

Maps Re-imagined: Digital, Informational, and Perceptual Experimentations in Progress

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URL: <http://www.iis.sinica.edu.tw/~trc/public/publications/DH2019/>.

Abstract: A map can be thought as the fixture of certain places in a time to an artifact of indefinite longevity. The fixture was completed at the moment when the artifact had been produced. The places depicted on the map, however, can always be re-interpreted. We are interested in technical arrangements about historical maps upon which new possibilities can be experimented. We report on our experience in re-basing and rendering of early 20th Century land survey maps upon the OpenStreetMap technical infrastructure. Successive layers of digitalization and transformation are performed so as to bring out new representations from the old maps. Populated places, road networks, administrative centers and boundaries, water systems and diverse landscaping areas – surveyed and mapped long ago on paper – become digital objects waiting to be examined and navigated online. These places, connecting us to the past as well as to the present, can now be perceived anew.

Old Maps, New Tech

Maps are rich sources of geospatial information. Old maps reveal how people saw the places in their world. Researchers take hints from historical maps to help them connect the places of today to those of the past. Change in place names, the vanished old trails and the emergence of new roads, or the shifting boundaries of settlements, all these details could well be observed when land surveys from different periods are compared for a particular region. There are stories to be told about how these differences come to exist.

We distinguish three kinds of digitalization for historical maps. One is built on top of the other in

stage. In the first stage, paper maps are scanned into digital images. The change from paper media to digital media makes the maps more accessible and open for other use. In the following stage, geospatial features in the images are identified and extracted into programmable objects. The shift from visual features to digital objects facilitates transformative and analytic use of the information from the maps. In the last stage, the maps, now exist as collections of digital objects, are reprogrammed for new functions and novel cognitions.

The three stages can be short-termed as the digital (from paper to image), the informational (from features to objects), and the perceptual (functional and cognitional reconfiguration) stages. In this report we focus on experimentations in the perceptual stage. In particular, we map-out and re-style early 20th Century land surveys of Taiwan on top of the OpenStreetMap infrastructure (the software system, not the map content). Work in the digital and informational stages, that is, image scanning and feature extraction, is performed (and had been reported elsewhere) before the work in this perceptual experimentation can start.

Reuse the OpenStreetMap infrastructure has many benefits. The software is open source, so it can be freely modified for experimentations. The modifications to the software are also free to redistribute, so the experimentations and the results can be reproduced by others. The development of OpenStreetMap is by a grassroots community effort where innovations occur quite frequently. In this experiment we use tools from others, and the tools we have developed are also free for others to use. The data format used in OpenStreetMap is quite straightforward (nodes, ways, and relations) and there are converters to and from other data formats. The styling of maps on OpenStreetMap is also customizable. Indeed we rely on this ability in OpenStreetMap in order to render datasets from old maps into new styles.

Taiwan Baotu: Maps of Early 20th Century Land Survey

The Taiwan Baotu was a collection of topographic maps published in 1906 (when Japan ruled Taiwan). It is the output of an island-wide land survey, and the collection includes in total 457 maps covering a major part of Formosa and the Pescadores Islands. The maps also incorporated many other types of geographic information. The maps illustrate administration areas with their detailed boundaries. The maps contain a wealth of place names in use in Taiwan at that time. It includes details about land use, transportation, as well as landmark and landscaping information about Taiwan in the early 1900s. An image from the Taiwan Baotu collection is shown in [Figure 1](#).

