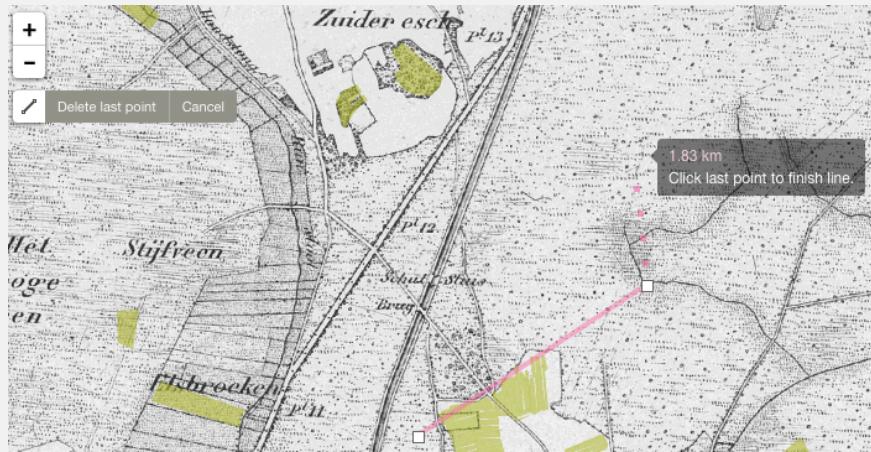


Master Geo-Information Science & Remote Sensing

Internship Report GRS00000



Building a Web-Based Geo-Visualization about
Field-Names of Drenthe

Wageningen University



Waag Society

Project Heritage & Location



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Abstract

Keywords

Abbreviations

H&L

Heritage and Location Project

CH

Cultural Heritage

GIS

Geo Information System

ICH

Intangible Cultural Heritage

RCE

Rijksdienst voor Cultureel Erfgoed

Chapter 1. Introduction

The amount of geospatial data has increased rapidly. Geospatial data is created and used increasingly every day in smart phones, digital maps, satellite navigation systems, websites, services and Apps. Almost 60% of all data is geographically referenced. Next to that, the modern computer technologies provide better opportunities for institutions, organizations and citizens to create and use geospatial data. Already a wide range of domains, use geo information systems [GIS] for management and decision-making purposes and the fields of application are still expanding.(Cartwright, Miller, & Pettit, 2004; Hahmann & Burghardt, 2013; MacEachren & Kraak, 2001; Tensen, 2014)

The magnitude and complexity of data sets with geospatial reference are a challenge in information science. How to transform this data into information and subsequently into knowledge? Data is a product of research, creation, collection and discovery. It is raw material, often boring, incomplete or inconsequential. It is not yet valuable as communication, for it is not a complete message. Often audiences are presented with data instead of information. (see figure) According to Nathan Shedroff, successful communications do not present data. Transforming data into information by organizing it into a meaningful form, presenting it in an appropriate way and communication context is the process to get the story to the audience. The use of the enormous amount of geo data to inform the general public is also still in development. Geo-visualization is one of the tools to turn large heterogeneous geo data volumes from information into knowledge. Geo-visualization integrates scientific visualization, cartography, image analysis, information visualization, data analysis and geographic information systems to provide methods and tools for visual exploration, analysis and presentation of geospatial data. (MacEachren & Kraak, 2001; Shedroff, 1999 ; Tensen, 2014)

The web is being used to produce new visual applications, going beyond the status of maps and other representations of geographic information. The World Wide Web has become an extremely efficient channel for transferring data, and also, has great visual capabilities. There is a need for creating user-centered geo designs to ensure that usable geospatial products are created and delivered. (Cartwright et al., 2004) This raises the interest for geo-visualization in publishing geo-referenced information on the web and getting the enormous amount of available data to the general public (Lin, Gong, & Wang, 1999; Tensen, 2014). Only a few methodologies specifically directed and web geo visualizations emerge which emphasized the scientific information visualization techniques as a way to handle these very large and complex data sets. New visual forms and practices emerge, but how and why do they differ from the more conventional cartographic forms?

In this research, web geo-visualization is explored through a case study in the field of cultural heritage [CH].

There is a big relevance of using geospatial data and geo information systems for the field of cultural heritage conservation purposes. Safeguarding and exploiting CH is high on the agenda and includes the use of digital management systems. Before this was a hand-made task, but with the growing computer science there are new ways for the digital preservation, innovation and updating cultural heritage data. The next step is to document cultural heritage data across geographic space to preserve and safeguard the amount of cultural heritage data on another level. More and more central and local authorities responsible for cultural heritage use GIS as one of the main infrastructure components when digitalizing CH data. (Deal, 2014; Drog, 2010; Meyer, Grussenmeyer, Perrin, Durand, & Drap, 2007; Petrescu, 2007)

For cultural heritage data, the issue of the representation of the results of inventories in mapping systems and updating and maintaining the data, remains open. Web-mapping applications can be used to make open access-easy to use formats, for the assessment and promotion of heritage data. Web-mapping is a suitable tool for visualizing and updating geo heritage data. In general, much of the spatial data being created and shared is strongly visual in nature, including photographs, video, maps and art (Elwood, 2011; Martin, Reynard, Pellitero Ondicolo, & Ghiraldi, 2014)

As stated by Deal:

Figure 1.
DIKW pyramid. From data to wisdom



(Shedroff, 1999)

Visualizations have the potential to greatly improve search and discovery for online collections, transforming how users interact with digital collections. Furthermore, changing technology is making it easier than ever to incorporate visualizations into search interfaces and websites. The time is ripe for cultural heritage institutions to begin experimenting with data visualization in earnest.

In the cultural heritage field, the temporal dimension plays an important role to explore data. (Cerasuolo, Cutugno, & Leano, 2012) Spatial-temporal data visualization assumes an important role in the data presentation to users. The three dimensional data form of geo data (spatial, temporal and descriptive) helps users understand and gain knowledge in the discovery process. This research is part of an internship at Waag Society for the project of Heritage & Location. (see) This report describes the work and the results from the development of a web-application for the project Heritage & Location.

Because a web-application will be built to visualize geographically referenced intangible cultural heritage [ICH] data this will be a design-oriented research. The context is a dataset of field names that were used by the local citizens around 1800 to refer to specific agricultural fields or areas, in Drenthe, the Netherlands. The information about the landscape that is hidden in the names gives a lot of historic information. Yet, noticeable is that this data is only known to a few selected historians. (Spek, Elerie, & Kosian, 2009) The data was supplied by the *Rijksdienst voor Cultureel Erfgoed* and based on the book “*van Jeruzalem tot Elzelakker, levende veldnamen van de Drentse Aa*”. More about the data will be described in chapter .

The research will be built up in 3 parts; first the possible visualization techniques will be explored through literature study. With the chosen techniques, the application will be built, for which certain design goals and requirements will be defined. In the end the application will shortly be evaluated.

1.1. Design goals

1.

The goal is to preserve the living heritage names of Drenthe, which are mostly stored in people's memory and so will disappear.

2.

Give people the possibility to explore them, discover them. For names cannot be found in the real surroundings, only in people's memory and now given a place to exist.

3.

Getting the stories out of the raw data and show people the surprising knowledge that stays hidden. Help people explore intangible cultural heritage and so the history of the Dutch landscape. Engage people in something interesting about the landscape.

We will do this by building an attractive web-application for the project Heritage & Location to show its potential of visualizing heritage data and preserving them. A big part of the web application will be a geo-visualization of the intangible cultural heritage data set of living field names from Drenthe. The interactivity of the web application, will give users the possibility to discover the names themselves in relation to the environment. The focus is on revealing hidden meaning of the raw data, to the general public.

1.2. Target group

The target group will be defined as the common citizen, living in Drenthe and show an interest in their direct environment and want to discover something about its history. It will not specifically be targeted at children or elderly but to a general public. The target group's language is Dutch.

1.3. The objectives

A. The target group must feel:

1. Attracted to use the application

2. Attracted to stay and play around with the application

3. Challenged to explore more

B. The target group must be able to:

1. Discover the meaning of the field-names in relation to their environment

2. Discover interesting stories and surprising facts about the field-names

3. Understand the field-names and their value

C. The application must be:

1. Intuitive and simple to use, so it shows quick and surprising results on the actions of the target group

2. Technically working in an efficient and error-safe way. User friendly.

Chapter 2. Background

In this chapter, the field names are further explained and their role in the cultural heritage field. Therefore, Also the field of cultural heritage is explained and its categories. Because this research was conducted in the scope of the Heritage and Location project at Waag Society, this will also be elaborated on. Also some background information on geo-data and the combination with heritage is given.

2.1. Field-names in Drenthe

A field-name is a toponym used for a small area of land or a certain surrounding. Mostly arable land, pasture lands, wastelands, uncultivated areas, hills, valleys, woodlands and swampy areas. The names are thought up by the local inhabitants for practical use in communication and spatial orientation. A field-name is often only existing in oral form and originates, develops or disappears while the environment changes. This makes field-names living heritage (see next section) and it exist only in people's memory. There for field-names fade away from daily lives and disappear with new generations. Written documentation of field-names date from the 17th / 18th and 19th century. Some names live through because they were taken up into official cadastre documentations or other landscape documentations. Nowadays, a new interest arrises for field-names as they can tell us how the landscape used to look in the 18th century. A collection of field-names was gathered by assessing peoples memories, old cadastre documents, maps and other collections. This mental map is now made tangible, by documenting as much as possible and digitalizing them into a GIS system.

Field-names tells us how the landscape used to look, which soil types, vegetation types or animals occurred. They link to specific landmarks or environmental characteristics of the direct village surroundings. The origin and meaning of field-names are mainly influenced by the geography of its direct environment, like water bodies, streams, soil properties and altitude in relation to its surroundings. They can be used for landscape design and planning, knowledge for historical research and inspiration source for artist. (Spek et al., 2009; "Veldnamen - Encyclopedie Drenthe Online,")

2.1.1. Living heritage

The field-names in Drenthe are called living heritage, which is one of the 4 kinds of cultural heritage categories according to *Volkscultuur* institution;

1. The physical environment. Including monuments, archeology sites and cultural landscapes.
2. Paper heritage; Stored in archives and libraries in the form of paper documents, maps and books.
3. Object collections, owned and displayed by museums. Only focusing on objects.
4. Living heritage; habits, traditions, religions and cultural events that people experience. From: ("volkscultuur,")

Categories 1,2 and 3 are tangible substances while category 4 is intangible heritage. UNESCO introduces the concept of intangible heritage data in 2003, to safeguard the importance of intangible cultural heritage and distinct it from tangible heritage and natural heritage. ("UNESCO Culture Sector - Intangible Heritage - 2003 Convention :")

The Convention of UNESCO introduces five domains of ICH The boundaries between those domains are extremely fluid.:

1. Oral traditions and expressions including language as a vehicle of the ICH.
2. Performing arts (dance, music, theater).
3. Social practices, rituals and festive events.
4. Knowledge and practices concerning nature and the universe.
5. Traditional craftsmanship, meaning the skills and knowledge involved rather than the craft product itself.

In the scope of the H&L project this research will focus on the connection of place and time in intangible cultural heritage. ICH can be shortly explained as all traditions and rituals of normal life, which gives people a sense of identity and continuity. ICH is transmitted from generation to generation and can be constantly recreated by communities due to interaction with their environment. ("UNESCO Culture Sector - Intangible Heritage - 2003 Convention:", Zeijden, 2011) Intangible heritage is strongly depended on the features of space and influenced by the space. Of course these traditions, habits , etc., have a place where they take place. Or they are about a place, have a spreading, an origin, a continuation, can cover multiple places, through time. (Karavia & Georgopoulos, 2013)

This applies also for the field-names in Drenthe, which is oral living heritage. Originated with a strong influence of the direct environment it exists in.

2.2. Waag Society

For this research takes place in the scope of the Heritage and Location[H&L] project at Waag Society, they both will be shortly explained.



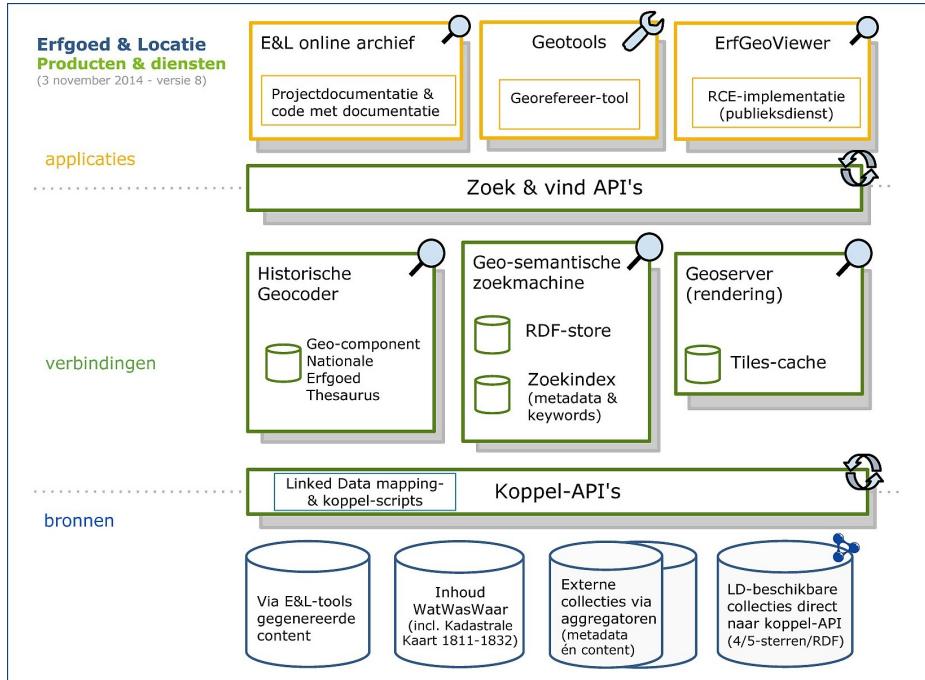
Waag Society is a Institute for art, science and technology. They develop technical interventions for relevant social innovation. In 7 labs they conduct creative research in the form of projects, creative care lab, creative learning lab, future heritage lab, future internet lab, open design lab and open wetlab. The Heritage & Location project (see next section) is part of the future internet lab [FIL]. The FIL focuses on the development of big and open data, making internet technology accessible and research the impact of the internet on society. ("Waag Society," n.d.)

