

# Virtual City Creation

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## Abstract

*We describe the creation of virtual city published on the Internet site and used for city propagation online. Our prototype (Virtual Kremnica) contains digital assets, including stories about town, digital storytelling with comics-like adaptation of legend about the foundation of the city, some Java applets with serious games (15 puzzle, Pairs, Snake quiz), 360° panoramas (dynamic in Java applet, static as .jpg images), short photo-walk, 3D VRML models of memorials, photographs from the past up to the present, vision of the future, and animation of workflow in Flash. The other parts of website consist of map (aerial image) with links to sights and their description, GPS coordinates, photographs and many more.*

## 1. Introduction

What is a virtual city? Dodge, Smith and Doyle [3] wrote that virtual city (VC) is digital equivalent of real city, where a user gets a real sense of being in an urban place. VC provides an electronic hub of services, activities, information and people located at a single place, on computer screen, just like real city is a focal point in geographic space. The term "virtual city" is widely used on the WWW to describe a diverse range of different information interfaces and content. VC can be categorised into 4 broad groups [3]:

- "Web listing" - web sites which describe themselves as virtual cities, but in reality are on-line guides. They are often created for advertising purposes, particularly for tourism promotion.
- "Flat" - use flat maps of cities or buildings as an interface to further information. For example they use a stylised town map as a graphical interface.
- "3D" - use virtual reality (VR) technologies to model the built form of cities, to varying degrees of accuracy and realism.
- "True" - are an effective digital equivalent of real cities, providing people with a genuine sense of walking around an urban place. To fulfil this demanding criterion, a true VC must have a sufficiently realistic built interface, a rich diversity of services, functions and information content, and the ability to support social interaction with other people.

Authors from University College London [9] divide virtual cities into: a) "Mirror World" – a version of reality existing in the machine, city in the computer, a parallel virtual world geographically linked to the earth or other bodies in the universe, b) "Virtual World" – may resemble the real world but which in essence is world created without importing any iconic representation which is tuned to match a real world.

In [6] and [7] authors describe algorithm for virtual city/museum creation:

1. We identify measure of interest and we try to identify globally interesting group of primary data.
2. Collecting of primary data – we document the data, measure, save and transfer from museum to workplace. It is needed to secure all this in technical, financial, secure, economically and effective way.
3. Processing of primary data, selection and creation of secondary data.
4. Design and implementation of hardware and software solution for projected virtual reality in museum and on the Internet.
5. We organize digital multimedia objects into a presentation, i.e. creating of scenarios based on steps 3 and 4. This creates the first prototype.
6. Integration, verification and testing of prototype of our virtual museum with various target groups. Collection of results, ideas, hints. We implement all new ideas and resolve problems.
7. Installation of the final virtual museum. Publication, distribution and propagation. Continuous evaluation of the solution.

We have modified this algorithm a little and have used it in our work.

## 2. Theory Overview

Interesting for us is also thought about virtual versus real towns. Are some of the "ingredients" of a city (chance and change, people, senses, effort, memory, context, contradictions, genius loci etc.) the same in digital and true world? Where are the boundaries between reality and virtuality? What is the relationship between virtual cities and cultural heritage? In [4] are some chapters about these issues.

Whether we are moving in real or in virtual world, we are still deciding by information received from sensory organs: V - visual, A - acoustic, K - kinesthetic (involving feelings coming from outside the body), O - olfactive, G - gustative. VAKOG plays in our thinking and feeling important role [10]. The boundaries of technology limit sensory perception. We use our eyes the most. We can add to the five senses an S - symbolic channel.

To understand the impact of interactive multimedia, it is necessary to make an overview of their structures and characteristics. All interactions take place in some medium. This issue has been written by Peer Mylov [12].

About history, present and mathematical base of VR writes [8]. Virtual world and its representation are talked about in [13]. Theoretical discourse on cultural heritage and digital media is resuming in book edited by Cameron and Kenderdine [1].

