A Prototype of SVG Map of Land and Building Tax Objects in Indonesia

Heri SUTANTA and SULARNO, Indonesia

SUMMARY

The Directorate of Land and Building Tax, the Ministry of Finance has already created digital maps of most of the big cities in Indonesia. The aim was to build a GIS of land and building tax objects, and later to increase tax revenue. The systems, named as SIG-PBB, were put on the district level. SIG-PBB uses MapInfo and Oracle as its core software. Tax payers have no access to the systems, and they rely on the invoice letter from the directorate to know how much money they have to pay. The availability of extensive spatial and attribute data in the SIG-PBB were invaluable assets for the improvement of public services. The idea was to put the SIG-PBB on the internet and let the tax payers know in advance the amount of money to be paid to the government. The Scalable Vector Graphic (SVG) was used as the file format of the prototype system.

The prototype system uses real data from the City of Yogyakarta. The digital maps were converted into ArcView shapefile. All attribute data, such as the tax payer, tax object number (NOP), selling value of tax object, width, type of land and/or building were extracted from the Tax Object Information Systems. The next step was to design the components of the SVG map. The first page was the whole coverage of the City of Yogyakarta. It composed of the maps the whole sub-district. User can interactively choose their option via mouse-click on the map. They will be directed towards map of villages, which consists of the block maps. Block maps were a certain area, usually not too large, defined by the Tax office as a basis for tax survey. In the block maps, user could browse the information regarding their tax objects. A Security tools have been proposed to prevent un-authorized user getting information of others' tax information. The security systems uses tax payer's name as the login name and 18 digit of tax object number as the password.

The prototype systems of SVG map of land and building tax was interactive and has relatively small file size. It was not depending on any proprietary format and could be viewed using MS Internet Explorer or Netscape Navigator equipped with free SVG viewer plug-in. Security system and option could be set using JavaScript programming. Online measurement tools allow the user to their land or building dimension, and therefore provide a checking mechanism for the tax office. Any tax-related information could be simply embedded to the systems via web programming.

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1. INTRODUCTION

Most of the visualizations of map or graphic at the web at this moment are using GIF or JPEG. These formats have been standardized by the World Wide Web Consortium (W3C), therefore all web browser have supported it well. However, they have fixed resolution which forced users to the 2 difficult options. If the resolution should be increase, then the file size become larger and consequently downloading time becomes longer. If the file size required to be reduced, the resolution can be lowered but the graphic quality will become worse.

Current web application seems that the requirements are not only small file size but also content of information of the objects or maps. The latter actually have already been supported by GIS software. In GIS software, with a mouse click, we can obtain information related to points, lines or polygons. The information usually opened in a new window, or a table window.

Rapid internet development has also affected government process and relation with community. It is now common to hear what is called e-Government. Three main function or service from e-Government includes (Indrajit, 2002):
−   Publish, a one way communication in which the government publishes information to public, who can freely accessing it.
−   Interact, a two way communication between the government and public. The application can be in the form of a portal which enables dynamic information searching. Other form may include a facility to discuss certain topics with government institution directly (chatting, teleconference, web-TV) or indirectly (e-mail, newsletter).
−   Transact, similar with interact. In addition, there is a facility where public can buy certain service from the government on line.

The development of internet GIS open up new perspective that spatial data can be shared to users who do not have access to GIS software. Internet GIS shows an interesting application, if it could be integrated as part of e-government. What the users should prepare is an internet connection with appropriate web browser, which is already exist in the market. All GIS operation will be done in the server having internet GIS software.

Although internet GIS has growing fast, the implementation of it in developing countries sees some obstacles, such as:
−   Lack of spatial data in digital format.
−   Although some maps are already in digital, but still not in GIS-ready format.
−   Lack of skilled staff to maintain internet GIS.
−   Financial problems to invest for such expensive internet GIS software from well known vendor with proprietary format

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With the introduction of scalable vector graphic (SVG), it is hoped that the development of a light weight and low cost internet GIS can be speed up. From the perspective of PBB map, it might be good starts to create a web map of tax objects to enable the tax payers see the geometric dimension of their tax objects. It is aimed to publish tax objects' related information to public using the web. The Directorate of Land and Building Tax has already developed an extensive spatial data of tax objects through its SIGPBB and attribute data through its SISMIOP. Those data are valuable assets and good starting point in developing web-based tax information systems.

