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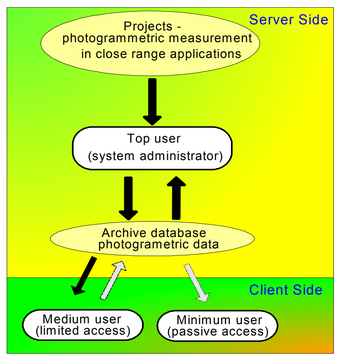
INTERNET DATABASE FOR PHOTOGRAMMETRIC CLOSE RANGE APPLICATIONS

PREMISES OF THE SYSTEM



Concept of the Internet database for photogrammetric close range applications

Designed photogrammetric database may be used in numerous close range photogrammetric applications: in production and quality control processes, vision metrology, deformation measurement, medical and biometric applications, curtural heritage documentation, etc.

The concept of the system is based on granting defined users access to the close range photogrammetric database and its operation in the Internet environment. Designing an on-line application for photogrammetric measurements was not the aim of the project.

Use of the Internet and its related technologies for the controlled sharing, presentation and transfer of data also allows implementation of the proposed solutions across local and corporation networks (LAN, WAN, MAN).

Three levels of access entitlement were defined to protect the database and its structure:

1. Top-Level User – system administration and administrator of DBMS (Data Base Management System), full access, management of projects and access rights
2. Medium-Level User – limited access, authorized user with wide, pre-defined rights, e.g. access to projects and data, ability of its modification and update
3. Minimum-Level User – passive access, viewing and downloading of projects and images without right of modification

Determining three levels of users involved defining their rights, which can be limited depending on a user's abilities and reliability. Users' roles can be dynamic, depending on the present size of the database and users' expectations.

THE STRUCTURE, FUNCTIONALITY AND LOGIC OF THE DATABASE

The universality of the system results from creating a database structure which is able to store all significant parameters of various project types and enables accurate, quick and efficient access to the collected data, as well as its transfer. In order to achieve this aim, the structure of relations, concept and functioning rules were defined.

Following the results of an analysis, a two-level approach was applied, i.e. a standard client-server model instead of three and more layered models, which are oriented on multi-client systems or require enormous computational powers and faster data transfer.

The elaborated basic structure of the database provides following information:

⇒ subject of projects and measurements
⇒ the type of digital elaboration
⇒ the type of digital measurement
⇒ data concerning project
⇒ information on the performer
⇒ parameters of applied digital sensors
⇒ parameters of capture sessions
⇒ parameters of a single digital image (EXIF Info, interior and exterior orientation parameters)
⇒ types and data from image measurements
⇒ types and geodetical observations (control points, distances, lines, polygons, planes)
⇒ results of point measurement
⇒ results of vector measurement
⇒ results of digital image orthorectification
⇒ results of quality and quantity thermal measurement
⇒ results of multi-sensoral processing
⇒ results of data extraction
⇒ parameters of thematical analysis
⇒ 2D and 3D visualizations data and parameters.

"Digital Camera-Sensor"	Characteristic
ID_Sensor	SMALLINT NOT NULL
ID_Name	SMALLINT NOT NULL
Model	VARCHAR(15)
Type_of_Sensor	VARCHAR(4)
Number	VARCHAR(20)
Date_of_Production	VARCHAR(8)
Characteristic	VARCHAR(100)
Total_Resolution	FLOAT
Number_of_ Columns	INTEGER
Number_of_ Rows	INTEGER
Sensor_Dimension_H	FLOAT
Sensor_Dimension_V	FLOAT
Pixel_Dimension_H	FLOAT
Pixel_Dimension_V	FLOAT
Spectral_Range_Min	FLOAT
Spectral_Range_Max	FLOAT
Radiometric_Resolution	FLOAT
Formats_of_Data_Record	VARCHAR(10)
Firm_Ware	VARCHAR(10)

