Introduction to Multimedia Cartography

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1. Introduction to Multimedia Cartography

Learning Objectives

You will be able...

- ...to describe what multimedia is.
- ...to list the main developments of multimedia's history.
- ...to identify the characteristic features of a multimedia application.
- ...to explain what multimedia cartography is and describe its main concepts.

Introduction

Maps are a convenient instrument to thematically and topographically visualize the situation of a particular territory. Not long ago, maps were available only on non-electronic media, such as newspapers or journals. In today's computer era, however, maps are also available in digital form, such as on computers, mobile phones, etc.

Various new aspects have to be considered when conceptualizing and designing such digital maps (e.g., the combination of different media, the implementation of interactivity, etc.).

The objectives of this lesson are to demonstrate the effects and components of a multimedia map.

This lesson contains many examples coded in SVG (Scalable Vector Graphics). Each standard-conform browser (e.g., Mozilla Firefox, Opera, ...) can show SVG code but for the Internet Explorer you have to install a SVG Viewer, e.g. the Adobe SVG Viewer. Some of the examples are complex and include additional interactions that might not be described in the text. Beside exploring the obligatory features of the examples, you are free to explore the whole applications in detail. But keep an eye on time.
1.1. What Is Multimedia

Learning Objectives

You will be able...

- ...to distinguish between non-multimedia and multimedia applications.
- ...to list at least four different types of media.

1.1.1. Definition Multimedia

Introduction

In the last few years, multimedia became a common expression. Every day you are confronted with multimedia applications without really realizing it. It is to say that multimedia does not only exist on a computer's screen, but also in today's newspapers. In this unit we will familiarize you with the term multimedia. You will learn what multimedia stands for and some examples will explain and clarify the fundamental ideas of multimedia.

The term "multimedia"

To understand the term multimedia, have a look at the following application and experience the given maps. The following questions help you to understand the example:

- What are the main differences between the three maps?
- Can I interact with the elements of the map?
- Which one of these maps do I prefer?

Click on the thumbnail to reach the example!
The following definitions serve with an answer for some of the above questions:

**Definition of Multimedia**

"Multimedia is interaction with multiple forms of media supported by the computer. The computer is both the tool of multimedia and its medium." (CARTWRIGHT et al. 1999, p. 1)

"Digital Multimedia is considered to be any combination of two or more media, represented in a digital form, sufficiently well integrated to be presented via single interface, or manipulated by a single computer program." (CHAPMAN et al. 2000, p. 12)

**The Term "media"**

The term *media* stands for

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**Multimedia = Combination of Media**

Consequently, the difference between our first two maps of the above example "Different maps" is the number of implemented media. Since the first map contains simply text, it is not considered a multimedia application. The second map, in turn, is a multimedia map as images are implemented that illustrate written parts.
The third map, too, is a multimedia map. But in addition to merely read text and view images, the user may interact with the map elements. As it is shown in the example, the user manipulates the map's appearance by passing over a certain element (e.g., a path \(^1\)) with the cursor.

It is customary for multimedia applications that they feature at least one of the media that is time-depending. We may think of playing an animation.

The use of different media ultimately helps users to understand and to keep in mind a website's content, because persons acquire their knowledge through various sense organs. When a scene has passed through various senses it will be kept longer in one's mind.

If you are interested in the topic "knowledge acquisition through various senses", have a look at the following article:

- Multimedia Design and Development for Distance Teaching of Electronics

1.1.2. Unit-Summary

An application is called multimedia application if at least two media are combined within it. If we speak of digital multimedia, the application has to be presented in a digital form, normally computers.

\(^1\) A path is a sequence of vertices. Thereby the connection type (line, curve) for every two points has to be specified.
1.2. History of Multimedia

Learning Objectives

- You will be able to list the main aspects of multimedia's history chronologically.

Introduction

In this unit we will provide an overview of multimedia's history. It will be shown what technical conditions the development of multimedia is subject to.

One important prerequisite for the development of multimedia systems is the technical development of computer systems themselves.

1.2.1. Hypertext

1945: Vannevar Bush and the MEMEX machine

Generally, the concept of multimedia is based on the concept of hypertext which was invented in the early 1940ies.

