The ICT as a Driving Force in The Field of Archaeological Research

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Abstract. The paper is a contribution to the domain of computer tools for archaeological excavations and research. The present project described in this paper has been undertaken in close co-operation of specialists from two universities including archaeologists and architects from the CAAD unit. The project objective is to assess the suitability of new media offering an alternative to the traditional methods in archaeological practice.

Keywords. Innovation; Research, Education & Practice; Integration of ICT within archaeological research.

Background of the project

The paper describes a concept of application of Information Computer Technology – ICT within the field of archaeological research.

The use of computer technology within the field of cultural heritage is not a novelty. Multimedia and virtual reality have become the focal points of recent researches (Maver, Petric, 1999). Particularly Virtual Reality – VR proved to be a successful method of presentation of important archaeological sites such as Newgrange in Ireland (Harbison, 1999) or Scara Brae in Scotland (Grant, 1999). There are even companies, such Learning Sites (http://www.learningsites.com) specialising in interactive 3D reconstructions of ancient worlds, e.g. ancient Assyrian palace in Nimrud (Synder, Paley, 2001). Also web sites have become a powerful tool for publicising the archaeological heritage and the example of Kilmartin Glen in Scotland should be mentioned here (http://www.undiscoveredscotland.co.uk/kilmartin/kilmartinglen/ index.html). All the above methods deployed in visitor centres, available on the CD-R or the Internet enable remote access, interpretation, and education. Such use of ICT seems, therefore, to be limited mainly to present the results of archaeological exploration, research and hypotheses.

There is, however, a number of examples of the advanced technologies deployment in the archaeological excavation practice and research. These cover diverse activities such as digital photogrammetric applications (Tsioukas, Sechidis, Patias, 2001) and data collection and management (Koistinen, Latikka, Pontinen, 2001). There were also experiments with systems allowing self-location, mapping, and note-taking during archaeological fieldwork (Leusen, Ryan, 2001).

Methods being currently in use during archaeological excavations in Poland

Poland and other Central Eastern European Countries have not participated in information and technology exchange for the last fifty years as a result of political situation during the times of so-called “Iron Curtain”. What is more, it seems, the gap increases dramatically due to the rapid development of the advanced technologies, from one hand, and the economical disturbances from

another. Presently archaeological practice in Poland uses mainly analogue methods in documentation and research. Traditional method of documenting an archaeological excavation site involves a number of people. It is challenging to direct such a large team to obtain documentation of required quality in a reasonable time.

Typically each archaeological site is first divided into exploration units. Secondly, all measurements are done with ordinary measuring tape and the found objects are inventoried on the sheets of millimetre paper in the scale 1:20. Then, verified are redrawn in the scale 1:100, while the comprehensive drawing is done in scale 1:500. Thirdly separate drawings on the tracing paper are prepared for different archaeological objects (e.g. flints, ceramics, etc.). Fourthly, each object is given its unique ID number and archived within analogue database. The above-described process is the starting point for analyses, interpreting, visualisation of hypothetical settlement layouts and further research. The complete documentation is extensive, it is not surprising then the successful data management and retrieval is problematic. Any analysis demands another redrawing of plans obtained from the excavation site. Furthermore, to achieve detailed information on a particular object, it is necessary to explore not only plans but also catalogues, boxes, etc. As a result the documentation volume increases with every research. What is more, it is even difficult to estimate impact of mistake accumulation during the process of redrawing or data omitting on the actual findings.

There have recently appeared attempts to introduce computer technology to the Polish archaeological practice. The ArchTerra project should be mentioned here (http://www.muzarp.poznan.pl/muzeum/muz_pol/ArchTerra_PL1.htm). The project was, however, focused rather on the Internet-based publishing research results and findings with no impact on the archaeological excavation works.

Methodology

The paper describes a project, which aim was to enrich and largely replace traditional methods in archaeological practice with a new approach deploying digital and computer technologies. Although the aimed target was to introduce advanced technology (using the state-of-the-art technology including GPS, GIS, digital photogrammetry, data bases, etc.) from the earliest stage of work at an excavation site, our work in progress has had to be limited to facilitating data already obtained in the traditional way, described above. The reasons for such a hybrid approach were twofold: first there were budgetary and technological constraints; secondly, the experiment period spanned over the winter time which in the Polish climate is not suitable for any excavation activities.