Keys and attributes in the "Digital Camera-Sensor" table

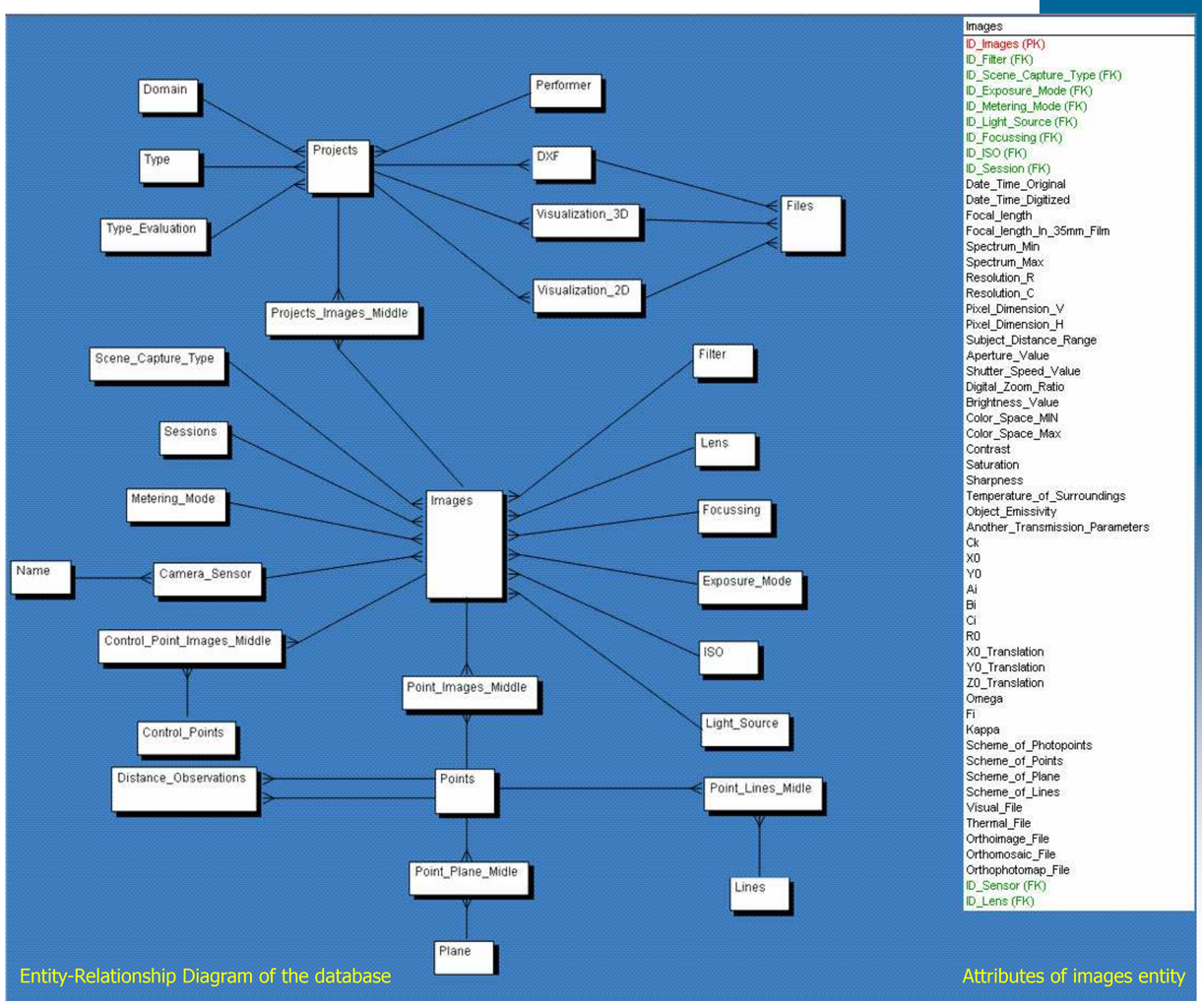
"Lens"	Characteristic
ID_Lens	SMALLINT NOT NULL
Lens_Name	VARCHAR(15)
Model	VARCHAR(15)
Number	VARCHAR(15)
Date_of_Production	VARCHAR(8)
Characteristic	VARCHAR(100)
Focal_Length_Min	FLOAT
Focal_Length_Max	FLOAT
Aperture_Range_Min	FLOAT
Aperture_Range_Max	FLOAT
Schutter_Speed_Min	FLOAT
Schutter_Speed_Max	FLOAT
VOF	FLOAT
Focusing_Mode	VARCHAR(10)

Keys and attributes in the "Lens" table

In the presented system, a freeware Firebird® database server was used. Firebird License Conditions: InterBase® was released by Borland under InterBase Public Licence, a variant of Mozilla Public License Version 1.1 (MPL). It was serviced by Borland Delphi™ programming environment.