In 1945 Vannevar Bush wrote an article about a virtual machine (Memex: Memory Extender) which was able to browse and annotate large collections of documents including a mechanism to create links between various documents. (BUSH 1945)

From Bush's concept evolved the concept of hypertext systems. Hypertext is text which is extended by links. These links act as pointers to other pieces of text that are located elsewhere, either in the same document or in another document or both. Using these links enables users to "browse around" in one or more documents.
Concept of Hypertext

From Bush's concept evolved the concept of hypertext systems. *Hypertext* is text which is extended by links. These links act as pointers to other pieces of text that are located elsewhere, either in the same document or in another document or both. Using these links enables users to "browse around" in one or more documents as you can experience in the following example.
Concept of Hypermedia

Hypertext can be extended to Hypermedia that supports the linking of graphic, sound and video elements in addition to simple text elements. A hypermedia-application is basically based upon two different concepts:

- **page-based**
  Text and images are arranged in a two-dimensional system that is similar to the way text and images are arranged in textbooks and journals. Time-dependent elements (e.g., video and sound) are embedded within the page as if they were images.

- **synchronization-based**
  Time is the central organizing principle. Elements are arranged in time and often a timeline is used so that they are presented as a sequence.
As it has been discussed, both the page-based and the synchronization-based concept have arisen in the 1940ies. Yet only after several years of development could these concepts be converted into running applications as it is shown in the above examples.

1.2.2. ARPANET

The introduced concepts of hypertext and hypermedia were running only on one single computer up to then. In those years, the desire for connecting several remote computers increased steadily until in 1969, a network system was developed met these demands. This computer-network was called ARPANET and was created by the United States Defense Advanced Research Project Agency (ARPA).

ARPANET allowed government and research institutions to share information. A user could log into a remote computer, print documents on a remote printer and transfer files between remote machines. The most significant achievement from ARPANET was the Internet Protocol (IP) and the Transmission Control Protocol (TCP). These protocols constitute the basis for network-communication. Their characteristics will be discussed in a further lesson.

ARPANET was the forerunner of today's internet. Among other services, the internet nowadays renders the service of making available multimedia applications to a wide public.

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2 A network is a group of two or more things or people. This notion is often used in terms of “computer network”, where computer systems are linked together so that they can exchange data and share resources.
1.2.3. Apple Hypercard

Before the internet became what it is today, another technical development considerably influenced the progression of multimedia: In 1987, Apple Computer Corporation developed one of the first hypertext-systems that were available to a bigger group of users: Apple Hypercard (Hypermedia Authoring-System).

Hypercard is a hypermedia programming environment running only on the Macintosh platform. The data models basically consist of cards and collections of cards, so called stacks, and the cards can be connected in different ways. Beside data, each card may contain graphics and buttons that intrinsically trigger other events, such as sound or video. "It most closely resembles a database application in concept, in that it stores information, and is graphical, flexible and creates files that are easy to modify." (Wikipedia)

Each object in a Hypercard system (such as a stack, card, text field, button, etc.) is associated with certain scripts. These scripts contain specifications for actions taking place when a user selects an object with the mouse or when other events occur.

If you want get more information about Apple Hypercard, visit the Wikipedia Website.

Example of Apple Hypercard (copyrighted by Apple). (Wikipedia)
1.2.4. World Wide Web

Up to then, all described services were available only for a selected user group (developers and Macintosh users). To make multimedia publicly available and accessible on all platforms, Tim Berners-Lee developed the World Wide Web (WWW) in 1991. WWW is a hypertext-based system that operates over the internet (be aware that the World Wide Web is not the same as the Internet; the difference will be discussed later on in this module). Distributed documents, stored on remote computers, can be accessed electronically via web browser software. The WWW is made up of three standards:

- The **Uniform Resource Locator (URL)** which specifies how each page of information is given a unique address at which it can be found (e.g. www.karto.ethz.ch)
- The **Hyper Text Transfer Protocol (HTTP)** which determines how a web browser requests information from the server and how the server makes the data available.
- The **Hypertext Markup Language (HTML)** is a mark up language designed for the creation of web pages, i.e., information presented on the WWW. HTML encodes the information of a web-page so it can be displayed on a variety of devices. HTML is generally written in text files stored on computers connected to the internet.