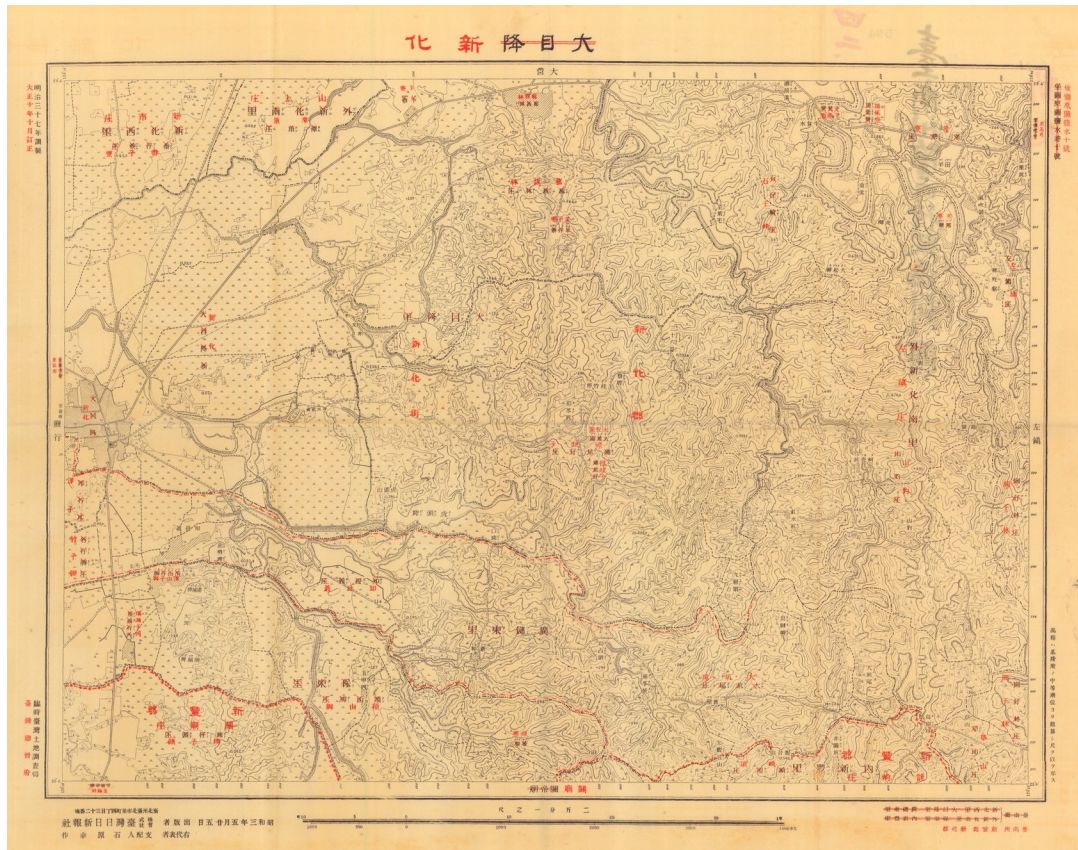


Figure 1. Map on the area around Sinhua (新化) Township (high-resolution image available online at: <http://publicdomain.tw/u/pd4pd/m/Xin-Hua/>)

Re-imagining Taiwan Baotu in OpenStreetMap

Once the feature datasets have been extracted from the Taiwan Baotu, all kinds of visual styling can be applied to them in the OpenStreetMap to generate new maps. An identical dataset can be rendered into different maps of the same area. We present below a sampling of the styles available in our current implementation. Please note that we merge in all datasets extracted from the individual maps from the Taiwan Baotu collection. In our OpenStreetMap realization of the Taiwan Baotu, there are no longer 457 maps, but one dataset for the entire collection. Further, the map can now be zoomed in and out in different scales. For illustrative purposes, in the following we use the area roughly corresponding to the map in [Figure 1](#).

[Figure 2](#) shows a new rendering of the area, following mostly the original Taiwan Baotu map style. However, new markers are used to re-style certain keys in the original map. For example, the Chinese characters for trees (林) are now used to replace the symbols for trees. The markers are adaptive to different zoom levels which result in nice visualization. In [Figure 3](#), the dataset is rendered to emphasize different landscaping areas and their boundaries. [Figure 4](#) is the rendering of the Baotu dataset with the default OpenStreetMap style to give the old map a modern look.

[Figure 5](#) is the current OpenStreetMap map of the area. Comparing details in [Figure 4](#) to [Figure 5](#) using the same mapping style help us better perceive changes to the landscape of the area. [Figure 6](#) and [Figure 7](#) are zoomed out views of [Figure 4](#) and [Figure 5](#) respectively.

We experiment with other styles in rendering the Taiwan Baotu datasets. [Figure 8](#) is the rendering of the Tainan and Anping area, using the Ink style. [Figure 9](#) is the area rendered in the Green style and [Figure 10](#), just for fun, is the area in the Ukiyo style. The rendering of Taiwan Baotu datasets into maps of different styles can be [experimented online](#).