The prime idea was, therefore, to integrate all the research activities based on the documentation obtained from the site, within one common computer platform allowing full data retrieval. The site from the Neolithic Era at Wilkostowo in Kujawy Region was chosen to test the method and software for the purpose of this experiment.

The present project described in this paper has been undertaken in close co-operation of specialists from two universities including archaeologists and architects from the CAD unit. Usually, collaboration with architects is of crucial importance for archaeologists when working on reconstruction of a spatial character of excavated site. This time it was rather architects experience with management of architectural designs with the use of CAAD software, which appeared to be necessary in comprehensive approach linking archaeological plans and drawings with databases.

At the beginning the hand-drawn plans were transformed into digital documentation with co-

ordinates of all archaeological objects. The task was divided into two stages. First, plans were scanned and transformed into digital equivalents. Secondly, the obtained digital plans were used for the purposes of a database enabling sorting and retrieving archaeological objects by their various attributes. This, along with the use of particular software modules allowed graphic representation of findings.

The software of two types was deployed during this experiment:

- WiseImage Pro by Consistent Software
- ArcGIS by Esri

WiseImage (http://www.csoft.no) is one of the most complete packages for working with raster images and vector files. This software was used during the early stage to receive plans in form of bitmaps and then to vectorise them (Figure 1.). The scanned plans were cleaned and calibrated (with a suitable calibrate grid) to eliminate deformation resulted from the paper bending. Next step was to separate points and shapes representing archaeological objects. Selected elements were moved to different layers to allow further editing. This was done through the so-called "binarisation". After sorting the objects were vectorised and exported to be analysed with the use of another software - ArcGIS.

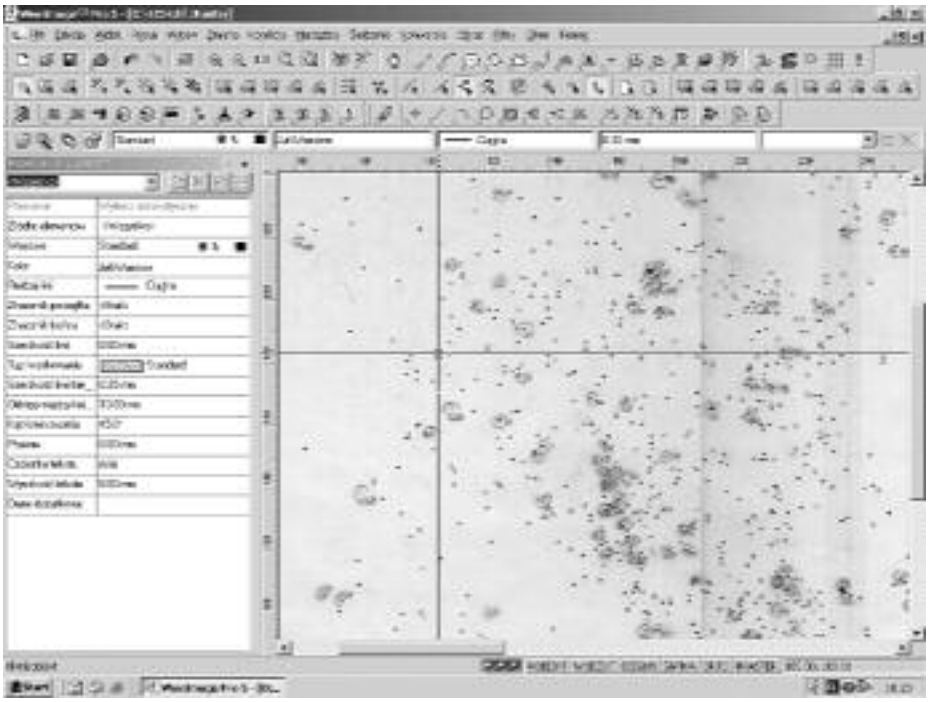

Figure 1. Example of a map digitised with the use of WiseImage.

ArcGIS (http://www.esri.com/software/arcgis/overview) is a family of software being a complete, single, integrated system for geographic data creation, management, integration, and analysis (Figure 2.).