2.2.1. Heritage and Location project Waag Society

The project H&L is owned by the Rijksdienst voor het Cultureel Erfgoed [RCE] , and at Waag Society a historical-geo thesaurus and tools are developed. The H&L project aims to develop a uniform system to link CH collections to existing geometries, with the use of place indicators in the metadata of the CH data. One of the tools is a historical-geocoder, to make heritage data, geo located and so link it in time and space to other heritage data sets and enrich knowledge. It combines multiple geo data sets with a time component and can be used easily to locate heritage data with a place notification. Big heritage collections with a place indication, though no geo data, can be linked to geometries. The goal of the H&L project is to know every place, administrative boundary, building and address that ever existed in the Netherlands. Figure shows the overview of the whole H&L project. Now focusing on the historical geocoder and thesaurus. ("erfgeo," n.d., "Erfgoed & Locatie," n.d.)

Figure 2.

Sheme of Hertiage and Location project. Products and Services.



2.3. Cultural heritage data & GIS

There is a big relevance of using geospatial data and geo information systems for the field of cultural heritage conservation purposes. (Droj, 2010) Explained here are several reasons why a GIS system is beneficial for digitalizing CH data; One, digitalizing CH data in a web GIS system can serve the goal to preserve the CH, by presenting the digital records in the form of focusing on its relation to place. Geographical information systems have proved their potential to present and exploit cultural heritage data. Second, such a system can be used for research aims. Implementing analysis on the spatial correlation of the CH data. The geographical relation and connection among various cultural heritages can be studied as well as the evolution through time and space and relationships between different datasets. So GIS can help to correlate and exploit heritage spatial relations and enrich the knowledge already existing. (Droj, 2010; Karavia & Georgopoulos, 2013; Lai, Luo, & Zhang, 2012; Meyer et al., 2007) This is also the third and the main goal of the Heritage & Location [H&L] project, enriching current datasets, by linking it in space and time to other datasets, which do not contain exact location data but do contain a sense of place in the thematic data description. By doing so, it is possible to improve the information access and improve the richness of the existing data of cultural heritage institutions. (“erfgoedenlocatie.nl,” n.d.) Assumption is that the place referred to in historical documents, probably refer to the identical real-world place if they are related in name.

Digitalizing heritage as linked data contains the following key aspects:

1. Identification, making the objects unique and identifiable.
2. Make it accessible through the Internet
3. Searchable, making it possible to index by search engines.
4. Re-usability. Linked-data makes it easy to use the data. (DEN | DE BASIS vindbaarheid)

2.4. Geo data

Geospatial data is data with a location, a connection to a location and oriented by their geographical relationships. Geo data has a nature of threefold: spatial, temporal and descriptive. The spatial dimension can be used to interpret the spatial dimensions and relation of data entities, an absolute and enclosed space wherein the geographic phenomena exists. The temporal dimension can be used to interpret the change in the data through time. The thematic dimension is to interpret what the data is about, a property that can be measured and assigned. The data component only concerns the raw observational data, with location, time and attributes. (Mennis et al., 2000; Nöllenburg, 2007) These three characteristics will be explained in detail in the next sections.

2.4.1. Spatial dimension

Geo data is different from other data because it is inherently structured with a spatial dimension. An X and Y location and sometimes a Z dimension. This contains the *where* of a particular phenomenon. Spatial objects can be physical, real objects in the world, or non-physical phenomena, like administrative boundaries. Continuous data fields cover large areas with no clear boundaries, like rainfall or temperature. A single object on the earth is discrete; they have sharp boundaries, like a house. But also the spatial structure tells a lot about the phenomena, is it random or regular clustered. The general assumption of spatial correlation tells that close things are more correlated than far apart things.

2.4.2. Temporal dimension

The time of happening of phenomena can be divided into 3 forms, it can happen/exist as a point in time, a period in time or on a certain interval in time. Also time can be classified into the four measurement classes, nominal ordinal discrete or continuous time model. Nominal would be; the 90ties, Christmas or the WWII. Ordinal contains relative order time statements like; before, after. Discrete is in years, seconds, minutes , etc.

Another differentiation is liner versus cyclic time ordering. Linear time is ordered along a path. Cyclic time follows a path of periodic turn phases. Like seasons, day and night. Serial periodic data is periodic time represented on a linear path.

2.4.3. Thematic dimension

The theme or attribute of a phenomena. The ‘what’ is happening in the world. This data is often stored in the attributes of the data, more than one attributes can exist. This data can be qualitative or quantitative, nominal ordinal discrete or continuous.

2.5. Geo-visualization

Geo-visualization is a combination of communication, scientific information visualization, geographic information systems and cartography. It comes after the collection of data, transformations and analysis. From the real world we go to data and all the modifications to the data. Eventually the data will be visualized, either a computer or on paper. The perception of people will interpret the data and turns the data into knowledge. In general, every map is a selective representation of reality and subjected to the interpretation of the human eyes. (Dibiase et al., 1992; MacEachren & Kraak, 2001)

2.5.1. Static geospatial visualization

Geo data has three basic symbols to represent the data, points, lines and polygons. Selecting the right graphic characteristic for data display is a challenging issue. Effective symbolization requires human creativity and judgment. The classic method for cartography is Bertin’s theory. This provides a classified system with four levels of data measurement and a list of graphic symbols that can be assigned to the visual variables. Bertin’s graphic variables are locations, size, density/size, texture, color, orientation and shape. See figure .

Figure 3.

Bertin's theory

	Point features	Line features	Area features	Nominal data	Ordinal data	Interval/Ratio data
POSITION	+ + + + +	wavy lines	shaded areas	Effective	Effective	Effective
SIZE	various square sizes	various line widths	shaded area patterns	Not Effective	Effective	Effective
VALUE	shaded squares	wavy lines	shaded area patterns	Not Effective	Effective	Marginally Effective
TEXTURE	various line patterns	various line patterns	shaded area patterns	Effective	Marginally Effective	Not Effective
HUE	color-coded shapes	color-coded lines	color-coded areas	Effective	Marginally Effective	Not Effective
ORIENTATION	rotated squares	wavy lines	shaded area patterns	Effective	Not Effective	Not Effective
SHAPE	various shapes	wavy lines	shaded area patterns	Marginally Effective	Not Effective	Not Effective

Figure 1. The visual variables and their effectiveness in signifying the three levels of measurement of data (after Bertin [1983]).

(Dibiase et al., 1992; Bertin, 2000)

After Bertin, other researchers have added to this method with more graphic variables. Morrison added more specifications on color, existing out of hue, saturation and value. MacEachren (1995) added the term clarity, build up from crispness, resolution and transparency. Caivano (1990) adds more dimensions on texture. Defining directionality, size and density of texture.

Deciding the right graphic variable to be assigned to a certain type of data, helps the viewer in defining the perceptual properties. For example, ordinal data needs the perception of being ordered, quantitative data of being proportional. While nominal data needs to be perceived as distinct categories. (Bertin, 2000; Caivano, 1990; Dibiase et al., 1992; MacEachren, 1995; Nöllenburg, 2007) ###Dynamic geo-visualizations Bertin's theory was designed in the context of static maps but is for a part the basis and seems applicable to the design of dynamic maps which require a set of dynamic graphic variables. A few forms of dynamic geovisualization can be named, animation, display of time or spatial temporal visualization and interaction. The dynamic categories are divided into 2D and 3D animations. In this research we only work with 2D animations because of limited technology. Also in the theoretical frame work we will leave this out of consideration.

They state that the dynamic visual variables will only give the right results when combined with the traditional static visual variables. (Köbben & Yaman, 1996)

Animation

Animated maps leave interaction aside, and use time to add a visual dimension to the display. The scenes in an animation show the state f the data at one moment accordingly. There is hardly any interactive control. Dynamic animated variables are

- Temporal position, when something is displayed.
- Duration, how long is something displayed.
- Order, the temporal sequence.
- Rate of change.
- Frequency or speed.
- Synchronization.

Animated maps contain dynamic variables. Scene duration, rate of change, scene order. (Kobben and Yaman; MacEachren; Ormeling, 1996)

Spatial - temporal

Spatial temporal visualization is the display of dynamic phenomena as a series of static maps. To analyze and understand patterns of temporal change of phenomena. The two categories are temporal animation and non-temporal animation. In temporal animation, display time and world time are directly related. While for non-temporal, no direct relation between display time and world time is present. Kraak and Klomp give a slightly different categorization, but can be compared to the Köbben & Yaman. Kraak & Klomp talk about time-series, successive build-up and changing representations. (Dibiasi et al., 1992; Köbben & Yaman, 1996; Nöllenburg, 2007) See table .

Dibiasi states that dynamic variables can be used to emphasize the location of a phenomenon, emphasize the attributes or visualize change in the spatial, temporal or thematic dimensions. (Dibiasi et al., 1992)

Table 1. Categories of possible animations for dynamic phenomena.

Köbben & Yaman		Kraak & Klomp
Temporal	Direct relation between world time and display time	World time
Non - Temporal	No direct relation between world time and display time	Time-series
		Aggregated time
		Database time
		Successive build-up
		Changing representations

Information from (Köbben & Yaman, 1996; Kraak & Klomp, 1996)

Dynamic visualization variables are identified by Dibiasi et al. (1992), MacEachren (1994), Kobben and Yaman, and Blok (2000) and are gathered here and put into one overview. Based on Blok Blok provides a framework for animated representation of dynamic geo-spatial phenomena. (Blok, 2000) She provides a range of dynamic visualization variables to be used for monitoring purposes of spatial temporal relationships. Blok's framework more aims at the exploratory use of visualization while this research, aims at the display and communication part of the geo-spatial phenomena for explanatory use. Though, this author finds that Blok's dynamic visualization variables can be applied for both purposes. As Blok also states; the ultimate goal is to contribute to the development of representation methods and interaction tools, which are also found in the explanatory visualization forms.

Interaction

Interactivity is one of the key aspects of geo visualization. The full potential of interaction in geo visualization lies in linking multiple views of the same data on the screen. Term used is Guided discovery. Interactive visualization gives the control of the animation to the user, they engage in sorting, highlighting, filtering and transforming. The level of detail displayed and the speed can be determined, so information is less likely to be missed.

Two main interactive visualization techniques are introduced by Buja et al. form Nöllenburg (2007).

1.

Focusing individual views. The user can modify the single display and what is seen. Choose the perspective, magnification level and level of detail. For example a set of navigation controls can be provided to zoom, pan and rotate. Layers can be selected to display or different attributes can be available to choose from.

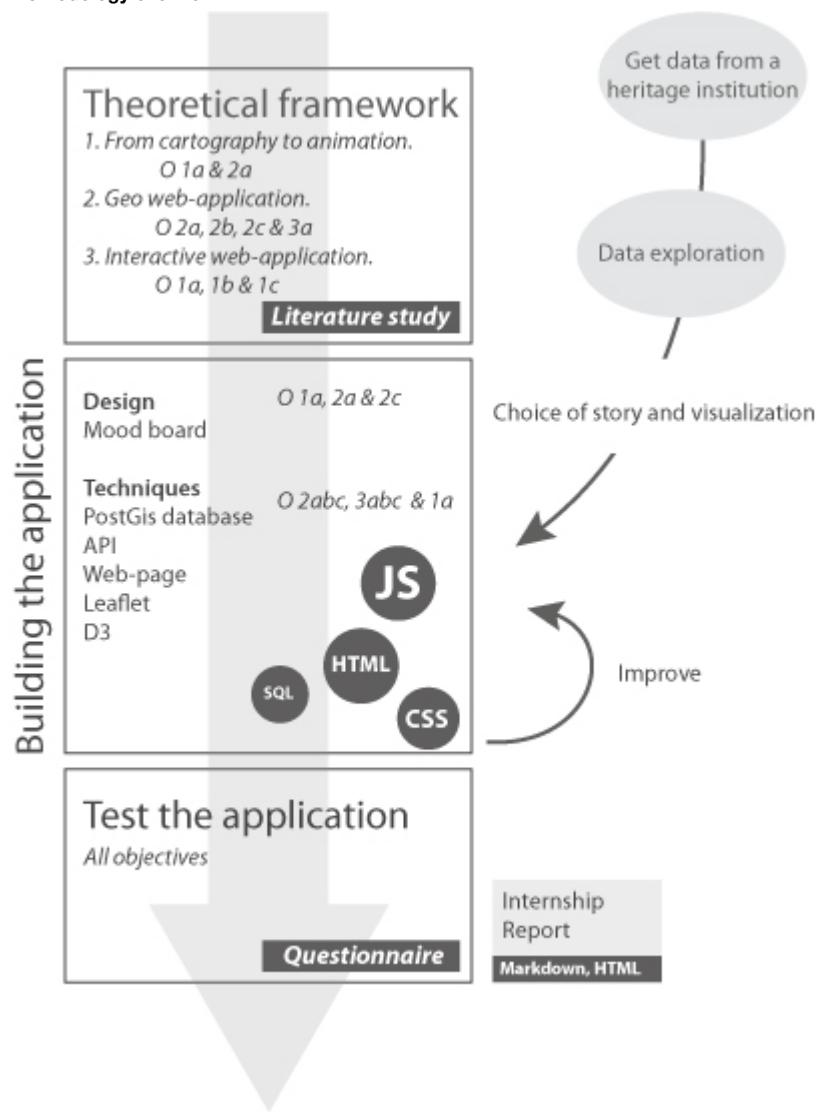
2.