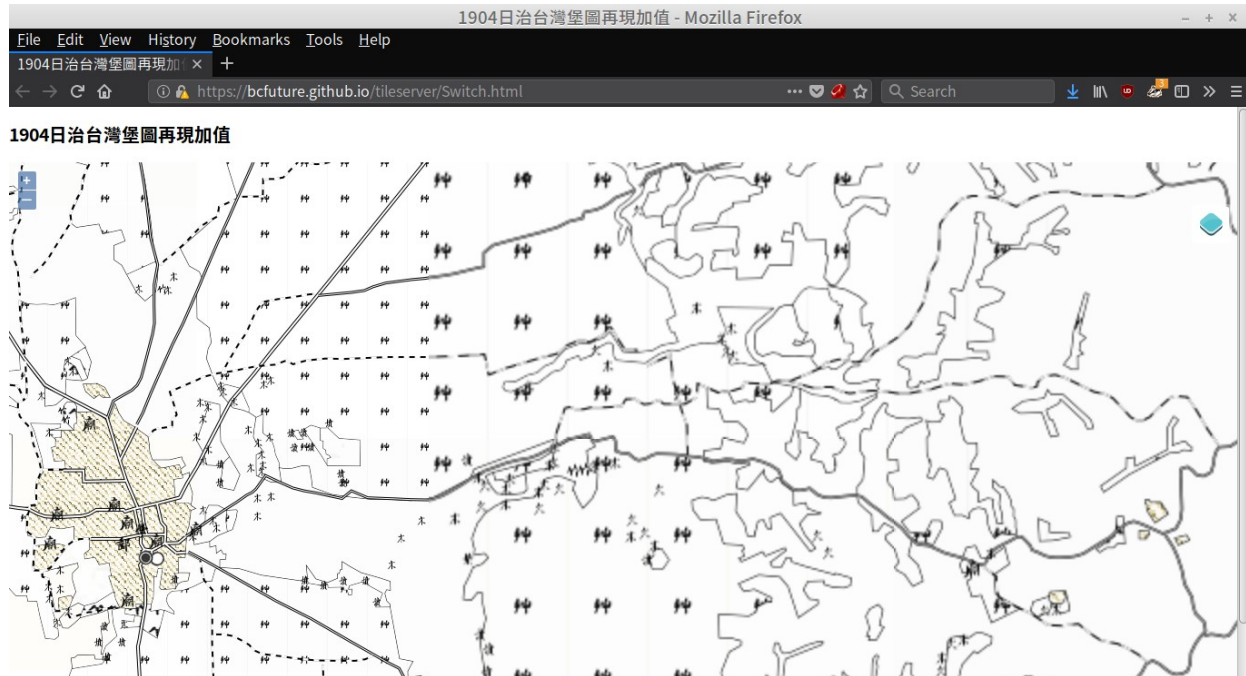


Figure 2. New rendering of the area around Sinhua, original Baotu style mostly

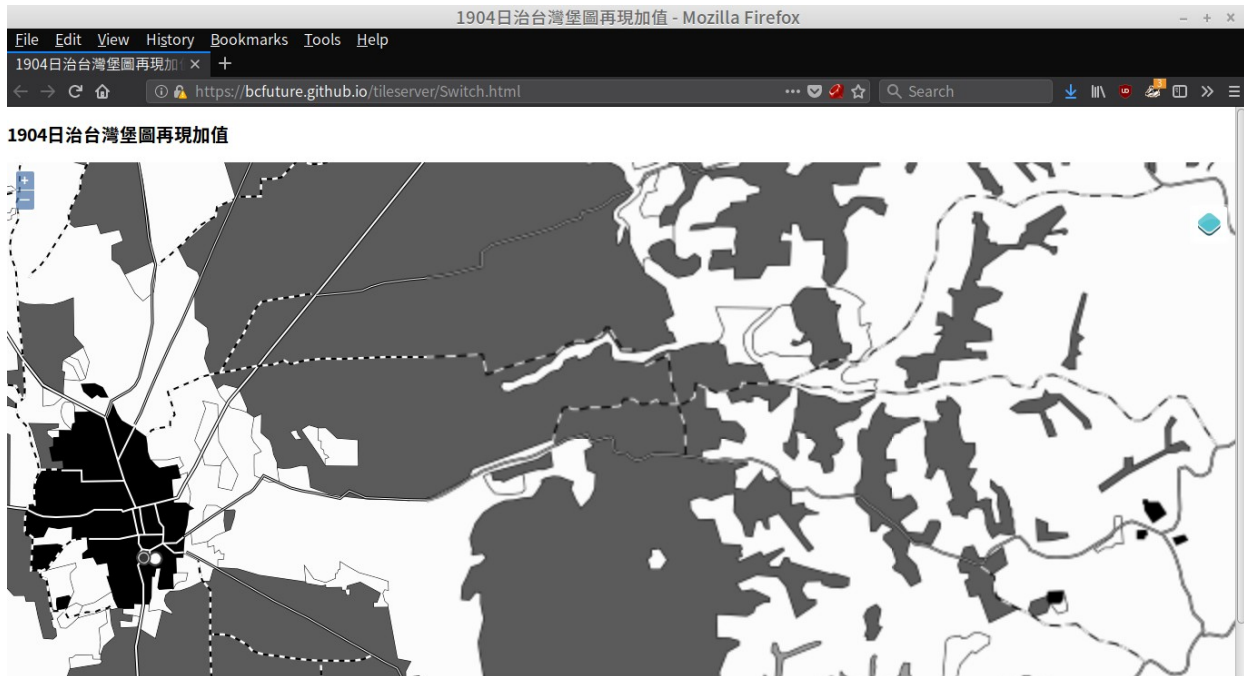


Figure 3. New rendering of the area around Sinhua, matching texture for landscaping