Currently there is no a web-based tax information systems, especially with spatial data attached to it. On the other hand, public demands on transparency seem to increasing. Those facts trigger this research on developing a prototype web-based map of land and building tax using scalable vector graphic.

2. SCALABLE VECTOR GRAPHIC (SVG)

2.1 The Development of SVG

There are already vector formats for graphic presentation, as discussed by Neumann & Winter (2001). They have object-oriented with flexible resolution, highly interactive and can be attached with animation. The drawback for spatial data dissemination lies in the fact, that they a proprietary format. Commercial software format, like Macromedia Flash, is an example. The use of it in a web browser needs a plug-in.

SVG development started at the end of 1998, pioneered by a working group of W3C. First application of SVG format was in September 2001, and since then the W3C recommends it as a standard for graphic format on the web. The development of SVG, actually was based on the development of XML. eXtensible Markup Language (XML) was developed since 1996, and received recognition from W3C in February 1998. It was not a new technology, but a derivation from SGML (Standard Generalized Markup Language), which was developed in the early 80's.

Similar to HTML, XML also using element marked by opening tag (started with '<' and ended with '>'), ending *tag* (started with '</ ', ended '>') and attribute element (parameter defined with opening tag, such as <form name="content">). In HTML tag and attribute have been defined, while in XML users can program it according to the requirements. According to Utdirartatmo (2003), basic characteristic of XML are:
– Separation of data with visualization.
– Freedom in the creation of tag (extensible), which enable user to define his own tag.
– Searching of the content is better. If a web page was made in XML, user will easier in finding information.
– Integrating data from different sources is easier.
– Write once, use everywhere.

As the SVG format was based on XML, the advantages of XML are inherently exist. At the current stage in web mapping, SVG mainly used to visualize 2D graphic in XML code. In

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principle SVG can be used to create 3 types of graphic objects: path (straight and curved line), pictures and text.

The advantages of SVG is that the graphic will not lose its quality in zooming-in or zooming-out operation (scalable), since it is made in vector format. Furthermore, the geometrical accuracy of spatial object will also be maintained in SVG format. The boundaries of a parcel will exactly the same as it was surveyed in vector format. Nevertheless, it also poses a disadvantage, if the SVG file can be download then the whole accurate spatial data will be handed-over to third party.

Content of information can be attached in SVG, and enable user to browse necessary attribute data. A connection to database is also possible which can provide data update ness. Although SVG is a vector in nature, shadow effect, color gradation and lighting scenario can also be made. A JavaScript code can be attached to the SVG document to improve its interactivity.

The disadvantage of SVG may include the fact that not all web browsers are SVG-enabled. A plug-in need to be installed to enable web browser (MS Internet Explorer or Netscape) read SVG document. The good news is that the plug-in (like Adobe and Corel SVG Viewer) is available for free.

2.1 Examples of SVG format

PBB map contains the following spatial form: lines and polygon. Most of the polygons are in box shape. To create a line feature, tag <line> was used. Below is an example of SVG document to generate a line. The result will be a line from point 1 (X_1=127, Y_1=65) to point 2 (X_1=127, Y_1=200), colored red and width of 2 pixels.

```
<line x1="127" y1="65" x2="127" y2="200"
style="stroke:red;stroke-width:2"/>
```

To create a polyline, for example road feature, the following notation is an example.

```
<polyline points="100,200 100,20 10,100 100,20"
style="stroke:yellow;stroke-width:1"/>.
```

The result will be a polyline, passing through point 1 (X_1=100, Y_1=200), point 2 (X_1=100, Y_1=20), point 3 (X_1=10, Y_1=100), and point 4 (X_1=100, Y_1=20). The color assigned is yellow, while the pixel width is 1.

Buildings and parcels sometimes has box shape. To create a box shape in SVG, tag <rect> was used. In the following example, we intend to create a box shape feature, started at coordinate (80,53), width and height are 189 and 52 pixels, respectively. The color is green with neat line in red (indicate a house in PBB map).

```
<rect x="80" y="53" width="189" height="52"        style="fill:green;stroke:red;
```

stroke-width:1"/>

Most of the buildings and parcels usually in polygon shape. Two tags can be used to draw a polygon, tag <polygon> and tag <path>. The following SVG document is an example to draw a polygon.