Linking multiple views. Linking means simultaneous highlighting of data items in multiple views in possible different formats. This can be combined with brushing; selecting display objects by pointing on them or encircling them on the screen. This stimulates visual thinking because data can be displayed in different ways and be analyzed from different perspectives. The number, type and arrangements of the different views depend on the task, the user and the available space on the screen or specific interface. (Nöllenburg, 2007)

Chapter 3. Method

Figure 4.

Methodology overview



because the internship is conducted for the project Heritage&Location at the Waag Society. In the project several heritage institutions take part, and so came into contact with possible data providers. After explaining the general goal of this study to them, the data needed for this report was provided by *Rijksdienst voor Cultureel Erfgoed*. With the data, the subject of the research took more form.

The report will be build up in 3 parts; first geo-visualization and web-application techniques will be explored through literature study. With the found techniques, the web-application will be build, for which certain design objectives will be defined. In the end the application will be tested according to the set objectives and found literature.

This research will be a design-oriented research, trying to fulfill the design goals and objectives. By taking the objectives into account, the goals will be fulfilled. Therefore the objectives are given numbers and letters, to easily refer to them, when they are covered. See figure for an overview of the working procedure and where the specific objectives are addressed. The whole process will be more iterative and chaotic than the overview shows. Most creative choices and decisions will be taken by the researcher and her preferences.

Once the general goal was established; making a web-based geo-visualization, the case study in the field of cultural heritage had to be defined. This,

3.1. Theoretical framework

Three things will be looked at in the literature research. First, a literature research is done into geo visualization techniques and already available methods. Going from the conventional cartographic techniques to the modern techniques. Including animation and change. This to cover objective A1, to make the application attractive, and B3, understanding the geo-data. Second, literature about building geo-web applications and the available techniques will be consulted. To cover objectives, B 1-3 and C1. Adding knowledge and experience from preceding research. Last, will be looked at some frameworks explaining how to build an efficient, attractive and interactive web-application in general. Covering objectives from A.

This will all be summarized into the theoretical framework which can be found in the results chapter. The found literature will be used to make decisions while building the main application. Therefor the focus of the chapter will be on the field-name data set, and its characteristics and visual variables.

3.2. Building the web-application

After exploring the field-names dataset, a choice of story and way to visualize the data is made, which will be explained in section . This will immediately be implemented into building a web-based geo-visualization. The focus will be on building the web-application and finding the best way to visualize the data. While doing this, decisions and choices will be made on the developed framework. There will be several things that will be taken into account during this stage.

Section

- The idea and design

Section

- Techniques needed to make the web-application. (O C 1-2)
- Techniques for geo support. (O C)
- Visualizing of the geo data. (O B)

Section

- Designing the webpage. (O A1)
- Writing the information in text, that is needed in the web page. (O B 1-3)

Both the design and technical building will be done by the researcher.

3.2.1. The idea

Because the origin and meaning of field-names are mainly influenced by the geography of its direct environment, like water bodies, streams, soil properties and altitude in relation to its surroundings. In order to visualize this relation, as stated in objective B1, the geographical surrounding in relation to the name has to be shown. Because the field-names are already categorized by a previous study, easily this distinction can be made.

Several ideas came up to do this, as many characteristics are of influence. The main goal for the visualization can be stated as:
> Visualize the meaning and origin of the field name by showing its relation with its direct environment.

The first ideas:

- Showing soil related field names on a soil map. This can be a current or old soil map.
- Showing height related field names on a height map.
- Showing ground water levels in relation to field names about water, swamps and soil types.
- Vegetation types, present on a field in the current situation vs what the field-name tells us about the historic vegetation.
- Showing names with relation to wind direction, in their position relative to the closest town or city.

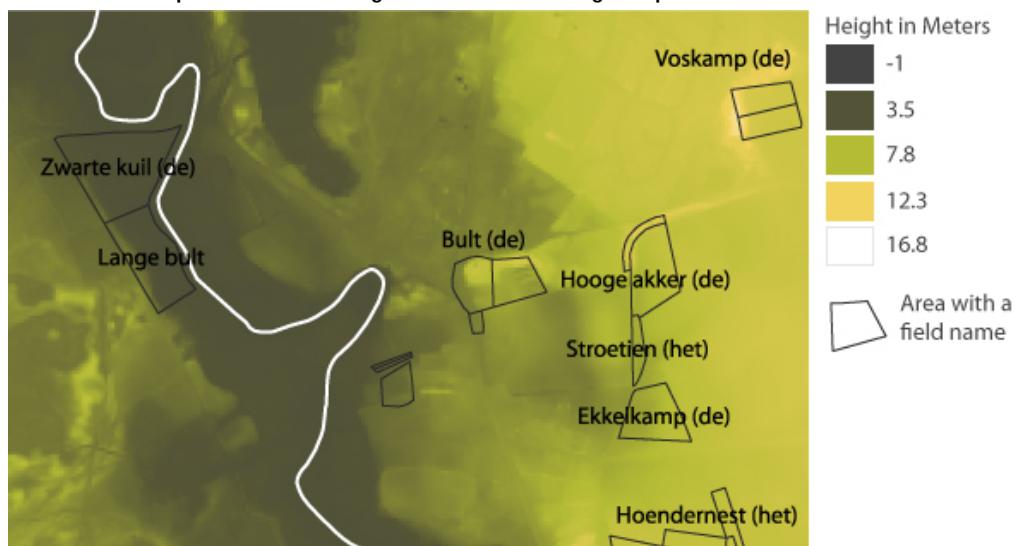
Main idea

Eventually one of the ideas was chosen. Namely, showing the field names on a height map. By doing this, it includes also names related to water and swamps, for lower areas are more wet then higher areas. Also vegetation types, dependent on wet or dry situations, will be included for their is a relation.

Figure shows some fields with names related to height. Though less clear then the examples above, some fields do indicate small increases or decreases in the in relation to the area around. The Bult and the Hooge Akker are clearly on higher ground then the fields to the West. Where de zwarte kuil indicates that it is a lower field.

Figure 5.

Field-names example of names with height indication on the height map



Though, field-names are only related to its direct environment, as far as the naked eye could see, for it is human invented. The relation of a field with a name can only be shown in relation to the direct environment, and not on a general overview map. For example, a name like 'Bultakker' (bump field) tells up that this field lies higher then its surrounding fields, not what the exact altitude it is. In order to include this in the visualization, showing the polygons on a map won't be sufficient. Chosen is to draw a transect of the height data and indicate the names of the fields on this.

// tekeningengetjes

Interactivity will be added to the transect line, letting the user define the transect line themselves and explore the different objects located on and around the transect line.

For this is needed:

Webpage A map showing the area, where a line can be drawn to locate the position of the transect line. A area where the defined transect line will be drawn and can be explored. A explanation about how the application works. Other interactive features to navigate through the webpage.

Data Data about the height of the study area and all the field-names with its categories. Additional stories and explanation texts about the meaning and origin of the field-names. Additional pictures of the landscape characteristics.

Backend Linking the data with the webpage. See paragraphs .

Variations on Main idea

For also on this main idea some variations can be made, these will be shown here.

- Soil properties as colors of the fields. Or pattern of the specific soil type. Like stones, clay, sand etc. Giving colors or patterns to the fields according to the soil property. Like a *Stonefield* or *Redfield*.

- Pop-ups with explanations and texts. Linking field-names to textual explanation, adding pictures of the surroundings and landscape characteristics. Vegetation types, animal occurrence.

- Adding pictures or symbols of vegetation types and animals on the transect line. As well as houses to indicate towns and cities. Water bodies as blue dips in the transect line. Give more explanation per category or field-name type. Include pictures of trees, shrubs, plants or animals with which the field name is connected.

- Creating a small 3d landscape by adding multiple transect lines, stacked in front of each other.

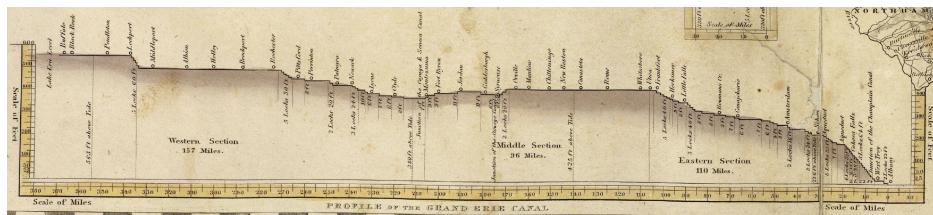
- Link stories provided to the line, so popups with provided stories from the book.

Mood board

For design ideas and color use a mood board was made. Pictures from the Internet combined with fonts. Search terms were, living heritage, cultural heritage, transect , old transect map and more. One of the main inspirations was the following image:

Figure 6.

Inspiration Picture



Source: https://commons.wikimedia.org/wiki/File:1832_Erie_Canal.jpg

Complete mood board; see appendix

3.2.2. The data

Field-names

From the *Rijksdienst voor Cultureel Erfgoed* of the Netherlands a dataset with living field-names in Drenthe was supplied. This data contains field geometries that have a field-name, a name or toponym given to the plot or area by the people living in the neighborhood from around 1830. These field-names were derived from studies by Naarding and Wieringa, together with het *Drentse Archief* and het *Meertens-Instituut*. Old toponyms on old maps, tell us a lot, but here they used another source; the memory of the local inhabitants, where generation after generation the field names keep on living. The polygons were drawn by hand or the names were assigned to plots from the cadastre maps from 1830.

These field-names contain a lot of information about how the landscape used to look. Because most field-names are based on their direct environment. The most important factors influencing the forming of field-names are ; natural relief, natural water and the vegetation structure. (Spek et al., 2009) This information is highly important for nature conservation and heritage preservation. (Spek et al., 2009)

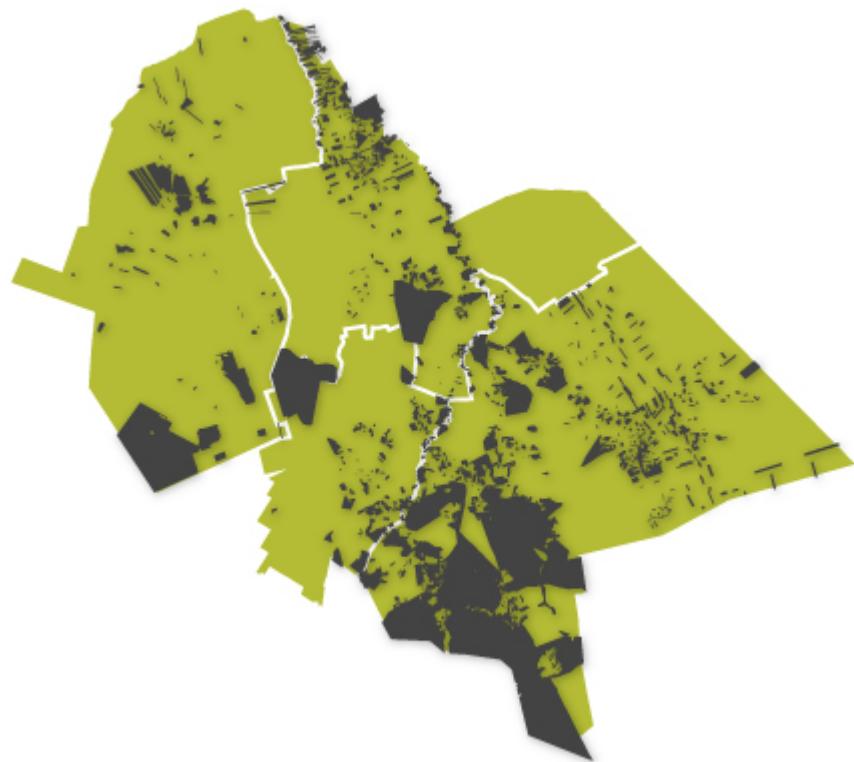
Further reference about the field names in Drenthe can be found in the book "Van Jeruzalem tot Ezelakker, Levende valdnamenatlas van de Drentse Aa". (Spek et al., 2009)

The dataset contains in total 1747 polygons with a field-name. Projection Rd new. EPSG28992

This results in the following coverage of field names:

Table 2. Field-name Amounts per source

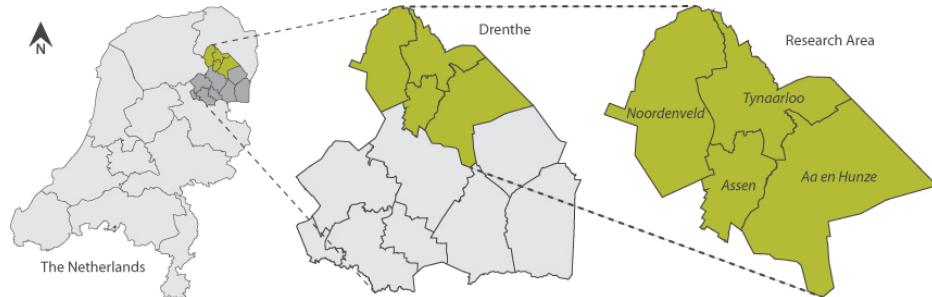
Figure 7.
All fields with a field name.