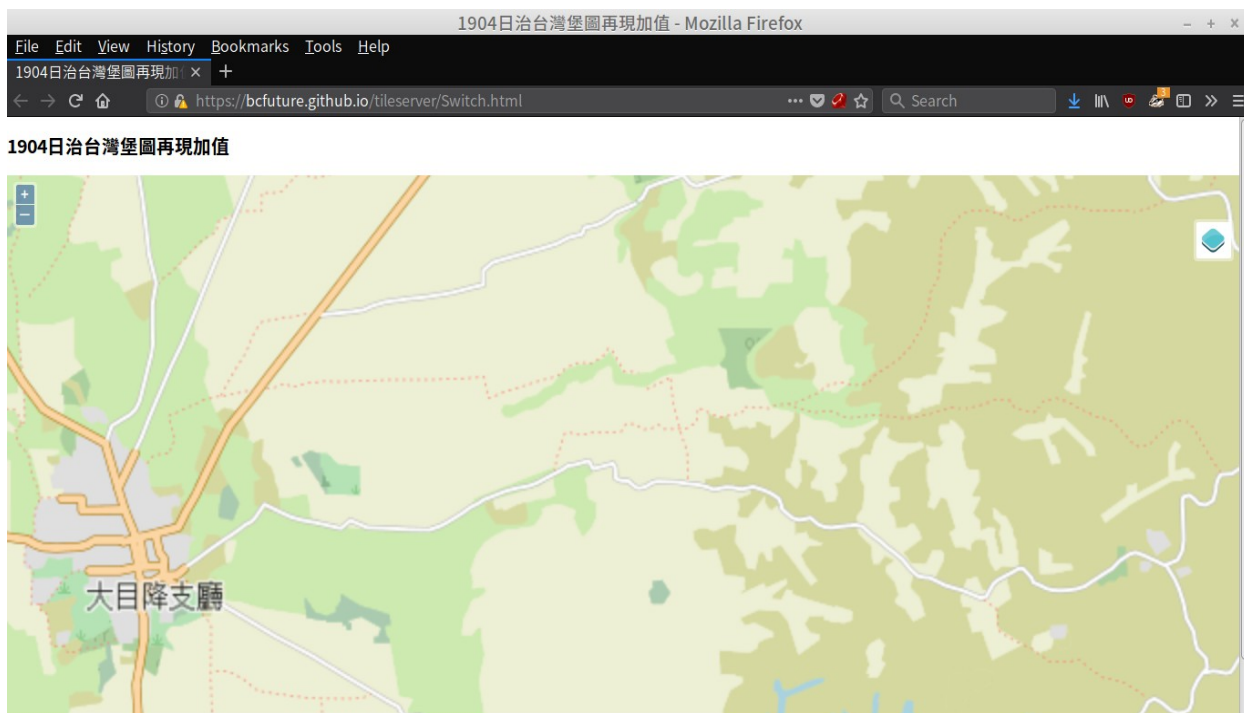
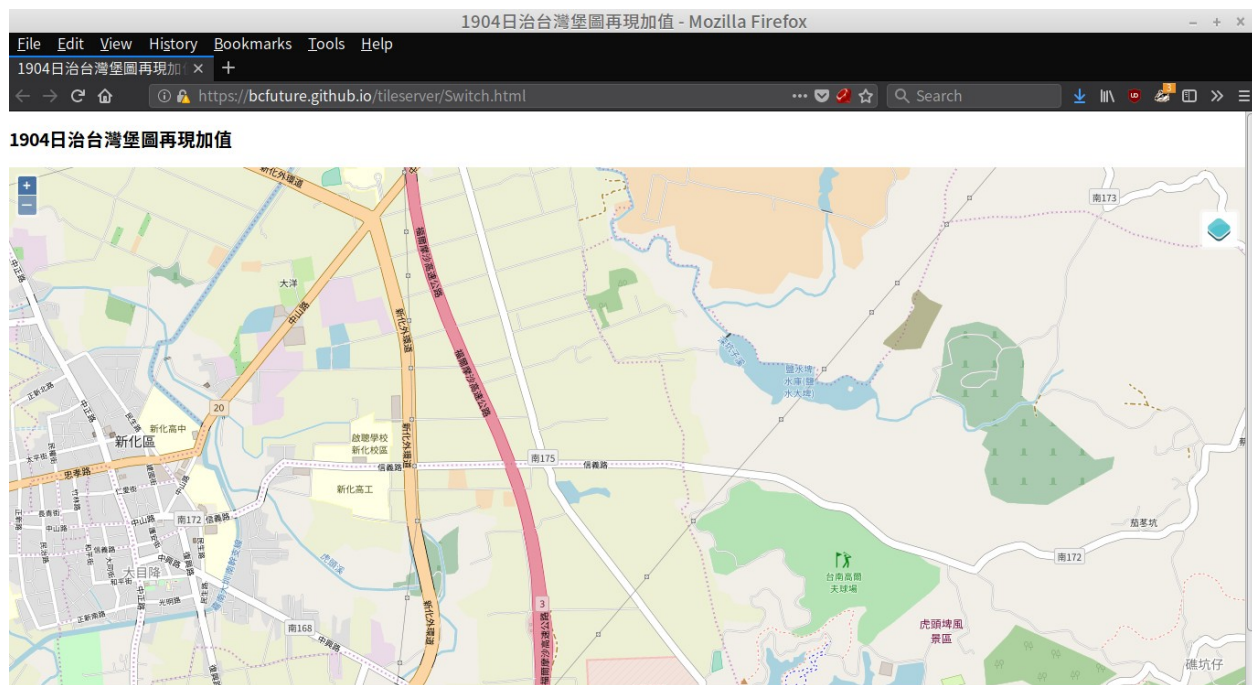