When the graphics is linked with a database (GIS), each point on the map is given a unique identification. For the analytical purposes it was, therefore, necessary to unify the system of objects representation with the use of points, multipoints, lines and polygons. The table in database included detailed information on the objects including location, type, size, etc. This was enhanced with drawings and photographs to form an integrated excavation site documentation. Such an interactive resource became a basis for any further multimedia presentation including schemes, diagrams but also models and animations.

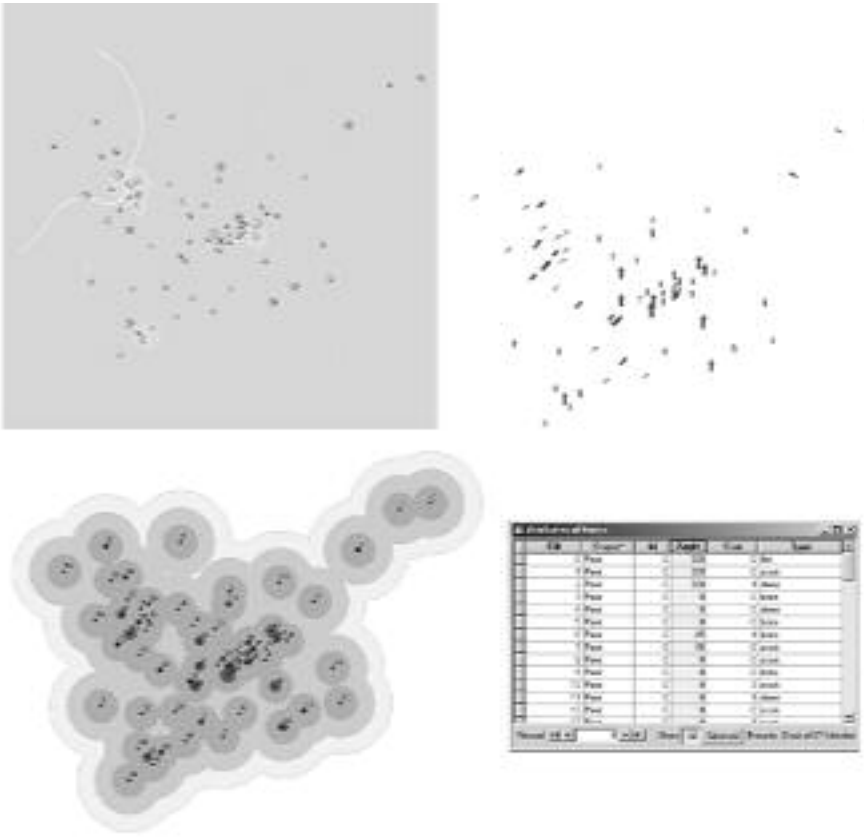

Figure 2. Example of analyses done with the use of ArcGIS.

Results and future prospects

The experiment proved to be a successful method in terms of facilitating the archaeological research with the major focus on streamlining the process and eliminating the paper documentation accumulation. It is clear, therefore, that information technologies have a major role to play in moving towards a more modern form of providing and archiving archaeological material.

It would be, without doubt, more efficient to introduce ICT from the earliest stage of archaeological excavation. The combination of various data sources and methods (including photogrammetric, geodetic, GIS, CAD and archaeological) could enable the cumulative creation of comprehensive database (cf. Dierckx, Stellingwerff, Verbeke, 2002). Furthermore, the collected data can be used as source data when deriving virtual models, functional models or other uses more typical for archaeological practice, e.g.:

maps showing distribution of objects of any particular type;

the layers chronology with a simulation of the riverbed changes;

automation of the ceramics reconstruction process.

Such an approach, merging tools (CAD, CAM, GIS, FM) available due to the latest advancements, would replace the traditional methods from the earliest stage (i.e. determining the location of the archaeological site). It would be even possible to create new template for the whole preliminary process in archaeological research.

To facilitate the research process archaeology should, therefore, keep up with new technologies, as the use of tools of "digital archaeology" opens potential innovations allowing archaeologists to acquire, view, understand, question, interpret and finally visualise the data. The new, innovative approach can even become a driving force in the ongoing research. To conclude, it is necessary to mention that using the ICT opens a myriad of further possibilities in education, promotion and even tourism.

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