as highly useful (5).
- *How do you evaluate the usefulness of this technology as a tool supporting the visual assessment – the height of the development?*
  This aspect of the tool usefulness was highly appreciated. The average grade was 4.76, which is the same result as in the case of the question on using it as a tool supporting the procedures of public consultations. The distribution of the answers was as follows:

30 % of the respondents evaluated it as useful (4), and the remaining 70 % as highly useful (5).

The open question, "*What are the problems in the reception of this kind of visualisation?",* was answered in the same way by the majority of respondents. Most of them pointed out to the same deficiencies of the system.

- As far as the equipment was concerned, the respondents pointed out to the aspect of convenience of the used devices. It was emphasised that for professional use definitely 8-inch tablets or bigger should be used, cause it will provide more detail, real impact to be easier to perceive proportionally to the size of the screen. The reflections of the sunlight appearing on the screens of the devices were also considered a bit of a problem.
- As far as the augmented technology was concerned, the use of satellite signal for location of the virtual objects was considered a problem. It was pointed out that the accuracy resulting from the specific character of the system was not adequate. Some of the respondents (5 %) thought it was a nuisance that the virtual object was floating against the background of the picture recorded by the camera of the device.

Summary

The experiments carried out confirmed that the proposed solution is useful and the AR technology should be implemented in a larger scale in the aforementioned fields. During the in situ research with the use of the MLBE V4 application it was observed on numerous occasions that the participants were discussing the matters of the object spatial form and its location proving in this way that using such type of tools support perception of the investment project in its real planned context is highly desirable. The tool was used in the way it was expected to be. The author's proposed solutions allow focusing the users' attention on the methods of effective landscape composition taking into account the existing spatial context. It allows visual assessment from freely selected and dynamically changing locations, which may be done by an unlimited number of users.

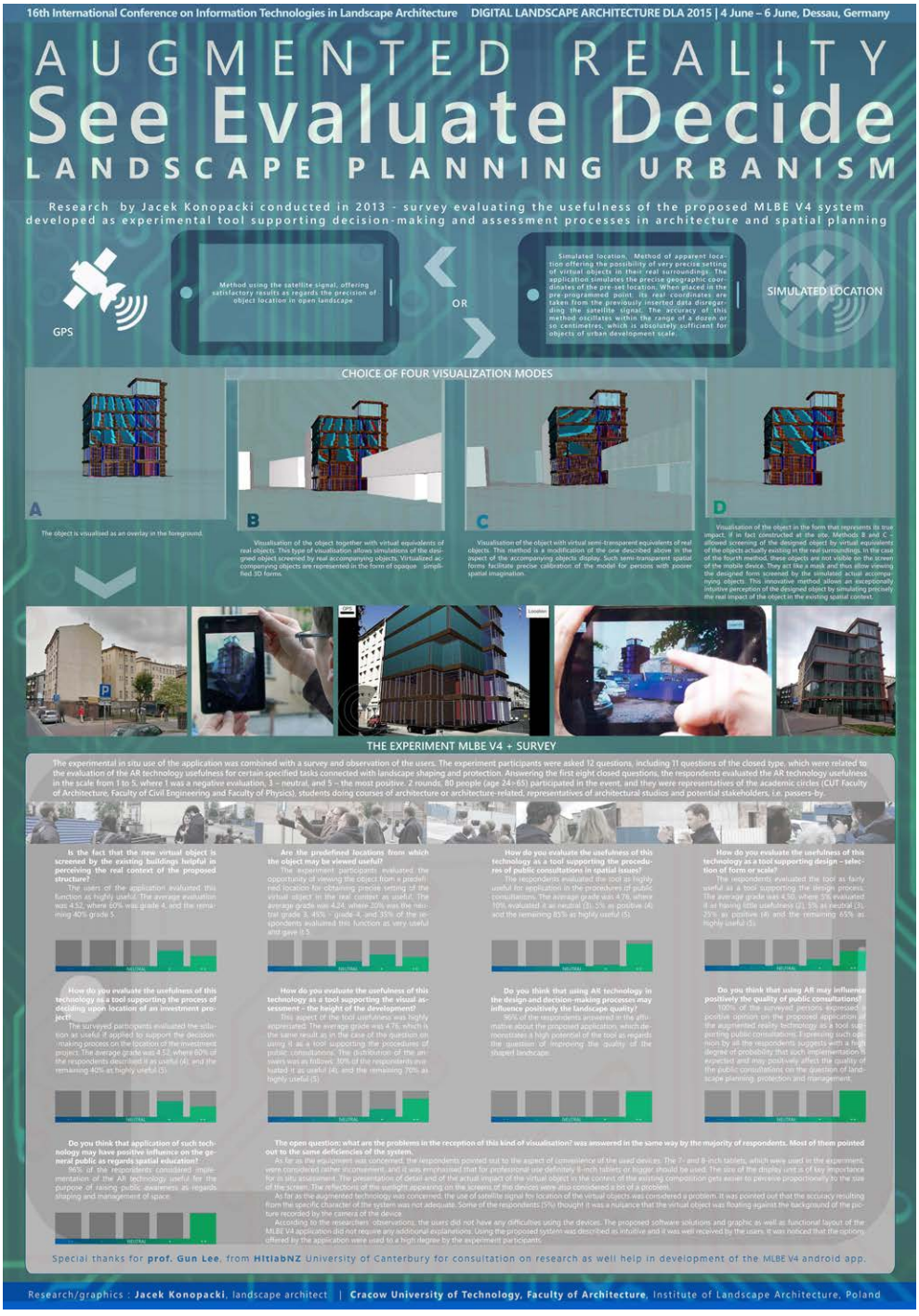

Fig. 1: Poster describing main goals of MLBE4V Experiment; Author: Jacek Konopacki