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<path d="M 10 10 L 50 10 L 65 30 L 65 50 L 10 50 Z" style="fill: lavender;
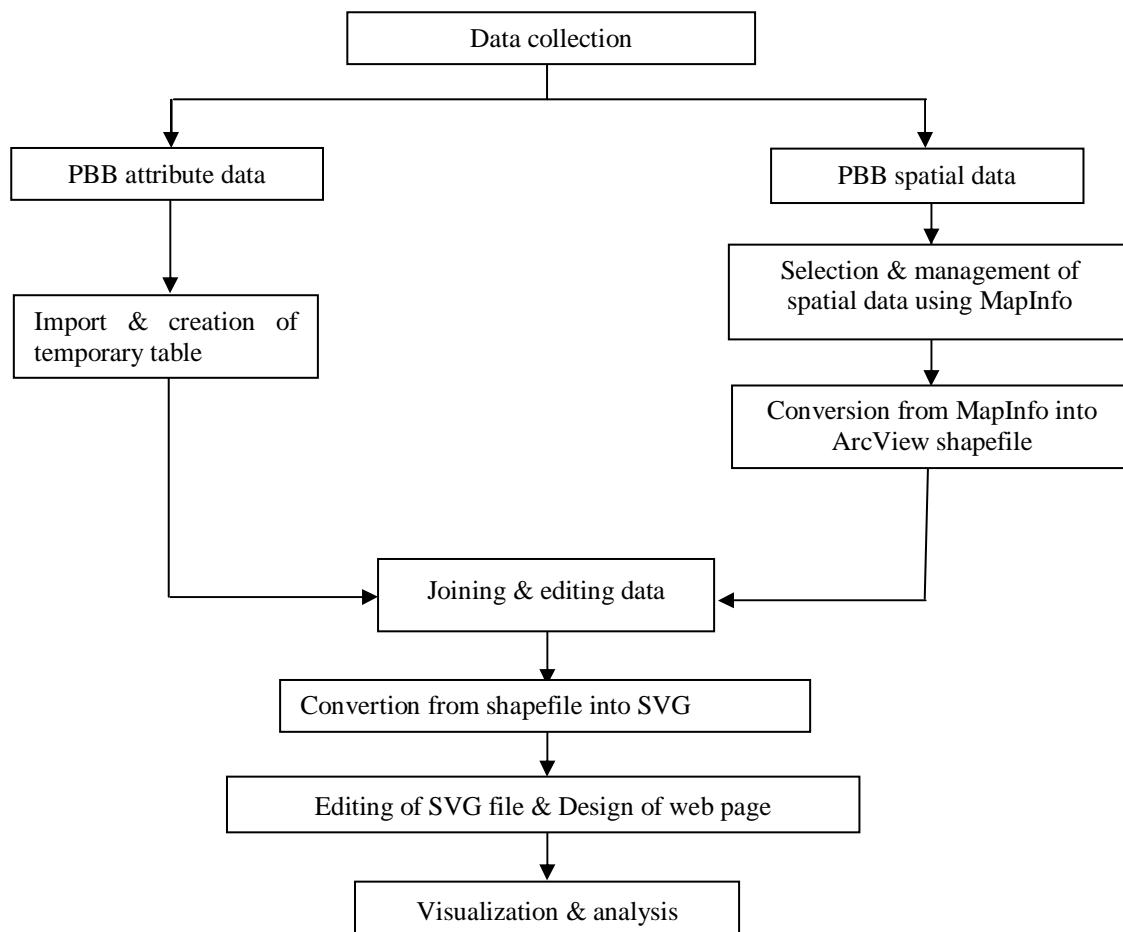
stroke: blue; stroke-width: 1px"/>

From the above code, the SVG will draw a polygon starting from coordinate (10, 10). The notation "L" stands from Line to which means draw a line to a certain coordinate. In this case, draw a line to coordinate (50,10) and so on. The notation "Z" means the end of the line, and therefore a line will be drawn from the last coordinate to the first one. The color will be lavender, while the color of the line will be blue, and the width is 1 pixel.

3. GENERATION OF SVG MAP OF LAND & BUILDING TAX OBJECTS

3.1 Conversion into SVG Map

The whole process is presented in figure 1. It was started with data collection from PBB Office of Yogyakarta. The attribute data are presently stored in SISMIOP, a tailor made database system tax objects and tax payers built under Oracle. The spatial data are maintained using MapInfo.