How to create an interesting story for DS? Morphology of fairytales - Propp functions will help us (see [4], [11], [14]). More focus on the theory of stories, their tellability and interactivity is in [12]. About neurolinguistic programming and metaprograms writes author in [10].

Interesting information source is also between virtual cities on the Internet, although presentations of cities are varied levels. Some offer interesting virtual tours, others are lagging behind in this direction for several years.

### 3. Virtual Cities and Kremnica

VC integrates data of different disciplines together. For our project, it is a combination of little town and its history, with creative, artistic and literary work, even with a little overlap into the field of psychology and human perception through metaprograms. Moreover, some essential knowledge of mathematics, informatics and computer graphics is needed, which form the theoretical basis of the work. This interdisciplinary project also uses knowledge from fields as virtual worlds, literature, art, history, cartography, cultural heritage, tourism.

We have decided to create our VC from the city of Kremnica, which was known in the past as a rich town, thanks to gold mining and minting nearly native gold florins. In 1950 Kremnica (116 sights) was enlisted in Town Monument Reserve of Slovakia.

Kremnica has a large number of more or less well-known cultural and artistic monuments, landmarks, exhibitions and interesting places in the middle of a beautiful nature. Every year in the town or near vicinity, various events are held. Extensive history associated with gold is tied

to Kremnica together with many beautiful legends. We have decided that our virtual city will be a true image of the famous mining town, but even at best this can not be realistically achieved in detail in a project carried out by one person.

## 4. Implementation

We summarize the whole process of virtual city creation. We present some of the ways on how we have collected data and how we have made photos, and also describe how we have divided websites and created their navigation (PHP, CSS). Subchapters are split according to technologies, which we have used: DS (Flash), serious games (Java), 3D models (VRML), panoramas etc. We briefly add justification of selected technologies and realization process.

### 4.1. Web Sites of Virtual Kremnica

The base of the whole project is website [5] on domain *duskova.sk*. We have created it in the PHP technology version 5 and we try to be SEO optimised and we have also validated all pages against XHTML 1.0 Transitional DTD. Design is valid CSS 3.0.



**Fig. 1. Gate into the Virtual Kremnica**

The index page of the portal (Fig. 1.) is the gate into the Virtual Kremnica (VK). We also provide convenient RSS 2.0 technology, which is used to announce news in VK. On all subpages, there is a project logo, which symbolises gold period of Kremnica.

Website structure of VK comes out from the many possibilities of the town. We tried on the town of Kremnica to apply a theory of metaprograms. Main

hierarchy of VK captures dynamic sitemap. A PHP script scans whole directory structure and formats it into HTML format (multi-leveled list of links). We created custom 404 error page in VK for better usability.

## 4.2. Data and Workflow

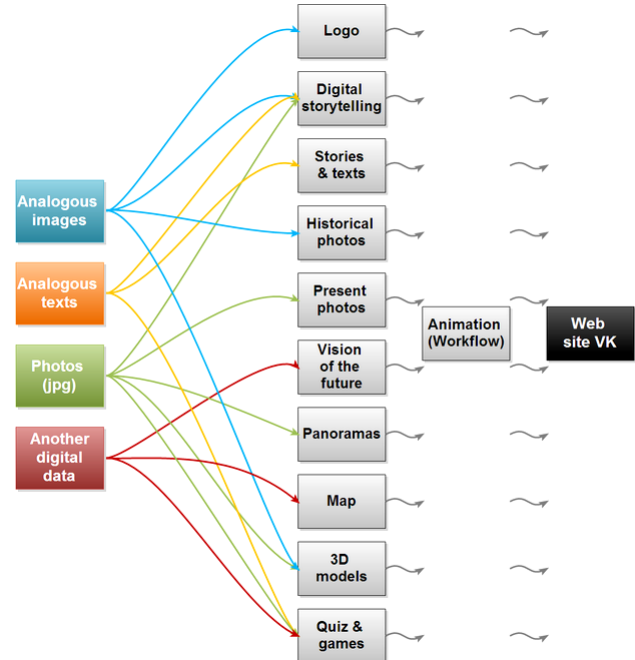
Longstanding and integral part of work on the VK was data acquisition. For many materials, we needed at least a written or oral consent of copyright holders or owners of the photographed object.