Figure 4. New rendering of the area around Sinhua, the modern OpenStreetMap look



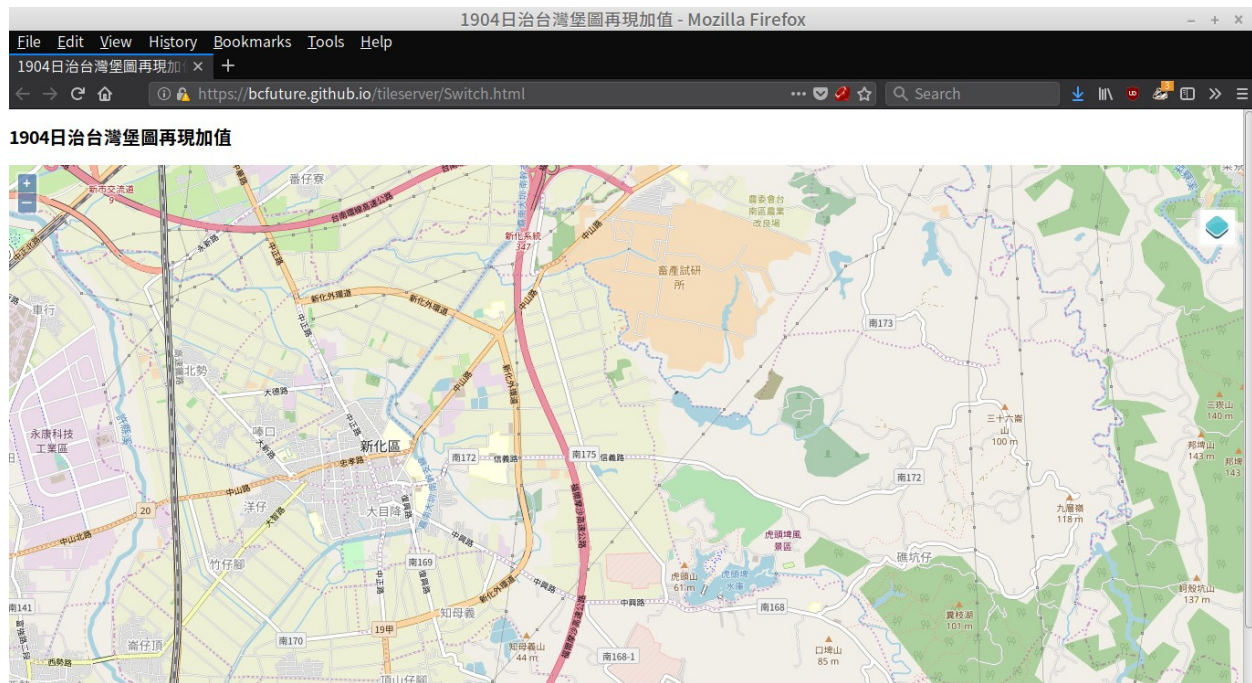


Figure 7. The current OpenStreetMap map of the Sinhua area, zoomed out (c.f. [Figure 6](#))