A significant division of data was introduced in order to facilitate management of client user groups, reduce data redundancy and increase flexibility and efficiency. As a result, 31 mutually connected tables and views with ascribed various rules were achieved. Advanced access to the database is enabled by the application interface, which enables use of the database structure. The interface's menu varies depending on the logged-in user's entitlement and resources available for a specific elaboration. All relations are a 1:N (one-to-many) type. Tools which significantly support the integrity of data, i.e. triggers, cascade update and, deletion of data from dependent tables, parentless record protection, performance, etc., were also introduced.

The design stage was supported with CASE (Computer Aided System Engineering) - type tools. The modeling of the data was based on the idea of a two-level approach to the data model, which assumes conceptual CDM (Conceptual Data Model) and physical PDM (Physical Data Model) independence of data.



Entity-Relationship Diagram of the database

Attributes of images entity

USER INTERFACE

As a result of the complicated structure of the tables inter-relations (the existence of indirect tables), the core problem was to design a user-friendly interface. A GUI (Graphical User Interface) based on MDI (Multi Document Interface) which enables, for example, working on several projects simultaneously, was chosen. Visualization of the concept of data flows between system tables was conducted based on the tree model, which is subscribed to every strategic table in the system.

Options offered by the client application:

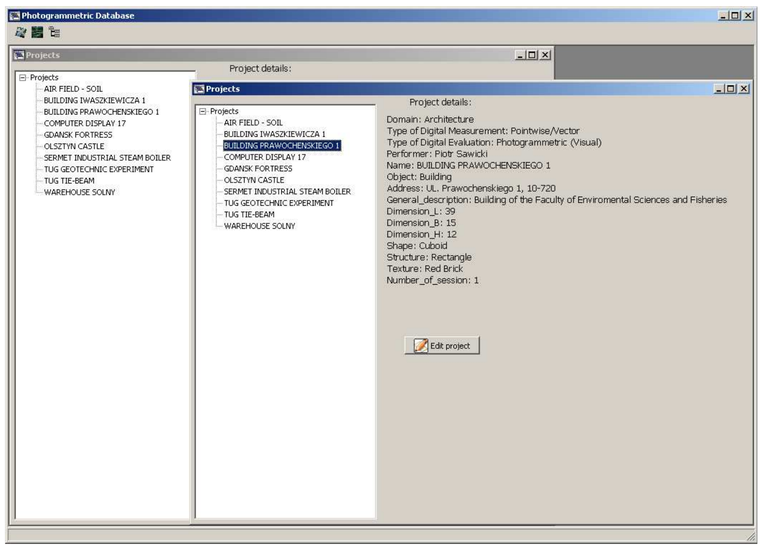
⇒ pre-selection of projects based on their basic parameters
⇒ adding new projects
⇒ showing parameters of chosen projects
⇒ downloading data from projects, e.g. input data (original images and files), output data (interior and exterior orientation parameters, rectified images, orthoimages, files, schemes and ID number of measurement points, visualization 2D/3D and their parameters)
⇒ modification of chosen parameters – option available only for top level users.