Here is an example of HTML-Code and how it looks in the browser:

```html
<html>
  <head>
    <title>First Homepage</title>
  </head>
  
  <body>
    This is my first homepage
    <b>This text is bold</b>
  </body>
</html>
```

You will learn more about the three standards **URL**, **HTTP** and **HTML** in a further lesson.

1.2.5. Authoring Systems

Today, multimedia applications are customary and yet they are still expanding. With today's advance of authoring systems it is relatively easy for everyone to develop a multimedia application. An authoring system is a program that generates complex multimedia presentations by using text, graphics, images and videos. The user does not have to have in-depth skills in programming languages. Two common authoring systems are Macromedia Flash or Macromedia Dreamweaver. The following example shows how easy it is to produce a small animation in the authoring system Macromedia Flash MX. Just click on the image below to see the example.

This example runs on each browser with the Adobe Flash Plugin. If you have not yet installed this plugin on your computer, download it on the [Adobe Homepage](http://www.adobe.com) and install it on your computer.
1.2.6. Unit-Summary
1.3. Multimedia-Cartography

Learning Objectives

You will be able...

- ...to identify the interactivity of an application.
- ...to list at least two map types and their characteristics.

Introduction

Multimedia-Cartography is a group of multimedia projects. As the name implies cartography is the main issue of these projects. Multimedia-cartography is based on traditional cartography and is its further development. The concept of multimedia cartography as well as its differences to traditional cartography is discussed in this unit. You will learn what interactivity of an application is and you will get to know the difference between various map types.

1.3.1. Interactivity

Cartography benefited a lot from the development and the ideas of multimedia systems and it continuously does. Multimedia cartography derived from the need to intuitively present geographical information on computer screens. In contrast to traditional cartography, a multimedia map combines various media and may feature interactivity.

Experience Interactivity!

Have a look at the following link and experience the application by considering the question What are the interactivities of the application?
(It might take some time to load the application)
In the above atlas example, interactivity is provided by:

- switching on and off data layers,
- clicking on icons,
- moving the mouse cursor over an element and getting some information,
- watching a film,
- listening to sound,
- etc.

The implementation of interactivity in a multimedia map is important as it allows the user to actively manipulate the map. Thus, a map may be tailored to various user's needs and requirements.

**What Exactly Is Interactivity?**
Primarily, Interactivity is a fundamental character of a multimedia application. It comprises the information flow between the user and the machine. Not only can a user manipulate the program flow to a certain extent but also information can be recalled. This recall should occur in a selective, intuitive and associative way. What does this mean? It means that the interactive features of an application have to be obvious so that the user is able to interpret their functions at a glance and without any help. In addition the users should have the possibility to choose which interactions they want to activate. Thus, the user avails information according to his interests.

However, it is important that adequate selection options are provided for interactive elements and that interactivity can be dealt with intuitively. Also, it is significant that users get an immediate feedback of the action they performed.
How Is Interactivity Realized?

Interactivity is realized by different instruments, for example by changing visualization options of a map (transparency \(^3\), colour gradient \(^4\), lighting \(^5\), etc.).

The following examples give you an impression, how interactivity might be realized. The first two examples show how to handle events like "mouse over" or "click". The third one is an example of changing the transparency or colour of an element.

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\(^3\) Transparency defines the ability of an object to allow light to pass through it. Therefore a transparent object is one that can be seen through.

\(^4\) Colour gradient is a smooth blending of shades from light to dark or from one colour to another.

\(^5\) Lighting refers to the devices or techniques used for illumination, usually referring to artificial light sources such as lamps or flashlights.
1.3.2. Map Types

There are two main groups in which screen maps can be divided:

- Static Maps
- Dynamic Maps

Each of these groups can be subdivided into:

- View-only Maps
- Interactive Maps

See also the following illustration.
Web Map Types

- **Static Maps**
  - **view only**
    Static view-only maps are only looked at. Interactions by users are not possible. Scanned maps, for example, are put as bitmap images on the internet. This form of presentation is a widespread way to make maps more widely accessible.

- **interactive**
  Static maps can also be interactive. Interactions, for instance, are provided by offering the user to click on various links, to zoom or pan into the map, to switch on or off some layers, etc. By this way, the user can choose the appearance or the theme of the map. Experience it in the following example by activating or disactivating various layers or by exploring the different navigation options. (If you have a slow internet connection you should better have a look at the navigation elements of the application "Navigation Tool", because it takes quite long to load the application)

- **Dynamic Maps**
  - **view only**
A dynamic view-only map may be realized in terms of a slideshow, by animated GIF images, etc. Images are shown one by one and the web browser software continuously repeats the sequence.