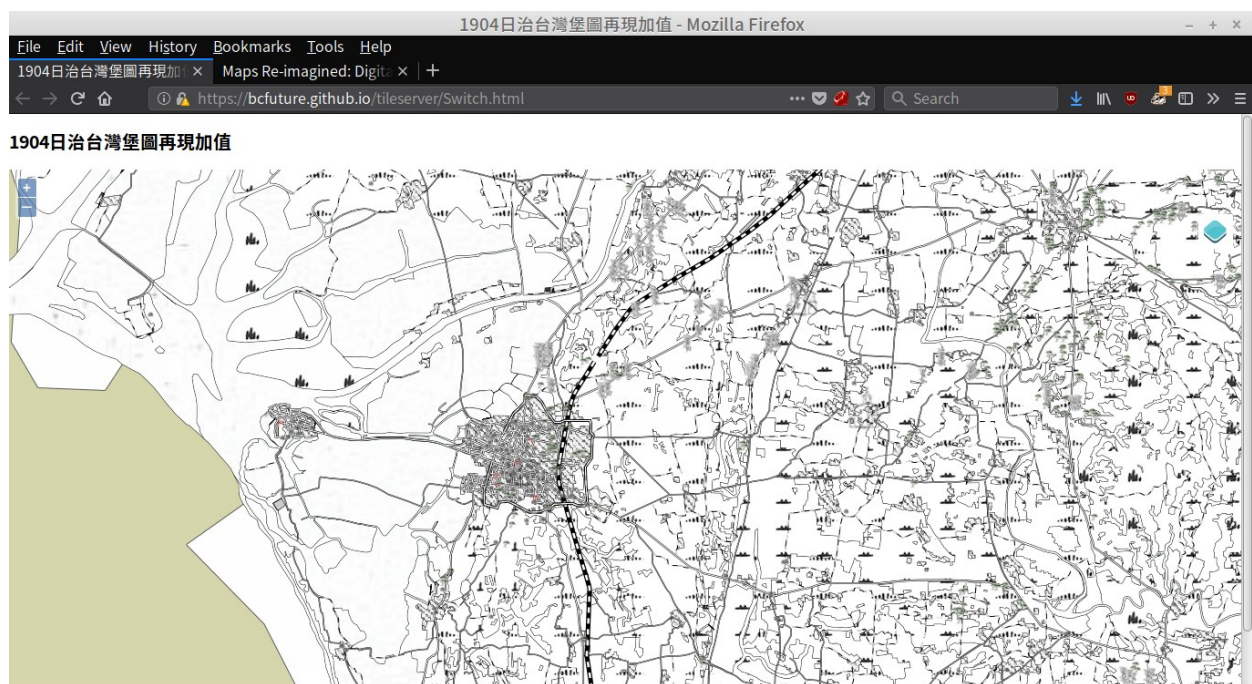


Figure 8. Rendering of the Tainan and Anping area, in the Ink style

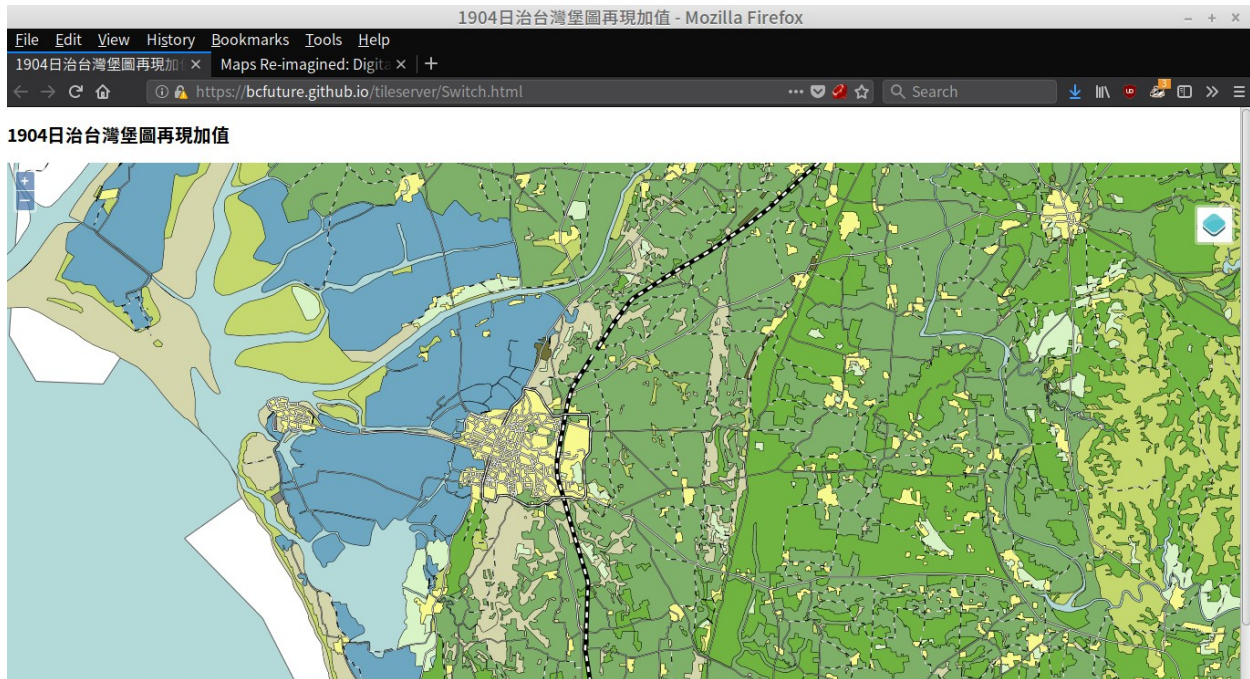


Figure 9. Rendering of the Tainan and Anping area, in the Green style

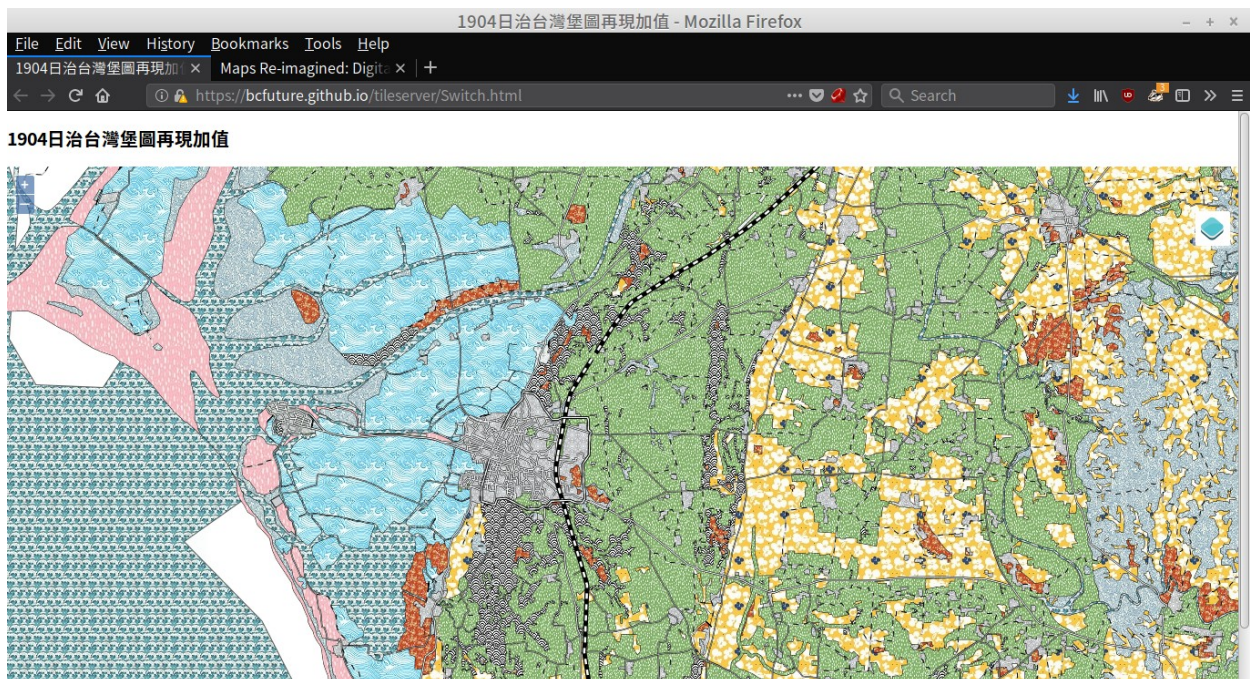


Figure 10. Rendering of the Tainan and Anping area, in the Ukiyo style

Background and Workflow

Our transformation of the Taiwan Baotu proceeds in stages. There are technical choices and styling decisions to be made along the re-imagination process. Our experimentations naturally are limited by the functionalities made available by the OpenStreetMap infrastructure. We depends thoroughly on existing technical tools and map datasets as well. The above factors however should not be considered just as constraints. Rather, upon these tools and datasets we are able to quickly test ideas and build systems. They are accessible and reusable, hence greatly help experimentations. We are very grateful.

The initial experiment we set out for ourselves is to re-make the Tainan portion of the Taiwan Baotu. Previously we had access to a collection of Tainan region image files digitized from the Taiwan Baotu paper maps. We were provided with several datasets of vectorized features already extracted from the images. The datasets are in the form of ArcGIS shapefiles. The shapefiles were converted into OpenStreetMap datasets with the help of available tools. They were rendered, in the default OpenStreetMap style, and put online by an OpenStreetMap server hosted by us (Huang et. al., 2015).