**Tab. 1. Workflow for city creation - input and output data**

Part of VK	Format of data (input, processing, output)		
Logo	analogous drawing	digitalisation (jpg), vectorization (svg), correction & export	png
Photographs	jpg	correction (xcf), watermark (php)	jpg, png
Historical photographs	analogous image	digitalisation (jpg), correction (xcf), watermark (php)	jpg, png
Vision of the future	jpg	without changes	jpg
Panoramas	jpg	stitching of panoramas (pano, pto), correction (xcf)	jpg, png
Panoramas 360°	jpg	stitching of panoramas (pano, pto), correction (xcf)	jpg + class
Stories & texts	analogous text	digitalisation (txt, rtf)	pdf, html
Digital storytelling	analogous text, analogous drawing, jpg	digitalisation (txt), correction (xcf, png), interface (fla)	swf, exe
Image map	tiff	trim, editing, scaling (xcf)	html + jpg
Animation (workflow)	jpg, png, svg, txt, avi	combination & processing (fla)	swf
Quiz & serious games	txt, xcf, png	programming (java)	class
3D models	analogous image (map, ground plan), jpg	creating of models (scn)	wrl, avi
Web sites	php, css, xml, js, ...		

We briefly summarize (Tab. 1.) conversion of data from input to output with specific file formats and also brief workflow processing various parts of the virtual city. In Fig. 2 we illustrate the workflow of various relations between input and output data in VK. Four types of input

data transform into many output formats, which are incorporated into the web portal. A brief workflow (animated overview of VK in Flash) is in the section "About project".



**Fig. 2. Workflow for city creation with respect to available data**

## 4.3. Digital Storytelling in Flash

At first, we select a text. The story by Jozef Horak about beginning of Kremnica and colonization of gold mountains around is well known and also popular. Its name in Slovak is "Kremnický zlatý clovek".

By editing of texts and creating a storyboard we have tried to keep maximum of original authenticity of story in digital form. We have created at first a detailed, thereafter a brief outline of the legend, which captures all the important moments of storyline. Then we have created a simple storyboard, which includes an approximate breakdown of the text and the outline of each image.

Our inputs were texts (analogous, .rtf, .pdf, partly .html) and image data (analogous and mainly digital photographs in .jpg, .png). Output was a digital storytelling (.swf in .html, .exe). Other formats used in this digital storytelling creation are .xcf, .eps, .pdf, .svg.

Basic interface, which we have designed for telling story in Flash 8, combines yellow background, vector based borders which create an imitation of old parchment and navigation buttons (Fig. 3.). All these controls have been created directly in Flash environment and are drafted

for a legend or other historical text. To operate the buttons and for other dynamic parts, it was necessary to use ActionScript. For animations of some scenes (changing the size or transparency of objects) we have used layers and Motion Tween technique of interpolation between the key frames.



Fig. 3. Story about beginning of Kremnica in Flash

Next step was image editing. Photos have been saved in .jpg format and retouched. Characters have been drawn manually and then as .png image have been imported to Flash, added into scene, vectorized and then converted to symbol. Last work on comics-like adaptation of legend was to integrate the .swf file into HTML code.

#### 4.4. Panoramas

We have used an ultrazoom camera and tripod for making photographs. We have photographed on the creative or manual mode, where we could fine tune some settings (exposure, ISO, aperture) to adapt to circumstances. In the interior, we have used flash several times.

Stitching photographs into panorama has been realised in the program Hugin or alternatively in AutoPano Pro.

The requirement of some right owners was to remove the safety devices of the shots. Other reasons for the correction were errors arising from stitching panoramas in mentioned software. Photographs in a larger size are in our gallery displayed with the logo of the VK in the bottom. We have created a visible watermark using the PHP graphics library GD (version 2), by combining two images in the final watermarked image.