Figure 1: Research stage

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The next step was to create a temporary table which will be used store attribute data from SISMIOP. The aim was to speed up data joining in ArcView. These attribute data will also be part of information that can be queried by the users. An SQL program was made to create temporary table. Content of the temporary table was based on the SISMIOP database, but can be further arrange according to what type of information will be presented in web page. Next step was joining data from SISMIOP with the temporary table. In order to connect ArcView with SISMIOP database, and ODBC (Open Data Base Connectivity) was made.

The conversion from MapInfo format to shapefile utilized a Universal Translator menu available in MapInfo. This operation needed because we used a converter to create SVG map. Our converter, MapViewSVG only works to convert shapefile into SVG, and not MapInfo file into SVG. Editing in ArcView aimed to make the visual appearance similar with its original map in MapInfo. Name of View window in ArcView was set as it would be the web page title. Map unit and distance unit was set to meter, as it would be appear in interactive distance measurement in SVG map. Map projection was not change.

Spatial data from PBB includes multi-level maps, spanning from provincial, district, sub-district, and village map. The proposed prototype will have slightly different components. Provincial map will not be included, since it has a huge database. The SVG map will consist of district, sub-district, village and block map. A block map is covers part of village, and was used as a basis for PBB survey. This block map was generated by extracting layers and tables that made up village map.

District map has one theme, sub-district boundary. At sub-district map, only village boundary will be visualized. Village map has the following layers: parcel, building, village boundary, block boundary, road, river, and text. Only 2 layers were visualized in the web map of village level, namely road and block boundary. In block map, 2 more layers was added, parcel and building.

Creating SVG file of the PBB map by writing SVG code as shown in part 2.2 will be time consuming and prone to errors. In this case we use to converter (SVG 3.3.6. and demo version of SVGMapper 1.3.9.). Those two were used to convert ArcView shapefile into SVG. The simple maps of District, Sub-districts, and Villages were converted using SVGMapper. The more complex map of blocks was converted using MapViewSVG.

In the conversion of bloc maps, some parameters were defined, such as: template, tools for coordinate read out, interactive distance measurement, zooming and panning. Dimension of the SVG map and themes to be included were also defined in this process. A mouse-over technique provides interactivity by enabling tooltip text, attribute information of the spatial feature. This tooltip text was further edited using *JavaScript* to provide detail information.

3.2 Editing of SVG Format

Results of the conversion process are SVG, JavaScript HTML, and XML files. HTML files were used to arrange visual appearance of SVG files and giving usable fasicilities. Javascript

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files contain code to generate additional facility. XML files contain data in text format that can function as a database system.

JavaScript and SVG file resulted from the conversion were further edited to add more interactivity and animation capability. In district map, columns were added to store data on sub-district's name, number of tax objects, NJOP, and width, and also animation files. List of sub-district's name equipped with an ENTER button to navigate to the selected sub-district.

In sub-district and village map, an object was added to SVG file to store information regarding tax objects in those areas. A JavaScript was attached to visualize the information. An arrow button was added as backward button to the previous page. In the village map, list of blocks was added with an ENTER button to navigate to the selected block. Three SVG files were created in block map, 2 for storing data and an arrow button for hyperlink to previous page.

XML files contain data on attribute of parcels and building, and saved in associated folder for each block. 2 types of XML files are exist:
- File *th2.xml*, contains information on building's attribute of each blocks. It was simply a converted form of building's attribute table into text format. All informations of each building were converted.
- File *th3.xml*, contains information on parcel's attribute of each blocks. It was simply a converted form of parcel's attribute table into text format, like th2.xml.

The two XML files were used as 'database', when user using facility that request on information about parcel or building data. To visualize attribute data, the SVG file does not request from a database, but from the XML files.

4. WEB PAGE DESIGN AND VISUALIZATION

4.1 Components of Web Page

SVG map was attached to HTML file, in order to have better visualization. Important components of the web pages listed in table 1.

Table 1.2: Important components of web pages

Page	File	Remark
District map	District_map.svg	Contain main map
	District_place.svg	Space for information
	District_legend.svg	Legend of the district map
	District_map.js and n district_inisialisasi.js	JavaScript code to present animation & information
Sub-district map	Subdistrict.svg	Contain main map
	Subdistrict_place.svg	Space for information
	Subdistrict_legend.svg	Legend of the sub district map
	District_back.svg	*Hyperlink* to get back to district map

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Page	File	Remark
	Subdistrict_inf.js interaktif.js	JavaScript code to present animation & information
Village map	Village_map.svg	Contain main map
	Arrows.svg	Space for information
	Village_legend.svg	Legend of the village map
	Subdistrict_back.svg	Hyperlink to get back to sub district map
	Inisialisasi.js and block_boundary_map.js	JavaScript code to present animation & information

Table 1.2: Important components of web pages (contd.)