In the Summer of 2017, we began to re-do the Tainan region with the goals of achieving better data quality and gaining more flexibility in map styling. We (re-)digitalized the entire Tainan region by vectorizing map features drawn from the Taiwan Baotu online imagery service provided by the Center for GIS, Academia Sinica, Taiwan (http://gissrv5.sinica.edu.tw/GoogleApp/JM20K1904_1.php). The features not only are recorded for their geometries (points, lines, and areas) but also for their semantics (map symbols). These features are annotated with the tags used in the OpenStreetMap datasets (<https://wiki.openstreetmap.org/wiki/Tags>). OpenStreetMap tags are pre-defined key-value pairs describing specific features of map elements. In a way, we use OpenStreetMap tags to re-model the semantics of Taiwan Baotu map symbols. At the same time, we keep an image catalogue of all the Taiwan Baotu map symbols.

We then use the TileMill editor (<https://tilemill-project.github.io/tilemill/>), with the help of the image catalogue above, to define a Taiwan Baotu map style for use by the OpenStreetMap tile server, so that map features extracted from Taiwan Baotu can be rendered online in a way similar to the original paper map style. This is the Ink style shown in [Figure 8](#). We produce two more map styles: a Green style mainly for illustrating different types of land use, and a Ukiyo style mostly for style experimentation and for fun. Map styles produced by TileMill are provided as style configurations to the Mapnik toolkit (<https://wiki.openstreetmap.org/wiki/Mapnik>) in OpenStreetMap to render map datasets into map tiles of the prescribed styles. Note that, no additional style configuration is required if datasets are to be rendered with the default OpenStreetMap map style (https://wiki.openstreetmap.org/wiki/Standard_tile_layer).