For publishing panoramas we have chosen Java applet by H. Dersch [2] for displaying of panoramas. In the section of Photo-walk from The Residence of the Chamber Count to The House under the Castle, hotspots are used.

#### 4.5. 3D Models (VRML)

We have created 3D models of buildings in VK from various base sources (photographs, ground-plans, other specific sources: personal visits, historical data). For the creation of objects, we have used the program TrueSpace. Frequently, we have used the program features like sweep or boolean operations. We have adjusted textures in GIMP (deformation of shape, contrast, cropping) and we have mapped textures using UV mapping. Then we have made adjustments directly to the VRML code (inserting animated objects, signature). Editing has been realized in pure text format. We have created three 3D models (The Lower Gate with Barbican, The North Tower and Charnel House, Heraldry of Kremnica), which are located on the VK website in the section "3D models".

#### 4.6. Java Applets and Serious Games

Into the part with games and quiz, we have programmed these applets: Pairs, 15 puzzle and Snake. Every game was slightly modified for the internet conditions and contains topics about Kremnica.

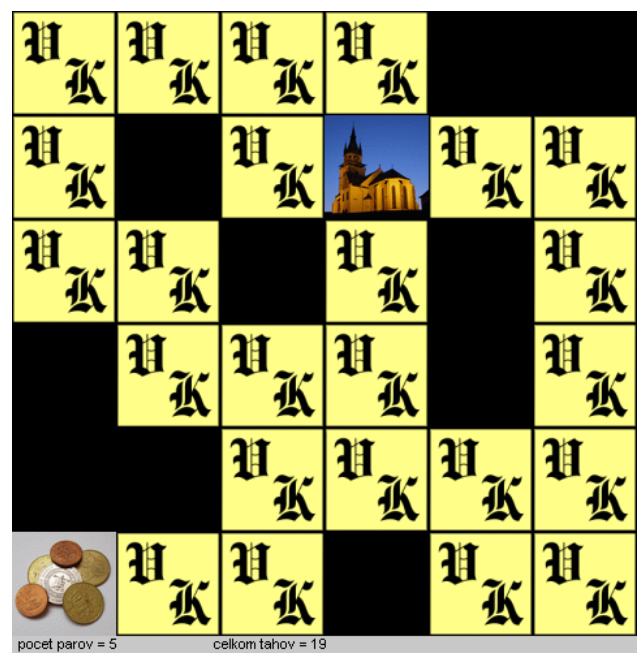


Fig. 4. Pairs in Virtual Kremnica

**Pairs:** Game was modified for one person. On the face of the Pairs are small photos from Kremnica, reverse displays the initials "VK" (Fig. 4.). After successfully finding all the pairs, a photo from Kremnica is displayed with notification of the end of the game. Applet can be easily extended for different languages or different sets of input images. It requires Java Runtime Environment (JRE) version 1.4 or higher.

**15 puzzle:** Graphics version of well known game, where the goal is to put together a sequence of numbers. The program selects a random photo of dominant sight of Kremnica. Algorithm divides the square picture to 16 sections, 15 of which can be put into required sequence by moving 1 piece at a time. Instead of the final piece, an empty black square is shown. Finally, the game displays the entire image together with a message about successful completion. The game works in JRE 1.4 or higher and can be easily extended to more input images or resized board.

**Snake quiz:** The section with mini games also contains a modification of well-known game Snake, which eats little objects on screen. In addition to basic characteristics such as acceleration scaled to 10 levels, ending the game on crash or self-hit, we have enriched this version with a quiz focusing on facts and events from Kremnica. Player is introduced by the story of the Kremnica's white snake legend. In the play area, two types of flowers are generated. When the snake eats the white one, player is given 1 point. When the red flower is eaten, the game is paused and the player must answer a question about Kremnica by choosing from three options. The game ends after reaching 50 points or by crashing of the snake. The player can suspend the game at any time by clicking on the "Pause" button or pressing the spacebar on the keyboard. After the game has ended, player can start again by clicking on "Restart Game".