Amount	Source
459	cadastral topographic map from 1832
452	Landjouw
278	Wieringa
18	Kadaster
515	Drents Archief

Based on this the total research location is determined, consisting of the municipality's Aa en Hunze, Assen, Noordenveld and Tynaarlo. All located in the watershed of the Drentse Aa.

Figure 8.
Research area, location in the Netherlands and the municipalities



The field names are already categorized in a previous study by the RCE by \$\$. The categories give a meaning to the name, of which environmental characteristic was of influence on the name creation. These categories are given in table . In the appendix a total overview of the categories and the names and alternative names can be found.

Table 3. Field-name categories

Code	Category	Count old	Count new
A	Altitude	116	1109
B	Soil type	79	551
C	Water related names	33	199
D	River valleys and swamps	270	926
E	Forest	175	3146
F	Drift-sand fields	59	223
G	Wild animals	38	181
O	Miscellaneous	0	85
W	Wind direction	0	165
Total		770	6585

AHN

The AHN2 tiles covering the research area were downloaded from nationalgeoregister.nl to show the relation of the field-names with the environment. The AHN has proved useful for historical research. Small differences in the landscape can be seen in the AHN2 and already historians and archeologist use it to discover old settlements that cant be discovered with the naked eye. (Actueel Hoogtebestand Nederland, n.d.)

The raster data has a resolution of 5 meters and a precision of systematic and stochastic error of max 5 cm the projection is RD new (EPSG28992). (Actueel Hoogtebestand Nederland, n.d.)

The maximum and minimum values of the total area are 29.5 and -1.9 meters respectively.

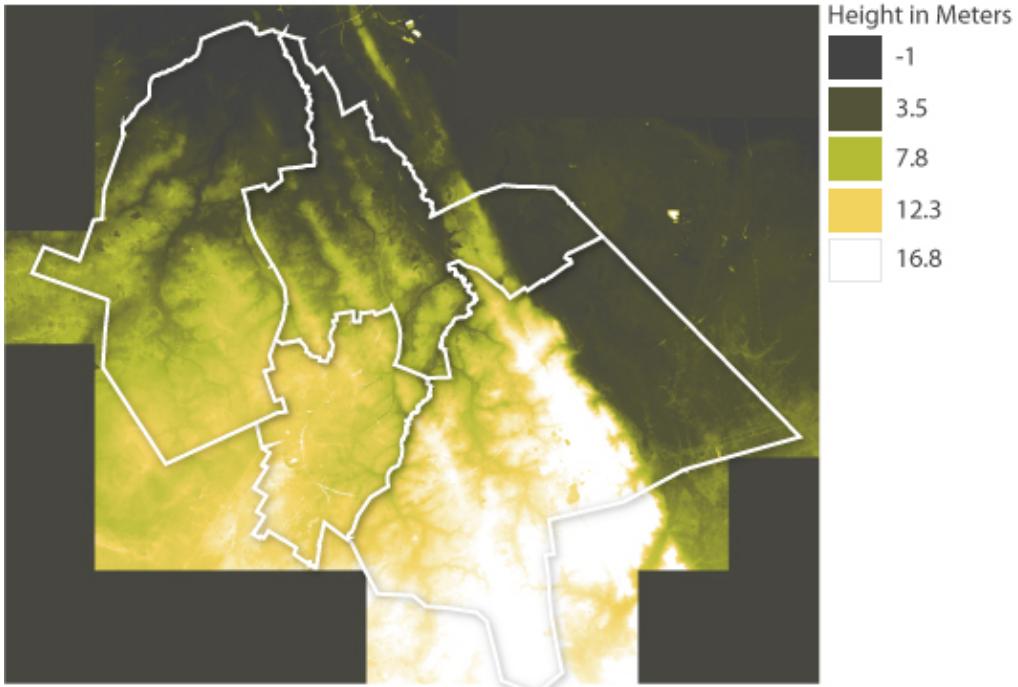
Figure 9.

AHN2 from the research area

See appendix for table with all the tiles used.

Kadaster parcels 1830

Data from the cadastre were also supplied by the RCE, showing the plots and parcels as they were in 1830. And can be used to refer the field-names to. The dataset is in projection RDnew(EPSG28992).



Water bodies

The water bodies are downloaded from the open data PDOK.nl. The Top10NLactueel contains all topology of the Netherlands on a scale of 1:25.000. From this dataset only the water polygons are used and clipped to the research area. So the names of the water bodies can be included into the application. ("TOP10NL | Publieke Dienstverlening Op de Kaart Loket," n.d.) EPSG28992

Table 4. Map sheets Top10NL downloaded

Top10NL_17O	Top10NL_1rW	Top10NL_1rO	Top10NL_1rW
-------------	-------------	-------------	-------------

3.2.3. Pre-processing the data

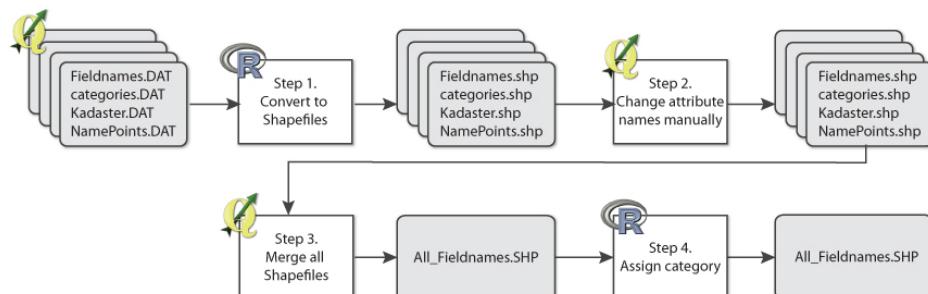
Field-names

All the data was delivered separate .DAT files and scattered over several folders and sources. All the possible datasets containing field-names were collected and displayed in one view. So this results in different sources saying something about the names. This also resulted in plots with multiple names, some differed slightly, some were totally different.

In order to work with the files in Qgis all the files needed to be converted to shape-files. This was done in R. See script appendix In QGIS, manually the attribute names needed were changed in one standardized name in order to merge all the data together.

Figure 10.

Flowchart field-name dataset processing



Code snippet 1. SQL adjustments

```

UPDATE veldnamen3 SET naam = naam_2 WHERE naam IS NULL;
UPDATE veldnamen3 SET atoto_co_3 = code_3 WHERE atoto_co_3 IS NULL;
UPDATE veldnamen3 SET atoto_co_2 = code_2 WHERE atoto_co_2 IS NULL;
DELETE FROM veldnamen3 WHERE naam IS NULL;
ALTER TABLE veldnamen3 DROP COLUMN naam_2 CASCADE;
ALTER TABLE veldnamen3 DROP COLUMN code_1_ CASCADE;
ALTER TABLE veldnamen3 DROP COLUMN code_2 CASCADE;
ALTER TABLE veldnamen3 DROP COLUMN code_3 CASCADE;
ALTER TABLE veldnamen3 DROP COLUMN code_4 CASCADE;
ALTER TABLE veldnamen3 RENAME COLUMN atoto_co_1 TO code_1;
ALTER TABLE veldnamen3 RENAME COLUMN atoto_co_2 TO code_2;
ALTER TABLE veldnamen3 RENAME COLUMN atoto_co_3 TO code_3;

```

Because this resulted into a lot of overlapping areas, instead, the field-names were all linked to the Kadaster dataset from 1830. So a single layer of polygons with multiple names is the result. This was done by spatially joining the datasets, or joining by the Kadaster ID's which most of the datasets contained. The ID contained; municipality, sheet map number, parcel number.

Eventually, the field-names that had no category assigned had to be classified as well. The cadastre field-names and .. were not included in the previous research by the RCE, but were added here, to have more coverage and amount of field-names.

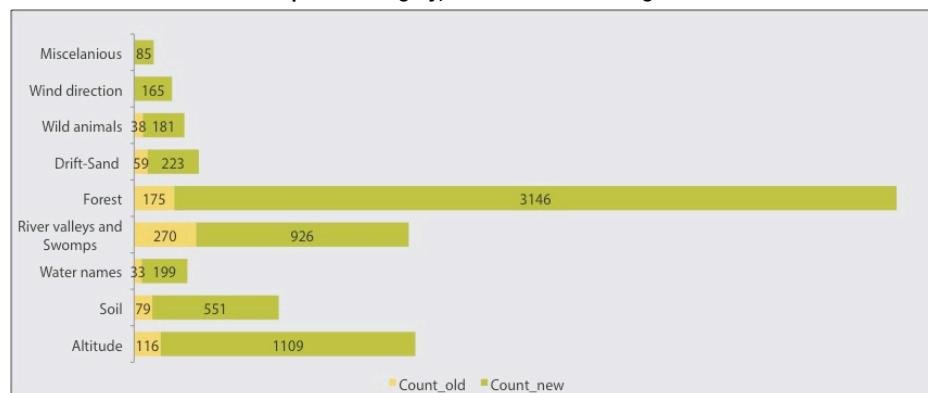
The classification was done in R. See appendix for the script A field-name can consist out of multiple words with a different meaning and multiple categories and lemmings can be assigned to one field name. The classification provided by the RCE was used. This contained per category, different codes and alternative words that signifies the same.

The script runs through all the field-names and all the possible categories, to match which category was applicable.

While reading few of the names, new ideas for a category came up and added. The category wind direction W.

Figure 11.

Amount of field names with a specific category, before and after categorization in R



AHN

The AHN is measured with laser altimetry or LIDAR. Laser beams shot from an airplane and localized with GPS. It is measured over several time periods and merged in the end to get a detailed measurement of the height. The eventual end product delivered is corrected to ground level.(maaveld) So vegetation, buildings and other object do not appear. (Actueel Hoogtebestand Nederland, n.d.) These filtered areas are given no-data values.

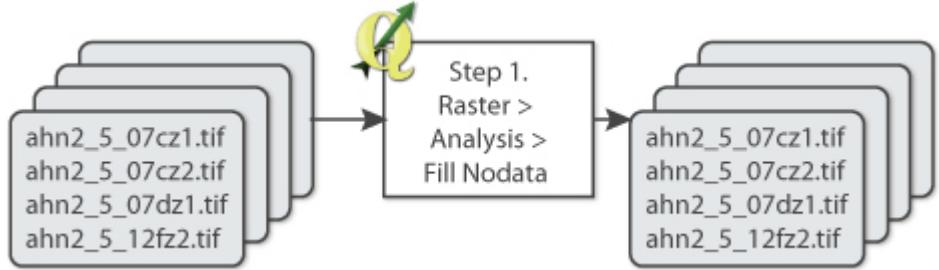
For use in the application, the transect line looks best when not containing any gaps. Therefore, the no-data values are filled by the fill no-data tool of Qgis. This takes an average of around 100 pixels to calculate the average height of the missing pixels.

Figure 12.

Flowchart AHN2 raster processing

Cadastre parcels

No preprocessing needed other then explained in preprocessing field-names.



Water bodies

Only processing was clipped to the research area. No other preprocessing needed other then was used for the AHN.

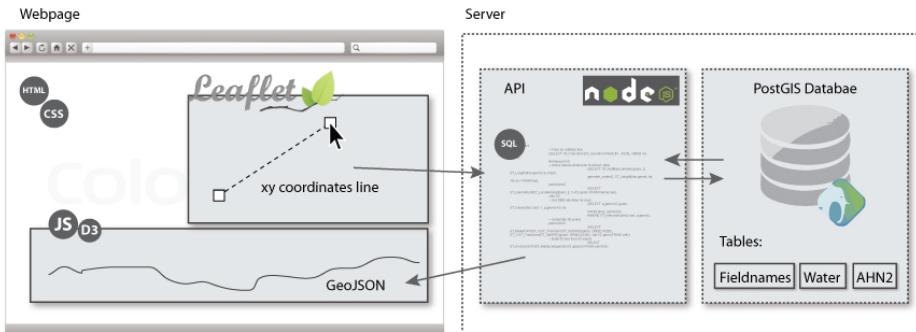
3.2.4. Back-end processes

First both client side and server side are build on one computer as a single seat set-up, in order to develop and test the processes. Once the desired result is achieved, the possibility to move it to a server will be regarded.

Figure shows the overall setup of the system. On the web page a line can be drawn by LeafletDraw on the Leaflet map. The coordinates of this line are edited to a line string format and parsed into a SQL query. This query is explained in paragraph . This query is asked to the API which requests the data from the PostGIS database. The response is a geoJSON array containing the heights on every 10 meters of the line. This data is parsed back to the script of the website and used to draw the transect line and all the other characteristics needed. The next paragraphs explain the database, the API, the SQL query and the website.

Figure 13.

