ADVANCED 3D VISUALIZATION OF OBJECTS IN CLOSE RANGE

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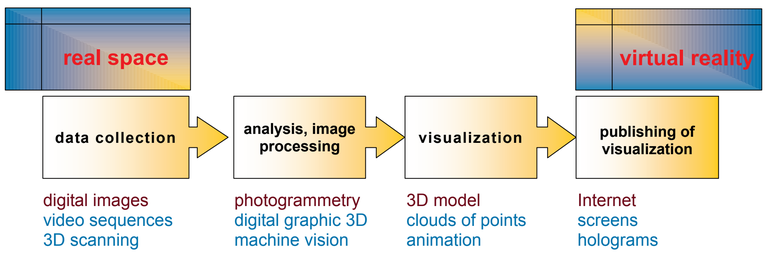
PROCESSING OF REAL SPACE INTO VIRTUAL REALITY



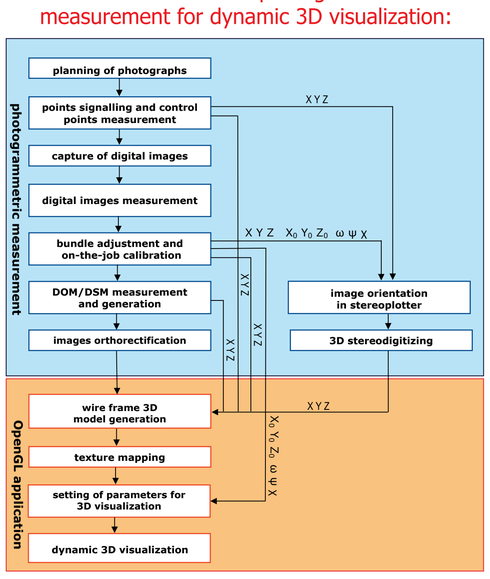
RECENT TOOLS FOR 3D OBJECTS VISUALIZATION

⇒ digital photogrammetric systems with a module for geometrical model construction and it's visualization, e.g. Topcon PI-3000
⇒ software for architectural and engineeral designing and 3D modeling from CAD/CAAD/CAM environments, e.g. AutoCAD, IntelliCAD, MicroStation
⇒ commercial programs for measuring and modeling the real world, e.g. ShapeCapture, Photomodeler Pro, 3D Studio Max, 3D Studio VIZ, Autodesk VIZ 4, AccuRender
⇒ Application Programming Interface (API) technologies, which standards support three-dimensional graphic in modeling and visualization of reality, e.g. Direct 3D, OpenGL, Fahrenheit, Java 3D
⇒ advanced specialized software, e.g. VIT NRC Canada
⇒ Internet tools enabling describing objects and animations in a 3D scene, e.g. Macromedia Flash, VRML, X3D, GeoVRML.

PHOTOGRAMMETRIC MEASUREMENT

The typical process of photogrammetric measurement of digital images consists of the following stages:
⇒ combined bundle adjustment in the object space with simultaneous on-the-job calibration of a digital camera
⇒ measurement and generation of digital object model (DOM) or digital surface model (DSM) in the TIN (Triangular Irregular Network) structure
⇒ digital orthophoto rectification for sample image
⇒ in addition, 3D sterodigitizing on a digital stereoplotter in defined thematic layers of all object parts for the vector planes elaboration
⇒ creation of wire frame models and polygons.

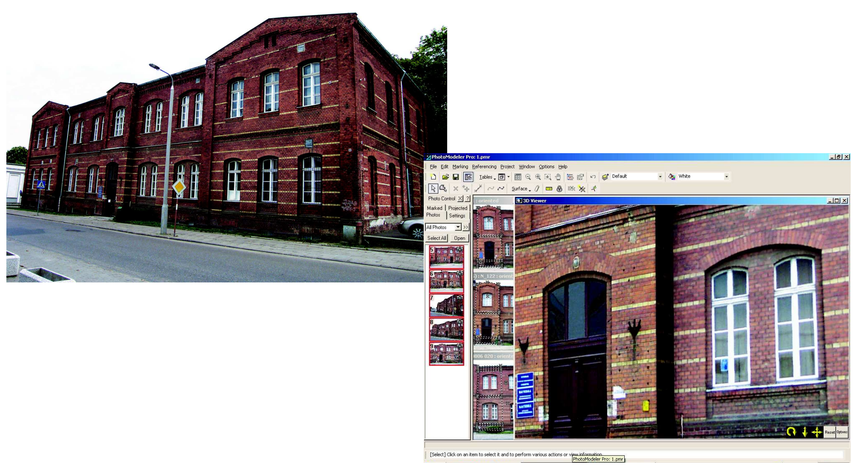
Detailed scheme of photogrammetric measurement for dynamic 3D visualization:

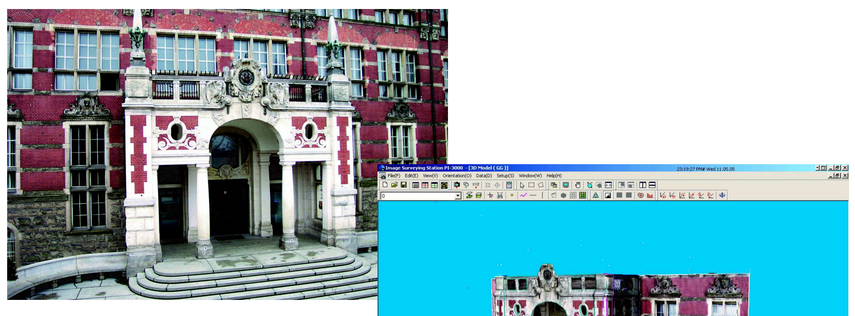


TEST OBJECTS

The authors performed an elaboration of two historic buildings situated in the campus of the Warmia and Mazury University in Olsztyn and the Gdansk University of Technology using the PICTRAN B/D/E/O v. 4.0 program, Video Stereo Digitizer digital stereoplotter, Topcon PI-3000 v. 2.10 photogrammetric system and PhotoModeler Pro v. 5.2.3 program. Architectural objects were recorded with a low-cost, non-metric compact digital camera Kodak DC 4800 with 2.2K x 1.4K resolution.

Test objects in elaboration phase in the PhotoModeler and Topcon PI-3000 programs:





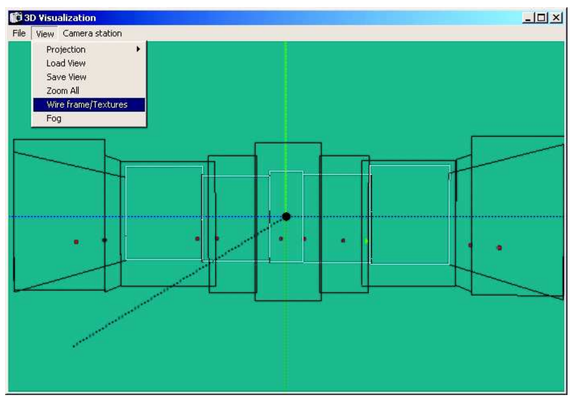
PROPOSED APPROACH FOR 3D VISUALIZATION

Proposed scheme of modeling and publishing of visualization for close range application uses measuring methods and digital photogrammetry systems, OpenGL standard graphic library with GLScene components, the Delphi programming language and Internet tools.

APPLICATION IN THE OPENGL STANDARD

The OpenGL standard was used in our original application for dynamic 3D visualization, since this graphic library is available for all major hardware and system platforms, and has rich documentation. Delphi programming tools enriched with GLScene components, were used in order to simplify the procedures of creating real 3D scenes.
Interactive visualization of 3D scene consists of the following stages:
⇒ import of wire frame model
⇒ select visualization parameters
⇒ changing of the size of textures, to adjust them to the size required by the OpenGL standard
⇒ texture resampling to the optimal size of 1024 x 1024 pixels
⇒ texture saving as 24 bit BMP files, with a description of transparency features (additional 8 bits)
⇒ texture mapping for 3D model
⇒ setting parameters of dynamic 3D visualization.

>>3D Visualization<< program windows:



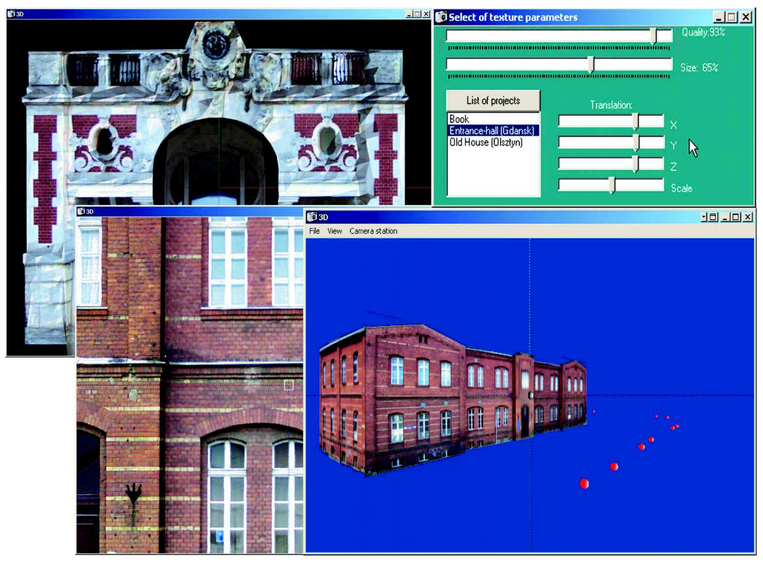
VISUALIZATION VIA THE INTERNET

The application is based on a client-server model, and uses the possibilities offered by the Internet to make the elaborated projects available to numerous users.
The server system offers:
⇒ choice of projects from the presented list
⇒ choice of project level depending on quality and size.
The client interface offers:
⇒ choice of a project
⇒ setting of visualization parameters
⇒ 3D visualization.
Following assumptions were made for optimal hardware:
⇒ mass users will not demand the high accuracy of digital 3D visualization
⇒ users will be enabled to set the level of accuracy and quality of the examined 3D scene
⇒ the application will search for existing projects in the Internet, will download them and enable their 3D visualization.
Project data essential to perform visualization consists of files, which:
⇒ describe the project (names of files, visualization parameters, etc.)
⇒ include geometrical data of visualized scene (quasi TIN)
⇒ include textures.

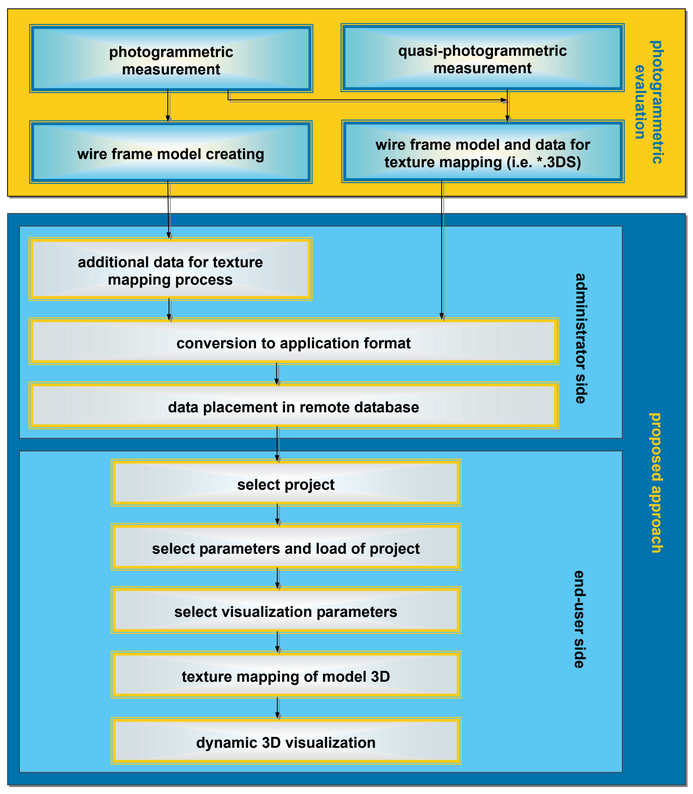
Geometrical data are compressed to LZH format (ratio 40-60%). Graphics of textures are saved in JPEG format (efficient and adjustable compression). Texture files kept on the server are actively modified during the download by PHP scripts located on the server and determined by the user. The user is able to set the level of loss of quality of JPEG images and scale of original texture.

The created client application >>3D Visualization<< offers the following options:
⇒ choose and import a project
⇒ set the size of textures
⇒ set the level of JPEG file compression
⇒ switch on/off camera station location indicators
⇒ switch on/off the axis of the model coordinate system
⇒ set the projection center in one of camera stations
⇒ import/save the coordinates of the projection center and projection angles
⇒ change the visualization scale
⇒ change the type of orthogonal or perspective projection
⇒ translate and rotate the presented 3D model
⇒ add extra visual effects, e.g. fog, changeable lighting (pointwise, dispersed).

>>3D Visualization<< program - visualized projects in user interface:



Process of 3D visualization through the Internet:



CONCLUSIONS

A graphic library in OpenGL standard, Delphi programming tools enriched with GLScene components and Internet tools were used in our original approach designed for dynamic 3D visualization of objects registered in close range. The application is based on a client-server model (a client role is played by Windows OS dedicated software) and, at the current stage, it communicates with PHP scripts using the HTTP protocol.
The application was tested basing on the results of a photogrammetric analytical and digital evaluation and model generation of architectural objects. The application proposed in the study enables dynamic and photorealistic 3D visualization through the Internet of objects recorded in close range.