The game works in JRE 1.6 or higher. Snake can be controlled using the keyboard (arrows). The algorithm generates a random distribution of flowers. In the area, 3 pieces are always present. When one gets eaten, another is added. A separate Java file contains a list of questions (from the past and present of Kremnica together with answers), which generates a random question, when a red quiz flower is eaten. Answers are also shown in random order. With a 25% probability, a flower is generated as a quiz flower, but not more than 5-times during the whole game play.

#### 4.7. Other Parts of VK

In addition to detail described components (listed above) contains VK a register of literature (books and journal publications), and web sites focusing on Kremnica. Another part of the VK includes aerial image, which can be used to access detailed description of the monuments with photographs. Every object has associated a little map with the object's location and also contains GPS coordinates.

On the home page of our portal, every day a PHP script automatically generates three different photos of the day that are chosen from all non panoramatic pictures used

on the pages. For opening photos from different seasons and time periods in higher resolution in a new window, we use JavaScript. We have placed a short public inquiry on pages which is more described in [4].

Web sites actually exist in two language versions. Pages are created in such a way, that a new translation can be easily performed by translating a one file (dictionary). There is no need to modify any source code of VK. For more details of the implementation language version of VK, see [4].

## 5. Conclusions

The project has already had a positive contribution to the city. It is used for propagation of the Kremnica city in digital world. This project was created as a part of diploma thesis, nominated and awarded by various national and international competitions and also published on some Czechoslovak conferences. One person during three years of work collected a vast amount of data from various institutions, processed them and added hundreds of newly captured photographs.

Many technologies are used in the project, such as: XHTML / PHP, CSS, RSS, Flash, Java, VRML, PostgreSQL database etc. Currently, 663 different files (.php, .xml, .wrl, .jpg, .png, .pdf, .swf, .class) create the website of Virtual Kremnica. All the pages try to be SEO optimized and valid against published XHTML, CSS and RSS specifications.

This approach could be used after a little modification in a creating of more virtual cities. Advantages and innovations of these methods are in metaprogram approach. Content is available in many ways (text, image, video etc.). For creating digital storytelling, Propp functions were used.

### 5.1. Discussion and Feedback

One form of feedback was public inquiry in electronic and also paper realisation. We have developed questions for inhabitants of Kremnica and other site visitors. We tried to determine how they perceive Kremnica, virtual cities, and whether they have the knowledge of some of these concepts. Other information we have from the statistics and reports from Google Analytics and other monitoring services (hosting provider, naj.sk).

We have gathered data from various monitoring services. Most services provide information about what visitors are most interested in (visited portal pages), where they come from (country, IP address) and how they have behaved on the web (visit length, number of page view), what are



the hardware and display properties (operation system, browser, screen resolution, support for Java and Flash).

Interesting is also the position of the portal in search engines for certain keywords. To improve the position of pages in full text search engines, as well as increasing traffic, we used the inclusion in the internet catalogs and other forms of promotion. Interesting information from visitors we obtained through personal or electronic feedback.

## 5.2. Future Work

Future plans include the finalization of this project into broad and interesting shape, both in contents and also in programming line.

## Acknowledgements

We thank doc. RNDr. Andrej Ferko, PhD. (FMFI UK Bratislava), RNDr. Zuzana Balážová (city mayor of Kremnica), lieutenant-colonel Ing. Marián Adamják (Topografický ústav Banská Bystrica), major Ing. Marcel Berezny (Topografický ústav Banská Bystrica), RNDr. Peter Borovský (FMFI UK Bratislava), Dr. Adriana Ezrová (MV SR štátny archív Kremnica), PaedDr. Elena Hašková (ZUŠ J. Levoslava Bellu Kremnica), the heirs of Jozef Horák, Ing. arch. Nadežda Hrašková, PhD. (FA STU Bratislava), prof. Peter Michalica, ArtD., Mgr. Mariana Novotná (NBS-MMM Kremnica).

We are also very grateful to the opponents and reviewers of older versions for their valuable comments and opinions.

Our project was partly supported by the Slovak Scientific Grant Agency (VEGA), project No. 1/0763/09.

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