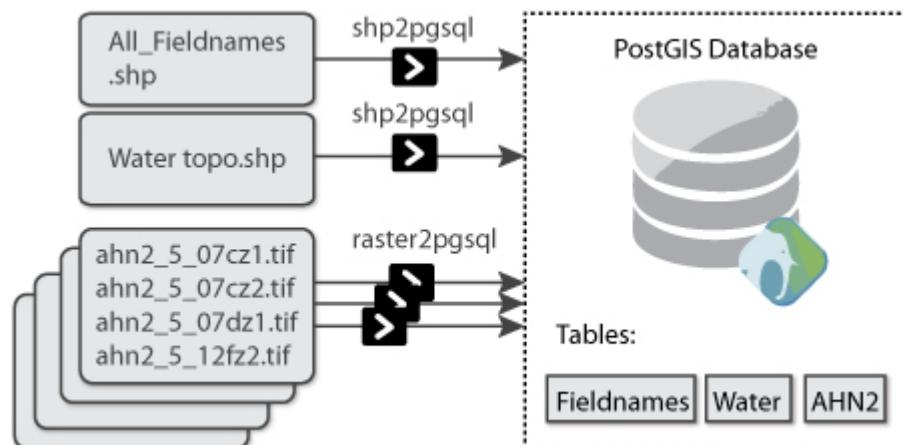
Back-end processes



Setting up the database

Figure 14.

Loading data into the database



The open source database PostgreSQL was installed with a PostGIS extension to create the needed database. It is currently the most popular free and open source spatial database (Steiniger and Hunter 2013). The PostGIS extension enables geographic objects like shape files and rasters. Everything was loaded in the Dutch projected coordinate system RD new (EPSG:28992)

Code snippet 2. Loading data in the database

```
Shp2pgsql
→ ~ shp2pgsql -s 28992 <path name>/veldnamen.shp veldnamen | psql -U user -d veldnamen

Raster2pgsql
→ ~ raster2pgsql -s 28992 -I -C <path name>/ahn2*.tif public.ahn2 | psql -d veldnamen
```

Setting up web-server or web API

A API or application programming interface, is needed to connect the web-application with the data in the PostGIS database. For this purpose Brian's node-postgres is used. Done with Node-Postgres for PostgreSQL client for node.js with pure JavaScript bindings. The API itself is a chunk of software code written

It supports parameterizes queries for PostgreSQL

So the functions are made to get from coordinates to a SQL query asking the height data from the AHN raster.
<https://github.com/brianc/node-postgres> <https://nodejs.org/about/>

Code snippet 3. Request & Response for transect line

```
app.get('/transect', function (req, res) {
  query(queries.transect, ['LINESTRING (' + req.query.linestring + ')'], function(err, result) {
    if (err) {
      res.status(500).send(err);
    } else {
      res.send(result.rows.map(function(row) {
        row.geometry = JSON.parse(row.geometry);
        return row;
      }));
    }
  })
});
```

API SQL queries

After a line is drawn on the Leaflet map with Leaflet Draw, the coordinates of the line are inserted into the request (\$1) as a LINESTRING format. The line is in WGS84 (EPSG4326) and needs to be converted to RDNew(EPSG28992) in order to extract the location with the other data at the right location.

Code snippet 4. The line

```
WITH line AS
-- Create line geometry
(SELECT ST_Transform(ST_GeomFromText($1, 4326), 28992) AS geom,
```

The line is then cut into parts of 10 meter and points are generated with its percentage location along the line.

Code snippet 5. Point and percentage at every 10 m along the line

```

linemesure AS
  (SELECT ST_AddMeasure(line.geom, 0, ST_Length(line.geom)) AS linem,
  generate_series(0, ST_Length(line.geom)::int, 10) AS i
  FROM line),

points2d AS
  (SELECT ST_GeometryN(ST_LocateAlong(linem, i), 1) AS geom, (i*100/ST_Length(linem)) AS percentage
  FROM linemesure),

```

This array of points is intersected with the AHN table to extract the height value for every point.

Code snippet 6. Get height per point

```

AHN AS
-- Get DEM elevation for each
  (SELECT p.geom AS geom, ST_Value(ahn.rast, 1, p.geom) AS heights, percentage
  FROM ahn, points2d p
  WHERE ST_Intersects(ahn.rast, p.geom)),

```

Also the points are intersected with the field names table to see if a point falls into a field, and which name and category code it belongs to.

Code snippet 7. Get field name for intersecting points

```

fields AS
  (SELECT naam AS naam, code_1_ AS category1, code_2_ AS category2, ST_Intersection(p.geom, veldnamen2.geom) AS geoms
  FROM veldnamen2, points2d p
  WHERE ST_Intersects(veldnamen2.geom, p.geom)),

```

Then the points are intersected with the water topology table to see if a point falls into a water body, and which name and category code it belongs to.

Code snippet 8. Get field name for intersecting points

```

--Get Water intersects
waters AS
  (SELECT naamnl AS waternaam, typewater AS typewater, identifica AS waterID, ST_Intersection(p.geom, water.geom) AS geomz
  FROM water, points2d p
  WHERE ST_Intersects(water.geom, p.geom)),

```

In the end all points that fall into a field or water body are joined to the total amount of points to contain the whole range of points.

Code snippet 9. Join all outcomes

```

points AS
  (SELECT * FROM AHN LEFT OUTER JOIN fields ON (AHN.geom = fields.geoms)),
points1 AS
  (SELECT * FROM points LEFT OUTER JOIN waters ON (points.geom = waters.geomz))

```

This is all send back as one complete GeoJSON response.

Code snippet 10. final GeoJSON response

```

-- Make points:
SELECT ST_AsGeoJSON(ST_MakePoint(ST_X(ST_Transform(ST_SetSRID(geom, 28992), 4326)), ST_Y(ST_Transform(ST_SetSRID(geom, 28992), 4326))
AS geometry, naam, heights, percentage , category1, category2, waternaam, typewater, waterID
FROM points1

```

Eventually the response of the request will be a GeoJSON. An example of the GeoJSON array is shown in .

Code snippet 11. Example GeoJSON response

```
[
  {
    "geometry": {
      "type": "Point",
      "coordinates": [
        6.6089395293246,
        53.0818691708253,
        8.05700016021729
      ]
    },
    "naam": "Zuurpol (de)",
    "heights": 8.05700016021729,
    "percentage": 0.826035566357403,
    "category1": "A1",
    "category2": null,
    "waternaam": null,
    "typewater": null,
    "waterid": null
  },
  {...},
  {...},
  {...},
  {
    "geometry": {
      "type": "Point",
      "coordinates": [
        6.62981923722014,
        53.0856490864126,
        4.8439998626709
      ]
    },
    "naam": "Gryze Steen",
    "heights": 4.8439998626709,
    "percentage": 55.5813292359005,
    "category1": null,
    "category2": null,
    "waternaam": null,
    "typewater": "meer, plas, ven, vijver",
    "waterid": "NL.TOP10NL.128375900"
  },
  {...}
]
]
```

3.2.5. Web design

Will be an inductive process. Mostly based on the researchers' preferences. The language in the product will be Dutch, for the data covers a part of the Netherlands and the target group is dutch. Internet mapping applications, is software that enables a developer to deliver and view geo-data and maps in a standard internet protocols and run in a normal browser.

Licenses

Only use of free and open source software is used.

Map5

Technology

HTML, CSS to build the webpage and the interactivity with JavaScript .

Packages needed for building the geo-application will be leaflet and d3.js. And possible leaflet plugins like, Leaflet Draw and Leaflet MiniMap. Leaflet is a JavaScript library for the creation of interactive maps by the founders of OpenStreetMap. Interesting for developers is probably the focus on desktop and mobile web browsers, and its use of HTML5. (Steiniger and Hunter 2013)

Technological advancements, such as browsers that support scripting languages natively, and standards, such as Cascading Style Sheets (CSS), Asynchronous JavaScript and HTML 5.

Leaflet

Code snippet 12. Leaflet map initializing

```
var basemaps ={  
    "_1830": L.tileLayer('http://s.map5.nl/map/gast/tiles/tmk_1850/EPSG900913/{z}/{x}/{y}.png' ),  
    "_2015": L.tileLayer('http://(s).tile.openstreetmap.org/{z}/{x}/{y}.png'),  
    "Hoogte": L.tileLayer('http://s.map5.nl/map/gast/tiles/relief_struct/EPSG900913/{z}/{x}/{y}.jpeg')  
}  
  
var map = new L.map('map', {  
    maxZoom: 15,  
    minZoom: 12,  
    layers: basemaps._1830  
});  
  
map.setView([53.079529, 6.614894], 14);  
map.setMaxBounds([  
    [52.861743, 6.458972],  
    [53.202277, 6.958035]  
]);
```

D3, data driven documents.

Code snippet 13. D3 request coordinates and drawing transect path

```
d3.json('transect?linestring=' + coordinates, function(json) {  
    var line = d3.select("#line")  
    line.selectAll(".transect")  
        .data(linestring)  
        .enter()  
        .append("path")  
        .attr("class", "transect")  
        .attr("d", lineFunction(json))  
        .attr("stroke", "#2B2118")  
        .attr("stroke-width", 3)  
        .attr("fill", "none");  
});
```

3.3. Testing the web-application

Third, a small test will be held to see if the product complies with the set goals and objectives. During the whole process, iteratively the web visualization was adjusted and tested again until the project ends.

The final test will be conducted with a small questionnaire. About 20 people will be asked to open the web-application and look at it, use it and play around with it. Afterwards, 8 statements will be given and asked to rate them to the level of agreeing or not. Ranks between a number of 1 and 5, from totally disagreeing till, total agreeing. Because the objectives were used in defining the statements, it tests if the application lives up to the objectives set for the user.

Because there is not a official testing group available, the participants will be colleagues of the Waag Society, the heritage institutions of the Heritage and Location project and possible, classmates and/or family and friends. This to have a broad general public.

Table shows the statements asked and their relation to the objectives. The complete questionnaire can be found in appendix .

Table 5. Questions and Objectives

	Objective	Statement
1	1 A	I think the application is visually appealing.
2	1 B and 1 C	I feel tempted to use the tools and functions in the application multiple times.
3	1 C	I feel tempted to use this application multiple times (in the future)
4	2 A and 2 C	The meaning and origin of the field-names became clear to me.
5	2 B	The shown information is surprising and interesting.
6	2 C	By using this application I understand more about the importance of safe-guarding the field-names as cultural heritage.
7	3 A	The application is simple to use.
8	3 B	Everything was working as I expected.

Chapter 4. Results

4.1. Theoretical framework

First, a literature research is done into geo visualization techniques and already available methods which are applicable to the field-names. Describing the field-name data in the kind of data it is and the visual variables which can be linked to them. This to cover objective 1a, to make the application attractive, and 2c, understanding the geo-data.

Second, literature about building geo-web applications and the available techniques will be consulted. To cover objectives, 2a, 2b, 2c and 3 to add knowledge and experience from preceding research to the techniques which will be used here.

Last, will be looked at some frameworks explaining how to build an efficient, attractive and interactive web-application in general. Focussing on a user centered design. Covering objectives, 1a, 1b and 1c.

4.1.1. Visualization of field-names

Geographical visualization can be used for 2 purposes; data exploration and information display. (Cartwright et al., 2004) By interpreting graphic representations new knowledge can be created and this can be distributed by visual communication. The one is exploratory, while visual communication is explanatory. (Dibiase, MacEachren, Krygier, & Reeves, 1992) Showing the field-names in an interactive application is explanatory visual communication. The goal of the field-names is explanatory, while the interactivity makes the data exploratory. When looking at the Map use Cube of MacEachren and Kraak, the field name application can be placed in the top corner. The application is about sharing information to a general and broad public. While making it interactive and so exploratory.

In figure the geo processing chain is combined with the series of visualization transformations. Showing that the position of the visualization as exploration and communication. Here we will focus on the visual information communication. To turn raw data sets into understandable knowledge on the explanatory level with a user-centered design. For the field-names the data collection has been done in previous studies. For this study only specific data transformations were required and so little data analysis was done. The main focus is on the communication for creating knowledge.

Figure 15.

Map use cube from MacEachren and Kraak

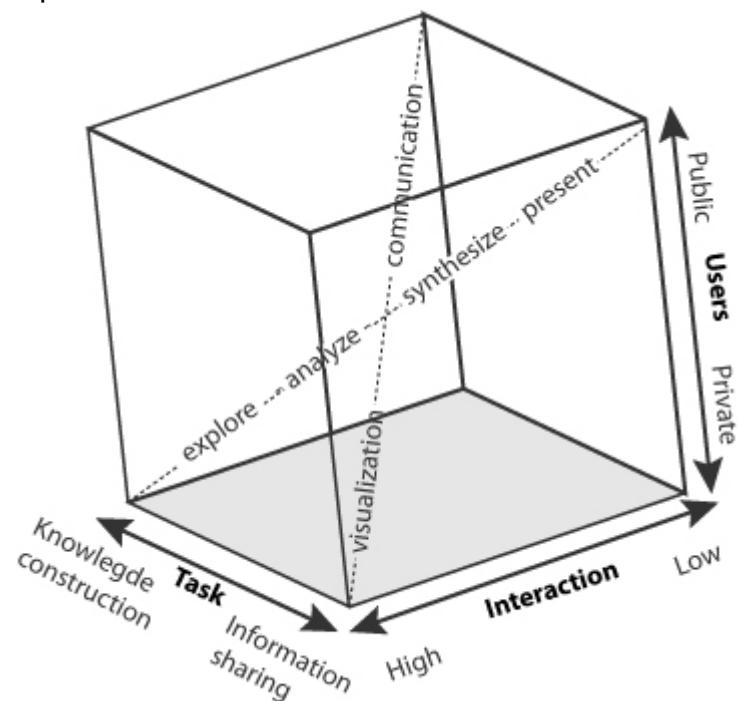
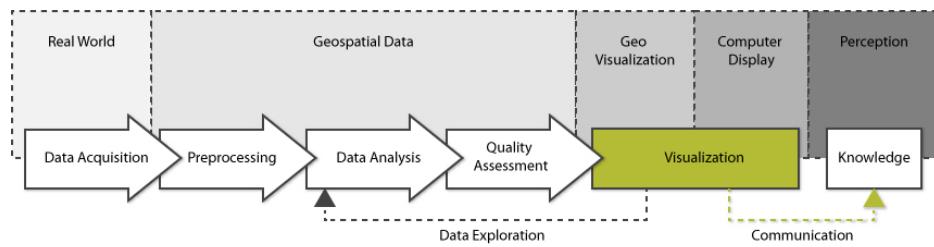


Figure 16.