ELECTRONICAL DATA SECURITY

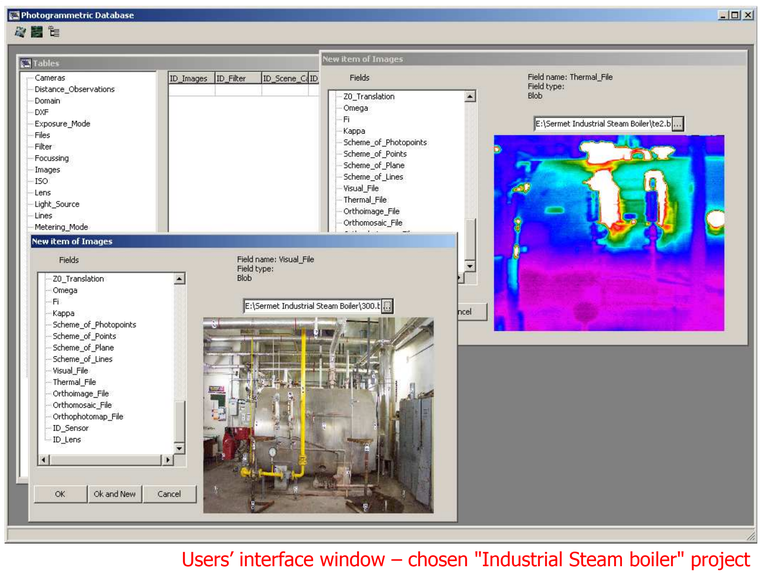
The database is designed for operating in VPN (Virtual Private Network). Determining three levels of access entitlement ensures database security and integrity. Only the Top-Level User is allowed to modify the database structure. The database must respect the confidentiality of processed data and user access rights. In the case of commonly accessible data, the level of protection must be equal to the level of protection of the most confidential resource.

Assuming full security of the host, on which the database system is operating, data transfer is the most vulnerable component of the system. Applied levels of user access are a consequence of efforts to design an efficient system.

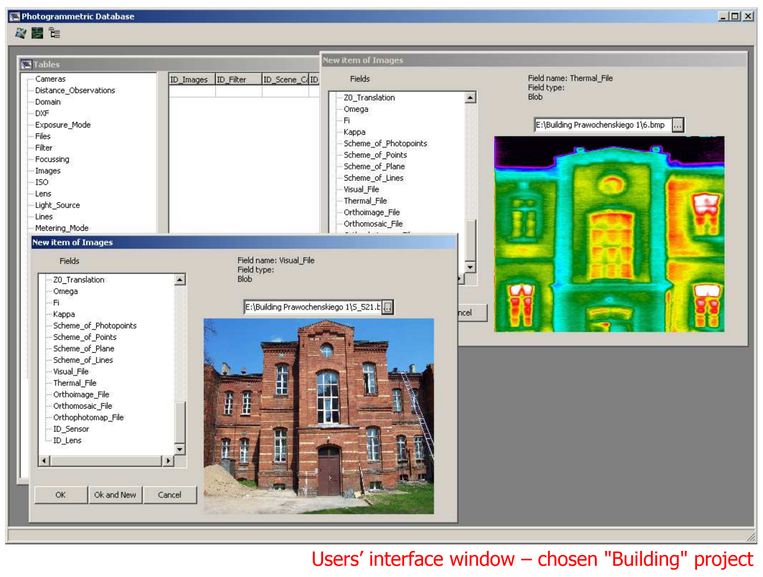
The standard usage of Firebird® does not enable introducing any cryptographic options. Consequently, there is threat of unintentional disclosure of information about customer (login/password) and transferred photogrammetric data packets. For this reason, tunneling SSH (Secure Shell) was introduced with additional, dedicated tools, e.g. PuTTY, ssh.com, OpenSSH. As a consequence, cryptographic properties and data transfer speed were amplified, with the additional application of on-line compression.



Users' interface window – chosen project



Users' interface window – chosen "Industrial Steam boiler" project



Users' interface window – chosen "Building" project

CONCLUSIONS

The presented information system is not an on-line application for real-time Internet measurements. The elaborated database stores and makes numerical and digital photogrammetric and thermographic data obtained from n-dimensional, close range elaborations executed in i-epoche available by twe means of the Internet. Access to the database enables further analysis, processing and extraction of information from photogrammetrical data.

In the system a standard client-server model was applied. Three levels of access (system administration, limited and passive access) of entitlement were defined to protect the database and its structure. In the designed system, a freeware Firebird® database server was used. It was serviced by Borland Delphi™ programming environment. The design stage was supported with CASE tools.

The system is characterized by independence from native Microsoft Windows technologies, such as MS Access™, or MS SQL™, uniqueness, use of practical solutions, reduction of system limitations and a high level of data security. Applied solutions considerably reduced costs of the project.