- **interactive**
  Dynamic interactive maps often contain dynamic processes via animations. Animations, in turn are frequently displayed by certain media players (Apple Quicktime, for example). Interaction options, however, are often limited to pause, play, stop, backward and forward buttons as the following example demonstrates (animation works only in Internet Explorer).
1.3.3. Unit-Summary

Interactivity comprises the information flow between the user and the machine. It allows a user to manipulate the program flow to a certain extent or recall information by a selective, intuitive and associative way. Interactivity is realized by different instruments, often by giving a user the possibility to change the visualization options of some elements.

We showed you that there are various types of map. Maps can be either static or dynamic. These maps in turn are split into view only and interactive maps.
1.4. Structure and Navigation

Learning Objectives

You will be able...

- ...to identify the structure type of an application.
- ...to distinguish between different types of navigation and describe in what they differ.

Introduction

Structure and navigation elements are vitally important within any multimedia application. Without them, orientation turns out to be difficult for the user. We will show you that there are different manners to structure your project and that there are different types of navigation.

1.4.1. Structure

Combination of Data

As mentioned above, a multimedia map combines data from different media. In most of the cases, these data are connected and related to each other by links. Many users appreciate this linking of data, because these links assist to understand the map's content or they provide further useful information. Otherwise, too many links may easily confuse the user and leads to a state which is best described as being "lost in Hyperspace". Too many links may deter users from the map and its content. Instead, they are busy to orient themselves. To avoid this effect, the map designer has to link data carefully and deliberately.

Non-Sequential and Sequential Structure

A multimedia project may be structured in two different ways:

- **Non-Sequential**
  Multimedia projects are for the most part composed like a network. Hyperlinks and other instruments recalling available information by non-sequential mode. The user can skip arbitrarily to any position of the network at any time and recall concerted information. In non-sequential multimedia projects it is very important that users are provided with a clear orientation and that they are able to navigate easily within the project in order to not be overcome with the "lost in hyperspace" effect.
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Non-sequential application

- **Sequential**
  Alternatively to the non-sequential method, a sequentially structured application leads the user through it step-wise in an exploratory manner. The downside of this structure is that users can not decide which part of the application they want to deal with next.

Sequential application

Usually, a non-sequential structure is chosen to design and implement a multimedia application.

1.4.2. Navigation

**Three Types of Navigation**
As just mentioned, it is particularly important that these applications are provided with functional user navigation. Users want to know where they are, where they can go next or where they have been within the project. There are three different types of navigation:

- **Spatial navigation**
  Spatial navigation is the process of orientating and moving through a virtual project. Implementations range from static-passive to interactive-dynamic. The following tools frequently serve as spatial navigation elements: arrow buttons, reference maps, pins, indices, paths, destinations, flights, etc.
  The following application is an example of how spatial navigation can be realized. Have a look at it by exploring its navigation tools.
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Spatial navigation (Neumann 2005)

Can you name three kinds of tools that the map uses for spatial navigation?

- Panning
- Zooming
- Reference map
- Full extent
- Location indicator

Temporal navigation
Temporal navigation guides users through the existing time segments of an application. Tools representing temporal navigation are, for example, list and slider or play-button, clock, etc.

The following example includes a timebar with a slider. Mainly the play, stop and pause buttons are used to control the animation. In addition you can manipulate the animation by clicking on an arbitrarily time segment in the time bar. In doing so, the slider jumps to the chosen year (hint: animation works only on Internet Explorer).
Thematic navigation

Thematic navigation takes the user through an application that features modifiable attributes of an application. The structure and arrangement of the navigation elements play a significant role. There are two different ways to structure such arrangements:

1. **Hierarchic**
   
   Step by step the user is led through navigation settings.
   
   In the following example diagrams can be created (click on the button "use test data" to jump to the Map Symbol Brewer). The applications leads you through the different steps.
Hierarchic, thematic application  (Schnabel 2005)

2. **Unstructured**
   The given selections are freely arranged. It is left open to users to define the order of the settings.