Geo processing chain and visualization series



The field-name data sets are static data, but will be displayed dynamically and interactive. It will let the user explore, and rediscover the information themselves, called *guided discovery*. (Nöllenburg, 2007) The user is no longer depended on what the cartographer puts on the map. (Ogao & Kraak, 2002) With electronic maps, the user can navigate and explore the spatial data themselves with the given functionality. In a dynamic interactive visualization, the user needs to switch between data presentation and exploration. (Ogao & Kraak, 2002) Knapp(1995) defined four visualization operation tasks to be considered; identify, locate, compare and associate. Identify is describing an object, locate indicates the search for an object whose identity was already known. Associate and compare is the ability to relate between two different objects.

Table 6. Visualization operators from Ogao & Kraak

Alt text (Ogao & Kraak, 2002)

To cover the four visualization operations the user interface for a web page should have the following basic components:

- Geo browser – the map. Spatial dimension. Let users navigate.
- Time bar – temporal dimension.
- Filters – selecting information, filter. Thematic dimension.

The field names are historic but do not contain a change in time. Therefore the time bar had no relevance in the application. The static display of the field-names will be on the map as simple polygons, to indicate their position and show the user the spatial dimension, the location and sizes of the fields. There will be a set of navigation controls available to the user. Also multiple background layers, from which the user can choose. The information will be shown in a transect map. So the same information is shown in multiple views and from different perspectives. (*linking*) The brushing technique is used to highlight the height on the line and the position on the map of that specific point so the user can link between the two presentations.

4.1.2. Web based geo visualizations & user centered maps

For making the map, Web Map software was needed to create a map in the browser. Some possible Web Map Frameworks that could be used and are widely known are OpenLayers, MapFish and Leaflet.(Steiniger & Hunter, 2013) They will be elaborated on to specify why the application makes use of Leaflet.

OpenLayers is a library for WMS (tiled layers) and WFS (vector layers). It implements a JavaScript API for visualization of spatial data in the web browser. Without a server-side component. (Steiniger & Hunter, 2013) (<http://openlayers.org/>)

MapFish, is an open source web mapping framework for building rich web-mapping applications. MapFish provides specific tools for creating web services that allows querying and editing geographic objects. (Steiniger & Hunter, 2013) (<http://mapfish.org/>)

Leaflet is a web-map service WMS, that returns geo-referenced rasterized maps or tiles. In this context a map is considered a two-dimensional visualization of features in the common formats jpeg or tiff. Leaflet is open-source JavaScript library for interactive maps. (<http://leafletjs.org>)

Leaflet currently competes with OpenLayers only with respect to the display of map tiles, because OpenLayers offers much more functionality when it comes to interactive and vector-based map-ping tools. Also MapFish provides much more capabilities. For this was not needed for this application, the choice was made for using Leaflet, being light and simple.

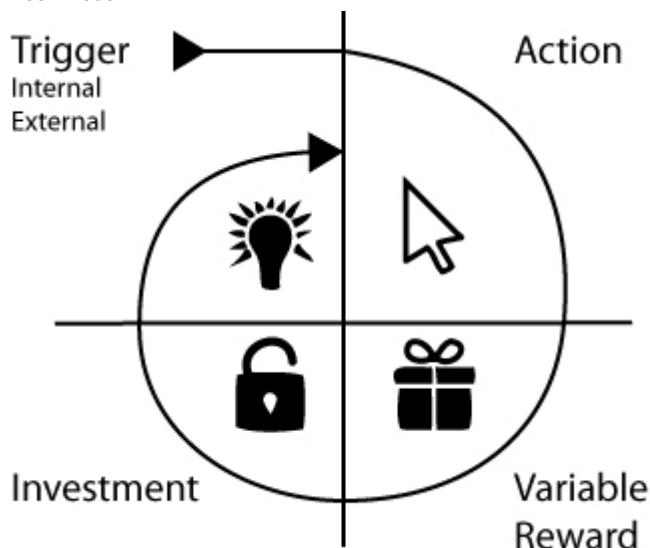
Leaflet also has the applicability to install plugins. For letting the user change the background map, the MiniMap plugin was used.

For building the transect line, d3 is used. A graphic drawing package. The transect line is therefore not a geographic representation but more information display. The geo-data is retained in the underlying data.

4.1.3. User centered designs or Customer engagement

To engage the target group into the application, the hook model is followed. This models explains how a user can become *addicted* to a online product. First there is a trigger, to make the user want to use the application. This could be either an external (e-mail, advertisement) or internal trigger. When using the product, the user can makes actions for which they have to be rewarded. If a user invest in the system they will likely stay and keep using the system, for they already put time and effort in that particular system. With multiple rewards and investments the user will go through the process again, for they get internal triggers to perform more actions.

Figure 17.
Hook model



In the field-names application the external trigger would be given by heritage institutions or environmental institutions. Informing the citizens about what interesting information there is to find about the Drentse surroundings. This could be in newsletter, pamphlets, online on their websites or even commercials. When on the site the trigger is the button, to press and go to the map. The action is to draw a line on the map of the users personal interest. After this the transect line is drawn and a lot of interesting information is displayed for the user to explore. This is called the reward. So in order to make the reward worthwhile, the information and transect line have to be visual attractive enough and contain

interesting and surprising information. For the long term a investment in the field-name application could be the adding of own field-names. So people that know some old field-names or have current names for particular areas of their neighborhood can draw them and save them to the system. Contributing to the conservation of the living heritage of field names.

4.2. The web application

The web application can be found on: \$ Some screenshots of how it looks:

Figure 18.
Welcome screen

Veldnamen in Drenthe

Ontdek het landschap en de verborgen namen!

Klik hier om naar de kaart te gaan!

Wat zijn veldnamen?

De tijd ligt niet eens zover achter ons dat veldnamen een vanzelfsprekend onderdeel vormden van de leefomgeving van veel dorpsbewoners. Het platteland was als het ware gestoffeerd met een rijk geschakerd kleed van veldnamen. Of het nu een akker betrof, een stuk groenland of opvallende plek, alles had een eigen naam. We spreken dan ook van een namenlandschap dat naast het geografische en het landbouwkundige landschap een plek op de kaart heeft veroverd.. Veldnamen lichten een tipje van de sluier op die over het dagelijks bestaan in vroegere tijden hangt. Ze reiken ons informatie aan over de inrichting van een deels nog woest en ledig landschap, zo zijn ze ons behulpzaam bij het ontcijferen van de geheimtaal die een dorpslandschap van soms eeuwen terug in zich draagt.

Veldnamen zijn te vergelijken met onze huidige straatnamen. Ze hadden in het agrarische werkkorps een praktisch nut in de communicatie en in de ruimtelijke oriëntatie. Samen vormden ze de basis voor een mentale kaart van het dorpslandschap. De veldnamen tiepen daarin als ijkpunten allerlei associaties, betekenissen en voorstellingen op. Waar ze uit het dagelijkse gebruik verdwenen, zijn in veel gevallen de verhalen erover nog springlevend.

In de twintigste eeuw, vooral in de tweede helft ervan, zijn het Nederlandse landschap en het gebruik ervan fundamenteel veranderd. Grootchalige ruilverkavelingen, intensieve landbouw, de urbanisatie van het platteland en natuurontwikkeling hebben de oude cultuurlandschappen weggevaagd, en deze ontwikkeling gaat nog dag in dag uit door.

Aandacht voor de oude toponiemen, de veldnamen waarmee we een oud en zelfs prehistorisch landschap kunnen ontdekken. Er zijn topografische kaarten die we bij het speurwerk kunnen

Hoe werkt de applicatie?

Met deze knop kan je een lijn beginnen te tekenen op de kaart



Eindig de lijn door nog eens op het laatste punt te klikken

Heb even geduld...



Nu wordt jouw hoogte doorsnede van het landschap getekend!

Ontdek de namen van de velden, er zijn verhalen, dieren en betekenissen te vinden



Klik hier om naar de kaart te gaan!

Figure 19.

Map status in beginning



Figure 20.

Map functionalities with mouseover.



Figure 21.
Map drawing a line function

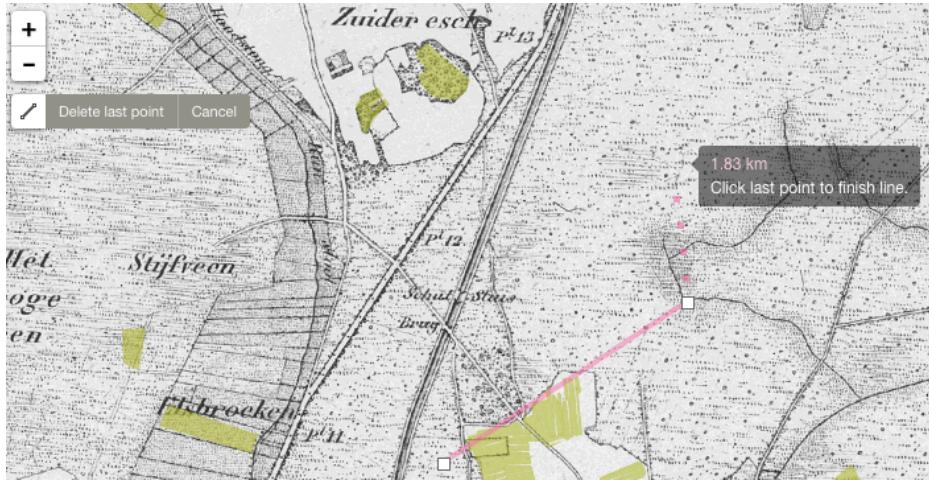
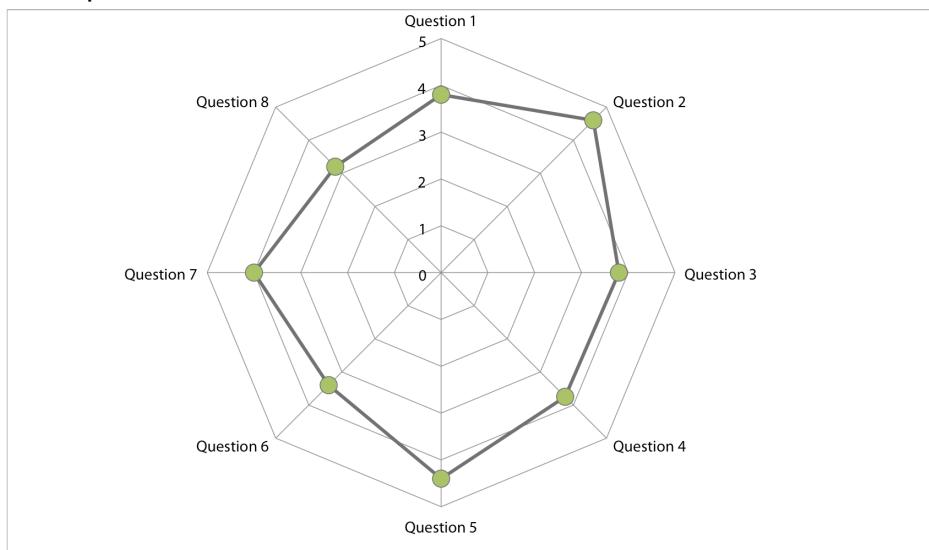


Figure 22.
Example interesting spot

4.3. Testing the web-application

Outcome questionnaire \$\$ people were asked to use the application and fill in the small questionnaire. The graph below shows the outcome of each question. With 5 being positive and 1 being negative. Question 2 about if people were triggered to perform multiple actions was answered the most positive. Also question 5 if the user found the information surprising and interesting scored high. Meaning that the application was perceived interesting and the user lingered around to discover more. Question 8 got the lowest score, the functionality did not work as the user would expect.

Figure 23.
Results questionnaire



For the total answer overview see appendix \$\$.

4.3.1. Remarks on the questionnaire

- “works logical, though information is missing”
- “Make the pop-up disappear when the mouse moves away”
- ” I miss a total overview of the page”
- “Finish line, not working.. “
- ” The elevation graph should follow the x,y of mouse instead of following just x”
- ” text window sometimes conflicts with the layer selector”
- “cursor on the map synchronies with the moving circle on the line”
- “also point selection, not only line”
- Ugly button on the introduction page
- I would like to know more about the different map layers
- drawing button for the line is hard to find
- While waiting, put a waiting sign.
- You would expect the information about the field to pop up when the moving circle is on the field, instead of the mouse.