For easy comparisons, we use OpenLayers (<https://openlayers.org/>) to overlap Taiwan Baotu, in various styles and all drawn from the same OpenStreetMap server, with other online maps (e.g. modern day OpenStreetMap or Google Map). This results in an experimental Taiwan Baotu (Tainan region only) map service (<https://bcfuture.github.io/tileserver/Switch.html>). The overall workflow is shown in [Figure 11](#) which is itself derived from the component diagram in the

OpenStreetMap wiki (https://wiki.openstreetmap.org/wiki/Component_overview). The parts marked in red are new or modified for our experimentations.

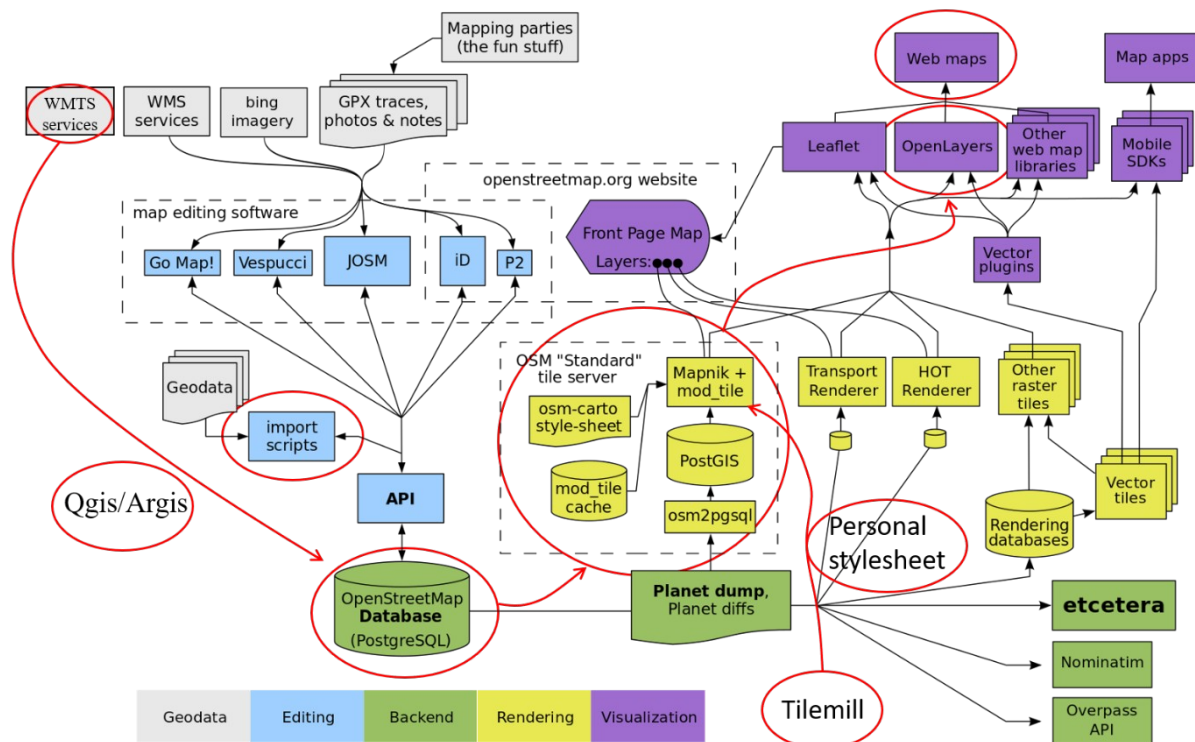


Figure 11. Workflow diagram, the parts marked in red are new or modified

Discussion

We have rendered the Taiwan Baotu datasets, which are extracted from maps produced more than one hundred years ago, using the OpenStreetMap infrastructure. The experimentations are both technical and humanistic. We try out to see how difficult the task is and how the maps look like. We are satisfied with the outcome. Our experimentations are humanistic in the sense that we see such transformative use of historical maps beneficial to researchers, teachers, and students in the humanities. Re-imagining the past with accurate datasets rooted in historical maps, we feel, could well generate interesting ideas for more research.

There is a wealth of literature on cultural cartography and visual cognition which we have not touched upon. We wish to draw lessons from these research areas and to continue our experimentations.

References

Huang, J.-P., Liu, H.-S., Liao, H.-M. and Chuang, T.-R. (2015) Old Traces, New Links: Representation of Taiwan Baotu in OpenStreetMap. In *Digital Humanities 2015: Conference Abstracts*. Sydney. Available at: <http://media.academia.tw/u/trc/m/baotu-in-osm-abstract/>.