Unstructured, thematic application  (Schnabel 2008)

### 1.4.3. Unit-Summary

A multimedia application can be structured in two different ways:

- **Non-Sequential**: The user can skip arbitrarily to any position of the application, which is composed like a network.
Sequential: Step by step, the user is lead through the application.

It is important for users operating with an application that the application always informs them about where they are, where they can go next, etc. Therefore it's important for a user that the application offers a functional navigation.

There are three different types of navigation:

- spatial navigation
- temporal navigation
- thematic navigation
1.5. Self Assessment

Choose arbitrarily a subject that is best visualized in a multimedia application.

Write a short (not longer than one A4 din page) essay about the concept of the application considering following questions:

• Which subject do I want to visualize?
• Which media visualizes your subject most effectively?
• What type of map do I want to implement (dynamic, static, etc.)?
• What is the structure of my application (sequential or non-sequential)?
• Does my project need any navigation elements?
• What are the interactive elements of my map?

If you have no idea what to do in this self assessment have a look at the following example which gives you some hints. In case you can’t find a topic to fulfill this self assessment, we propose you a few topics of which you can choose one.

Example:

Topic: Visualisation of Votings in Switzerland

• Chosen media: Graphics and Text.
• Chosen map: Map of Switzerland divided into districts.
• Map type: Static interactive map.
• Navigation: Spatial and thematic navigation:
  • Spatial: Reference map with zooming, panning and full extend functions.
  • Thematic: Selection lists with year and all votings.
• Interactions:
  • Mouseover effects (conjunction between legend and content)
  • Click effects (Clicking on a district effects to see detailed information about the votings in this district)
  • etc.
• Structure of thematic navigation: Non-sequential (the user can choose the order of the settings)

Topic proposals:

• Population of a country
• Occurrence of bats in Switzerland
• Avalanches in the canton Graubünden (1900-2000)
• Flood water in Switzerland in 2005
• Volcanoes
• My last holidays

Hand in the essay to your tutor.
1.6. Summary

Multimedia-Cartography differs from traditional cartography in several aspects. Digital multimedia combines more than two media. Not only images and text but also timebased elements such as sound, video or animation may be implemented in a multimedia project.

The development of multimedia relies on the development of computer systems in general. An article from Vannevar Bush in 1945 about a machine which was able to link various documents, was the starting point for the development of multimedia. From this concept evolved the concept of hypertext systems. Hypertext is text extended by links. These links are pointers to other pieces of text that are located elsewhere, either in the same or in another document or both. By clicking these links one can browse in one or more documents. Hypertext can be extended to Hypermedia to include the linking of images, sound, etc. A hypermedia application can be either page-based (organized like a book) or synchronization-based (time is the central organizing principle).

In a multimedia-cartography application, the map ought to be the main issue. There are various map types which can be implemented in an application: Static or dynamic maps which can, again, be subdivided into view only and interactive maps. The choice which map type is used in an application depends on the represented subject of the map.

The structure and the navigation of a multimedia application depends also on the function and the subject of the application. A multimedia application may be structured in a non-sequential (the application is structured like a network) or sequential (step by step the user is lead through the application) way.

To get an answer to questions like where I am in the application, where can I go next, etc. is very important for a user. Thus the navigation elements of an application play a significant role. A map may feature several navigation elements: spatial, temporal and thematic elements.

A multimedia map may feature interactivity so that the user has the possibility to interact with the map. A common instrument for realizing interactivity is giving the user the possibility to change the visualization options of a map.
1.7. Recommended Reading

  Chapter 1 and 3
1.8. Glossary

**Colour Gradient:**

Colour gradient is a smooth blending of shades from light to dark or from one colour to another.

**Event:**

An event is an action or occurrence to which an application can respond. Examples of events are clicks, key presses, and mouse movements (Microsoft Developer Network (MSDN)).

**Lighting:**

Lighting refers to the devices or techniques used for illumination, usually referring to artificial light sources such as lamps or flashlights.

**Network:**

A network is a group of two or more things or people. This notion is often used in terms of "computer network", where computer systems are linked together so that they can exchange data and share resources.

**Path:**

A path is a sequence of vertices. Thereby the connection type (line, curve) for every two points has to be specified.

**Transparency:**

Transparency defines the ability of an object to allow light to pass through it. Therefore a transparent object is one that can be seen through.
1.9. Bibliography

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