Chapter 5. Discussion

Firs, the short time span of the project, resulted in a product that is not finished. The iterative process had to be followed several times in order to come to a user centered design. Though, after the first concept of the application, the time was not found to conduct a good testing round and adjust the application to this. The advise and comments received in the end, where very useful but were not implemented any more. This is a pity, for the application could be further improved with the new ideas. One of the new ideas, was splitting up the screen in 3 parts. Firs a screen with information, then scroll through to the next screen, where the user can draw a line. If the line is loaded, a new screen is show with the transect line and the information behind it. If the user wants to go back to either the explanation, or drawing a new line, they can simply scroll up and start over again. This form of websites is called a carousel and starts to become more popular.

In general, the conducting researcher did all steps of the process herself, and a lack for specific skills and knowledge was there. Recommended would be to outsource certain parts of the development of an application to professionals with specific aimed skills.

The data was provided by the RCE, because this all came in a unknown file structure with no metadata behind the various datasets, the background and quality of the data was not looked in. Also the categorization of the names, without a category assigned yet, was done in a harsh and crude way. Simply a sting comparison was done, which also resulted in wrong assigning of categories. For example short words like *val* and *gat* could also appear in names which didn't refer to this particular relief structure. Also the order of the scripts, starts at the beginning of the table and runs on the order of categories through the possible categories, resulting in more use of names in the category of altitude and forests, then the last category wind direction and miscelanious. The order of the table and so the order of running the script can be seen in appendix . Also no human cognition came to pass for the process. Which makes the classification crude.

Also the AHN processing was quite crude. The no value pixels where crudely run through a default tool of Qgis to fill up. Other possibilities were using another version of the AHN or calculating the water bodies differently. On the other hand for the goal of the data, the data could be seen as too detailed. Using pixels of 0.5 m resolution is not really needed for the visualization. The same for the water bodies, these do not need to be that exact.

Data + preprocessing

web technology

Design

geo visualization

test

◦

Too much ideas for such a short time span. Not enough knowledge for the conducting researcher in this short amount of time.

◦

Not enough knowledge of design or technical construction.

Lack of professional knowledge about the data

Design Geo-visualisation is so broad and there are so many ways in which a dataset can be described that it is not possible to set up a framework in steps to follow.

Geo data visualisation Height is the recent height, is this still the same as in 1830?? A lot has changed since.

water areas smoothed out.

No temporal dimension added.

Scale is needed

Not the best way to visualize the correlation which the field-names have to their surrounding.

more specific stories needed behind the fieldnames.

Testing - questionnaire no experience. Maybe too positively asked. 5 levels might be giving the people an opportunity of choosing 3 which is no saying. The participants are influenced by that they like heritage and understand the project in the bigger picture. participants are biased. Not enough participants.

usefull comments. though no time to implement them.

Chapter 6. Recommendations

6.1. Website recommendations

Add more symbols and information behind it. Make the application suitable for multiple browsers. Let the user invest, possible idea: Draw a field and add a field name. Implement more of the thought up ideas to make it more interesting.

Chapter 7. Conclusion

Every geo-visualization needs to be looked at individually and specific for that type. A type of story must be selected to tell.

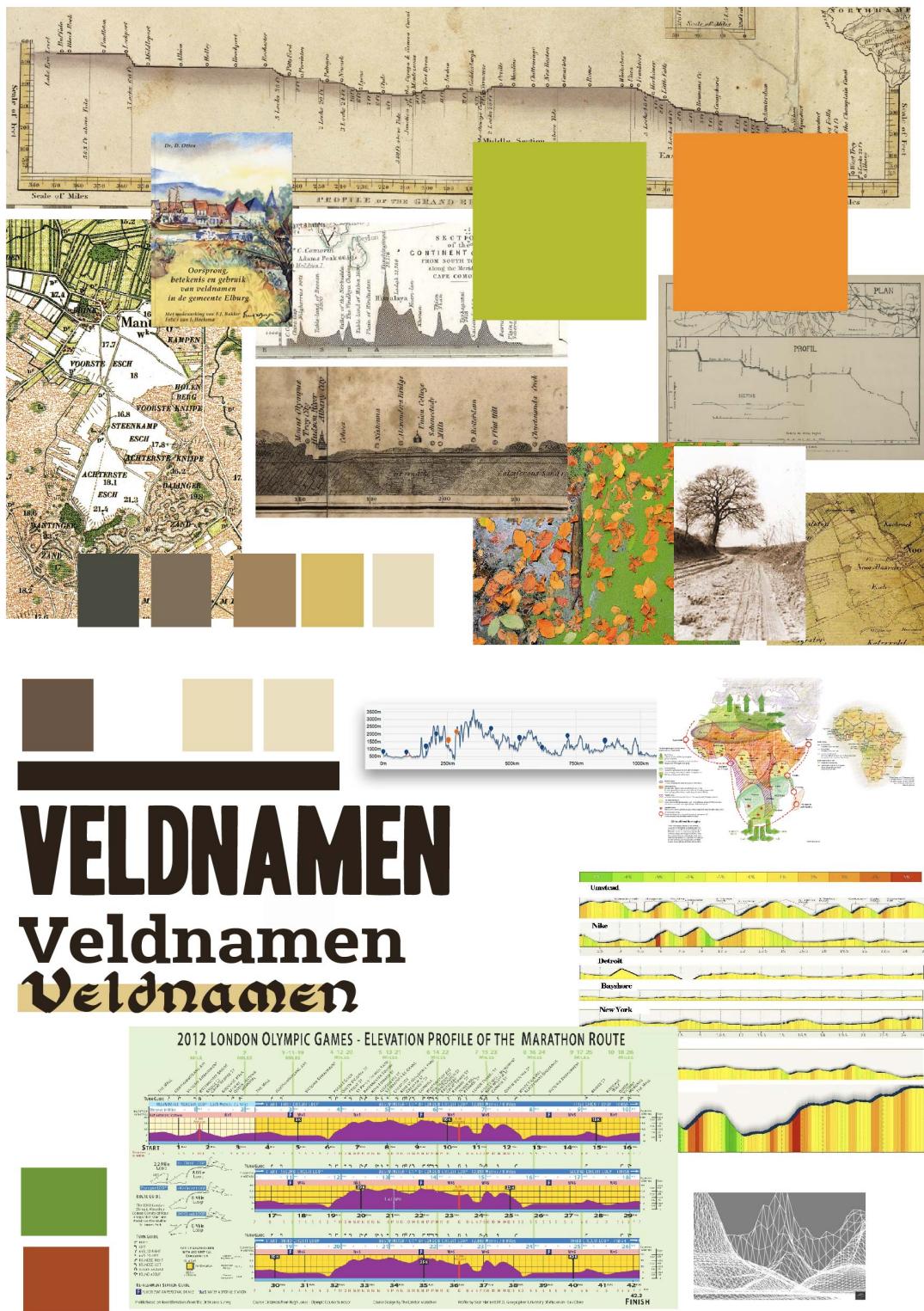
Chapter 8. References

- Actueel Hoogtebestand Nederland. (n.d.). AHN - Actueel Hoogtebestand Nederland - homepage [overzichtspagina]. Retrieved July 13, 2015, from <http://www.ahn.nl/index.html>
- Bertin, J. (2000). Matrix theory of graphics. *Information Design Journal*, 10(1), 5–19.
- Blok, C. (2000). Monitoring Change: Characteristics of Dynamic Geo-spatial Phenomena for Visual Exploration. *Spatial Cognition II*, 1(2000), 16–30. http://doi.org/10.1007/3-540-45460-8_2
- Cartwright, W., Miller, S., & Pettit, C. (2004). Geographical visualization: Past, present and future development. *Journal of Spatial Science*, 49(1), 25–36. <http://doi.org/10.1080/14498596.2004.9635003>
- Cerasuolo, F., Cutugno, F., & Leano, V. A. (2012). Visualization with a New Visual Metaphor for Hierarchical and Stratified Temporal Domain. In S. D. Martino, A. Peron, & T. Tezuka (Eds.), *Web and Wireless Geographical Information Systems* (pp. 57–71). Springer Berlin Heidelberg. Retrieved from http://link.springer.com.ezproxy.library.wur.nl/chapter/10.1007/978-3-642-29247-7_6
- Deal, L. (2014). Visualizing Digital Collections. *Technical Services Quarterly*, (April), 30–30. <http://doi.org/10.1080/07317131.2015.972871>
- DEN. Home. (n.d.). Retrieved May 6, 2015, from <http://www.den.nl/>
- Dibiase, D., MacEachren, A., Krygier, J., & Reeves, C. (1992). Animation and the Role of Map Design in Scientific Visualization. *Cartography and Geographic Information Systems*, 19(4), 201–&. <http://doi.org/10.1559/152304092783721295>
- Droj, G. (2010). Cultural Heritage Conservation by GIS, 1–6.
- Elwood, S. (2011). Geographic Information Science: Visualization, visual methods, and the geoweb. *Progress in Human Geography*, 35(3), 401–408. <http://doi.org/10.1177/0309132510374250>
- erfgeo. (n.d.). Retrieved July 22, 2015, from <http://erfgeo.nl/>
- Erfgoed & Locatie. (n.d.). Retrieved July 22, 2015, from <http://erfgoedenlocatie.nl/>
- Hahmann, S., & Burghardt, D. (2013). How much information is geospatially referenced? Networks and cognition. *International Journal of Geographical Information Science*, 27(6), 1171–1189. <http://doi.org/10.1080/13658816.2012.743664>
- Karavia, D., & Georgopoulos, A. (2013). Placing Intangible Cultural Heritage. *Researchgate.Net*, 675–678. <http://doi.org/10.1109/DigitalHeritage.2013.6743815>
- Köbben, B., & Yaman, M. (1996). Evaluating Dynamic Visual Variables. In Proceedings of the Seminar on Teaching Animated Cartography. Madrid, Spain: International Cartographic Association. Retrieved from <http://cartography.geo.uu.nl/ica/Madrid/ormeling.html>
- Kraak, M.-J., & Klomp, A. (1996). A Classification of Cartographic Animations: Towards a Tool for the Design of Dynamic Maps in a GIS Environment. In Proceedings of the Seminar on Teaching Animated Cartography. Madrid, Spain: International Cartographic Association. Retrieved from <http://cartography.geo.uu.nl/ica/Madrid/ormeling.html>
- Lai, J., Luo, J., & Zhang, M. (2012). Design and Realization of the Intangible Cultural Heritage Information Management System Based on Web Map Service. Springer-Verlag Berlin Heidelberg 2012, 605–612.
- Lin, H., Gong, J., & Wang, F. (1999). Web-based three-dimensional geo-referenced visualization. *Computers and Geosciences*, 25(10), 1177–1185. [http://doi.org/10.1016/S0098-3004\(99\)00076-X](http://doi.org/10.1016/S0098-3004(99)00076-X)
- MacEachren, A. M., & Kraak, M.-J. (2001). Research Challenges in Geovisualization. *Cartography and Geographic Information Science*, 28(1), 3–12. <http://doi.org/10.1559/152304001782173970>
- Martin, S., Reynard, E., Pellitero Ondicol, R., & Ghiraldi, L. (2014). Multi-scale Web Mapping for Geoheritage Visualisation and Promotion. *Geoheritage*, 6(2), 141–148. <http://doi.org/10.1007/s12371-014-0102-3>
- Mennis, J. L., Peuquet, D. J., & Qian, L. (2000). A conceptual framework for incorporating cognitive principles into geographical database representation. *International Journal of Geographical Information Science*, 14(6), 501–520. <http://doi.org/10.1080/136588100415710>

- Meyer, É., Grussenmeyer, P., Perrin, J. P., Durand, A., & Drap, P. (2007). A web information system for the management and the dissemination of Cultural Heritage data. *Journal of Cultural Heritage*, 8(4), 396–411. <http://doi.org/10.1016/j.culher.2007.07.003>
- Nöllenburg, M. (2007). Geographic Visualization. In A. Kerren, A. Ebert, & J. Meyer (Eds.), *Human-Centered Visualization Environments* (pp. 257–294). Springer Berlin Heidelberg. Retrieved from http://link.springer.com/chapter/10.1007/978-3-540-71949-6_6
- Ogao, P. J., & Kraak, M.-J. (2002). Defining visualization operations for temporal cartographic animation design. *International Journal of Applied Earth Observation and Geoinformation*, 4(1), 23–31. [http://doi.org/10.1016/S0303-2434\(02\)00005-3](http://doi.org/10.1016/S0303-2434(02)00005-3)
- Ormeling, F. (1996). Teaching Animated Cartography. In *Proceedings of the Seminar on Teaching Animated Cartography*. Madrid, Spain: International Cartographic Association. Retrieved from <http://cartography.geo.uu.nl/ica/Madrid/ormeling.html>
- Petrescu, F. (2007). the Use of Gis Technology in Cultural Heritage. October, (October), 1–6.
- Shedroff, N. (1999). Information interaction design: A unified field theory of design. *Information Design*, 267–292.
- Spek, T., Elerie, H., & Kosian, M. (2009). *Van Jeruzalem tot Ezelskoffer, Levende veldnamenatlas van de Drentse Aa. Matrijs*.
- Steiniger, S., & Hunter, A. J. S. (2013). The 2012 free and open source GIS software map – A guide to facilitate research, development, and adoption. *Computers, Environment and Urban Systems*, 39, 136–150. <http://doi.org/10.1016/j.compenvurbsys.2012.10.003>
- Tensen, T. (2014). Master Thesis Geo-data animations in television journalism: , 1–87.
- TOP10NL Publieke Dienstverlening Op de Kaart Loket. (n.d.). Retrieved July 13, 2015, from <https://www.pdok.nl/nl/producten/pdok-downloads/basis-registratie-topografie/topnl/topnl-actueel/top10nl>
- UNESCO Culture Sector - Intangible Heritage - 2003 Convention : (n.d.). Retrieved May 6, 2015, from <http://www.unesco.org/culture/ich/index.php?lg=en&pg=00002>
- Veldnamen - Encyclopedie Drenthe Online. (n.d.). Retrieved July 22, 2015, from <http://www.encyclopedia-drenthe.nl/Veldnamen.volkscultuur>. (n.d.). Retrieved May 6, 2015, from <http://www.volkscultuur.nl/>
- Waag Society. (n.d.). Retrieved July 23, 2015, from <https://www.waag.org/nl/organisatie>
- Zeijden, A. V. D. (2011). Immaterieel erfgoed en musea, (35), 4–6.

Chapter 9. Appendix

9.1. Mood board



9.2. Categories field-names form RCE

Lemming Code	Category	Category Code	Lemming	Name Alternatives
A1	Relief	A	berg	bergen bergje barg
A10	Relief	A	leest	
A11	Relief	A	richel	
A12	Relief	A	duin	dun dunne
A13	Relief	A	dal	daal dell dil
A14	Relief	A	kuil	koel
A15	Relief	A	waard	weerd
A16	Relief	A	kwab	kweb kwebbe kwabbe
A17	Relief	A	gat	
A18	Relief	A	put	
A19	Relief	A	laag	laagen laagte leeg lege
A2	Relief	A	bult	bulten bulste bultje bultien
A20	Relief	A	val	
A21	Relief	A	plat	
A22	Relief	A	vlak	vlakte vlakkien
A23	Relief	A	hol	
A24	Relief	A	glij	glijt gleet gleed
A3	Relief	A	hoog	hoge hoogte heugt
A4	Relief	A	hoorn	Horne hörne heurn
A5	Relief	A	hel	helle

A6	Relief	A	hul	hulle
A7	Relief	A	pol	
A8	Relief	A	hoop	
A9	Relief	A	nor	norre
B1	Bodem	B	zand	sand
B10	Bodem	B	grijs	grijze grauw
B11	Bodem	B	ele	
B12	Bodem	B	bruin	bruun
B2	Bodem	B	leem	
B3	Bodem	B	veen	
B4	Bodem	B	klei	
B5	Bodem	B	steen	stien stein
B6	Bodem	B	kei	kai kaai
B7	Bodem	B	zwart	
B8	Bodem	B	wit	
B9	Bodem	B	rood	rode
C1	Watermen	C	meer	meren
C10	Watermen	C	wiel	waal
C11	Watermen	C	zee	
C12	Watermen	C	vals	valsch
C13	Watermen	C	weier	weiert weijert
C14	Watermen	C	veentje	veentie

C2	Watermen	C	poel	
C3	Watermen	C	dobbe	
C4	Watermen	C	streng	
C5	Watermen	C	diep	
C6	Watermen	C	beek	beeck
C7	Watermen	C	water	
C8	Watermen	C	kolk	
C9	Watermen	C	leek	
D1	Beekdal_Moeras	D	broek	broeken broekje
D10	Beekdal_Moeras	D	gagel	
D11	Beekdal_Moeras	D	moor	moer moerde
D12	Beekdal_Moeras	D	goor	gor
D13	Beekdal_Moeras	D	sleek	slijk
D14	Beekdal_Moeras	D	rus	rusch
D15	Beekdal_Moeras	D	geel	gele
D16	Beekdal_Moeras	D	slob	slom
D17	Beekdal_Moeras	D	eis	
D18	Beekdal_Moeras	D	schol	scholte school schel
D19	Beekdal_Moeras	D	sek	sekke
D2	Beekdal_Moeras	D	maat	made maad maadje
D3	Beekdal_Moeras	D	mars	
D4	Beekdal_Moeras	D	vledder	vleer vlier fleer flier

D5	Beekdal_Moeras	D	stroet	stroot stroe
D6	Beekdal_Moeras	D	hem	ham
D7	Beekdal_Moeras	D	horst	hurst
D8	Beekdal_Moeras	D	oel	
D9	Beekdal_Moeras	D	riet	reit raait reet
E1	Bossen	E	loo	
E10	Bossen	E	haag	hagen heeg heg
E11	Bossen	E	els	elze eller elder
E12	Bossen	E	hulst	huls
E13	Bossen	E	den	denne
E14	Bossen	E	esch asch	
E15	Bossen	E	wilg	ween wene wede wee warff warve werff werv
E16	Bossen	E	eik	eek ekkel eck
E17	Bossen	E	hazel	hessel
E18	Bossen	E	struik	stroek
E19	Bossen	E	bramen	brummel
E2	Bossen	E	hees	heeze heze
E20	Bossen	E	meidoorn	hageldoorn
E21	Bossen	E	doorn	
E22	Bossen	E	bosbes	kreus kreuzen krös krözen
E23	Bossen	E	zwartebosbes blauwebosbes	bliek blik
E24	Bossen	E	bessen	

E25	Bossen	E	roos	rosen rozen
E26	Bossen	E	stok	stock
E3	Bossen	E	stobbe	stob
E4	Bossen	E	bos	bosch busch
E5	Bossen	E	hout	
E6	Bossen	E	holt	
E7	Bossen	E	laar	
E8	Bossen	E	wold	woold
E9	Bossen	E	strubbe	
F1	Veldgrond_stuifzand	F	veld	velt
F10	Veldgrond_stuifzand	F	lijsterbes	kwekeboom
F2	Veldgrond_stuifzand	F	heide	heide heet hiet
F3	Veldgrond_stuifzand	F	haar	hare
F4	Veldgrond_stuifzand	F	zuring	
F5	Veldgrond_stuifzand	F	woest	
F6	Veldgrond_stuifzand	F	wild	wilden wildernis
F7	Veldgrond_stuifzand	F	ruig	roege
F8	Veldgrond_stuifzand	F	brem	braam broam breem bram
F9	Veldgrond_stuifzand	F	wind	
G1	Wilde_dieren	G	fazant patrijs	hunder hoender hoonder
G10	Wilde_dieren	G	valk	
G11	Wilde_dieren	G	kraanvogel	kraan krane craan crane

G12	Wilde_dieren	G	reiger	
G13	Wilde_dieren	G	mus	
G14	Wilde_dieren	G	raaf	raven
G15	Wilde_dieren	G	duif	duiven duven doef doeven
G16	Wilde_dieren	G	mees	meeze
G17	Wilde_dieren	G	ooievaar	ooievaar heileeuver ooievaar eiber scholbos luibert
G18	Wilde_dieren	G	kraai	
G19	Wilde_dieren	G	spreeuw	spree
G2	Wilde_dieren	G	haan	hane
G20	Wilde_dieren	G	hond	hund
G21	Wilde_dieren	G	kat	
G22	Wilde_dieren	G	bever	
G23	Wilde_dieren	G	vos	
G24	Wilde_dieren	G	wolf	wolven
G25	Wilde_dieren	G	haas	hazen
G26	Wilde_dieren	G	konijn	
G27	Wilde_dieren	G	otter	
G28	Wilde_dieren	G	das	
G29	Wilde_dieren	G	adder	edder
G3	Wilde_dieren	G	uil	oel
G30	Wilde_dieren	G	mug	
G31	Wilde_dieren	G	luis	luizen

G32	Wilde_dieren	G	bij	iemen yment yemen
G33	Wilde_dieren	G	bloedzuiger	egel iegel
G34	Wilde_dieren	G	aal	alen
G35	Wilde_dieren	G	vis	visch
G4	Wilde_dieren	G	ekster	aakster jokster
G5	Wilde_dieren	G	kievit	kiewiet kieft Kieviet
G6	Wilde_dieren	G	eend	ent
G7	Wilde_dieren	G	gans	ganzen gaans gaanzen goos gozen goes
G8	Wilde_dieren	G	snip	
G9	Wilde_dieren	G	leeuwerik	
O1	Overig	O	sassen	
O10	Overig	O	wed	wet
O11	Overig	O	dansel	
O12	Overig	O	walg	
O13	Overig	O	alk	halk
O14	Overig	O	hartzeer	
O15	Overig	O	buis	
O16	Overig	O	helmer	
O17	Overig	O	staart	
O18	Overig	O	vlas	
O2	Overig	O	bol	
O3	Overig	O	viool	violen

O4	Overig	O	distel	dissel diesel
O5	Overig	O	bloem	
O6	Overig	O	ronsel	
O7	Overig	O	mos	
O8	Overig	O	klaver	
O9	Overig	O	groen	
W1	Wind	W	oost	ooster
W2	Wind	W	noord	noorder
W3	Wind	W	west	wester
W4	Wind	W	zuid	zuider

9.3. AHN tiles downloaded:

ahn2_5_07cz1.tif ahn2_5_12en1.tif ahn2_5_07cz2.tif ahn2_5_12en2.tif ahn2_5_07dz1.tif ahn2_5_12ez1.tif ahn2_5_07dz2.tif
 ahn2_5_12ez2.tif ahn2_5_11fz2.tif ahn2_5_12fn1.tif ahn2_5_12an1.tif ahn2_5_12fn2.tif ahn2_5_12an2.tif ahn2_5_12fz1.tif
 ahn2_5_12az1.tif ahn2_5_12fz2.tif ahn2_5_12az2.tif ahn2_5_12gn1.tif ahn2_5_12bn1.tif ahn2_5_12gn2.tif ahn2_5_12bn2.tif
 ahn2_5_12gz1.tif ahn2_5_12bz1.tif ahn2_5_12gz2.tif ahn2_5_12bz2.tif ahn2_5_12hn1.tif ahn2_5_12cn1.tif ahn2_5_12hn2.tif
 ahn2_5_12cn2.tif ahn2_5_12hz1.tif ahn2_5_12cz1.tif ahn2_5_17bn2.tif ahn2_5_12cz2.tif ahn2_5_17en1.tif ahn2_5_12dn1.tif
 ahn2_5_17en2.tif ahn2_5_12dn2.tif ahn2_5_12en1.tif ahn2_5_12dz1.tif ahn2_5_12en2.tif ahn2_5_12dz2.tif ahn2_5_12ez1.tif
 ahn2_5_12fn1.tif ahn2_5_12ez2.tif

9.4. R script converting files to shapefile.

```
filenames <- list.files()
filenames <- list.files(filenames , pattern = "*.TAB" ,full.names = T)

## x = list of folder files # cat = category folder
exportToShape <- function(x, cat){

  for(i in 1:length(x)) {

    name <- x[i]
    nr <- strsplit(name, "/")
    layer <- substr(nr[[1]][2], 1, nchar(nr[[1]][2])-4 )
    lemming <- substr(nr[[1]][2], 4, nchar(nr[[1]][2])-4)
    file <- readOGR(name, layer)
    file$category <- cat
    file$lemming <- lemming
    writeOGR(obj = file, dsn = "shape_vlak", layer = layer, driver = "ESRI Shapefile", overwrite_layer = T)
  }
}

exportToShape(filenames, "overig")
```

9.5. R script detecting categories

```
library(sp)
library(raster)
library(rgdal)
library(rgeos)
require(RPostgreSQL)
require(rgdal)

setwd("~/Users/waag/Documents/MGI_Stage/9_veldnamen/10_VeldnamenOrgineel/")

# csv alle categorien en Lemmings
categorie <- read.csv(file = 'Categorie_Aalles.csv', header = T , sep="," )

# shapefile alle velden + namen
velden <- readOGR(dsn = '/Users/waag/Documents/veldnamen.shp', layer = "veldnamen", stringsAsFactors = F)

# write shapefiel back
writeOGR(obj = velden, dsn = "veldnamen_cat.shp", layer = "veldnamen_cat", driver = "ESRI Shapefile")

# modifiving shapefile
velden$CODE_1[velden$CODE_1 != NULL] <- velden$ATOTO_CODE
## correctie
velden$CODE_1[velden$CODE_1 == "D02"] <- "D2"
velden$CODE_1[velden$CODE_1 == "E04"] <- "E4"
velden$CODE_1[velden$CODE_1 == 'G03'] <- "G3"
velden$CODE_1[velden$CODE_1 == "B03"] <- "B3"
velden$CODE_1[velden$CODE_1 == "G06"] <- "G6"
velden$CODE_1[velden$CODE_1 == "G07"] <- "G7"
velden$CODE_1[velden$CODE_1 == "A01"] <- "A1"
velden$CODE_1[velden$CODE_1 == "D03"] <- "D3"
velden$CODE_1[velden$CODE_1 == "D06"] <- "D6"
velden$CODE_1[velden$CODE_1 == "O08"] <- "O8"
velden$CODE_1[velden$CODE_1 == "O02"] <- "O2"

## categorien toevoegen
i <- 0
j <- 0

for( i in 1:length(velden$NAAM)) {
  naam <- velden$NAAM[i]
  for( j in 1:length(categorie$Lemming)){
    CODE <- categorie$Lemming_Code[j]
    tekst <- paste(categorie$Lemming[j],"|",categorie$amaltertieveen[j] , sep = "")
    geld <- grep(tekst, naam, ignore.case=T)
    if(geld){
      if(is.na(velden$CODE_1[i])){
        velden$CODE_1[i] <- paste(CODE)
      } else if(is.na(velden$CODE_2[i])){
        velden$CODE_2[i] <- paste(CODE)
      }
    }
    print(paste(naam, tekst, CODE, geld))
  }
}
```

9.6. Questionnaire for testing the application

Alt text