Page	File	Remark
Block map	Map.svg	Block map
	Head.svg	Title, denoted the block number
	Overview.svg	Overview map
	Th*query*.html	HTML file when a query operation is requested.
	Th.xml	XML file contain attribute data
	Svgside.svg	Space for information about building objects, located on the right side of main map
	Svgdown.svg	Space for information about land/parcel objects, located under the main map
	Legend.svg	Contain symbol of 5 themes in block map
	Back.svg	Hyperlink to get back to sub district map
	JavaScript files (.js)	JavaScript code to present animation & information
	Navigation buttons	Buttons for *zooming*, *panning*, interactive distance measurement, and coordinate reading
	Text input	Scale reading
	NOP list	Short cut for zooming in based on NOP

A table was used to arrange the position of district, sub-district, and village maps. The next step was to use HTML code to embed them. In block map, position of the components was arranged using browser coordinate. The colors of the maps were made different in order to help user better differentiate them. The color of block map was made exactly the same with the original map in MapInfo.

The realization of SVG format of PBB map includes 4 levels of maps, starting from district level, sub-district, village, and block map. To find information from a certain parcel, user has to look at the block map level. Navigation in the map is given using short cut keys combined with mouse click. A press on CONTROL key will make the mouse cursor become a zooming-in window. CONTROL + SHIFT keys for zooming out, while ALT for panning. These functions can also be accessed using mouse right click.

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4.2 Content of Each SVG Map

District map contains sub-district boundary. Each sub-district acts as a spatial unit which also functions as a hyperlink to enter to the sub-district map. When the mouse cursor moved over a certain sub-district, information on tax of it will be visualized in the right side of web page. The information listed are name and code of the sub-district, total number of tax payers, total width of parcels and buildings, total amount of NJOP parcels and buildings.

Sub-district map contains village boundaries. Action and information when the mouse cursor moved over a certain district is similar to the district map. The difference is only on the content of the information. A hyperlink, in the form of back arrow is provided to get back to the higher level map.

Village map contains layers of block and road. Layer of block is a hyperlink to enter the chosen block. When a block is selected, information regarding to the code of the block, name of the village and sub-district is presented. Block map contains layers of parcel, building, block boundary, road/river, and road label. Figures 2, 3, 4, 5 visualized the SVG map at district, sub district, village, and block level, respectively.
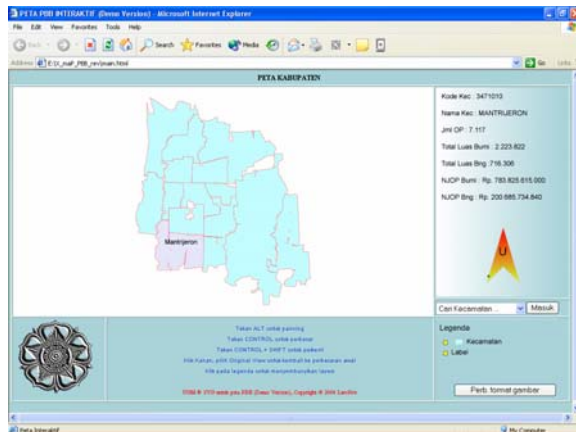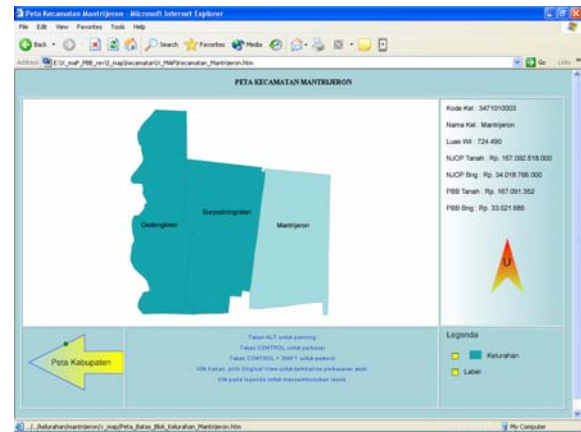

Figure 2: SVG map at district level
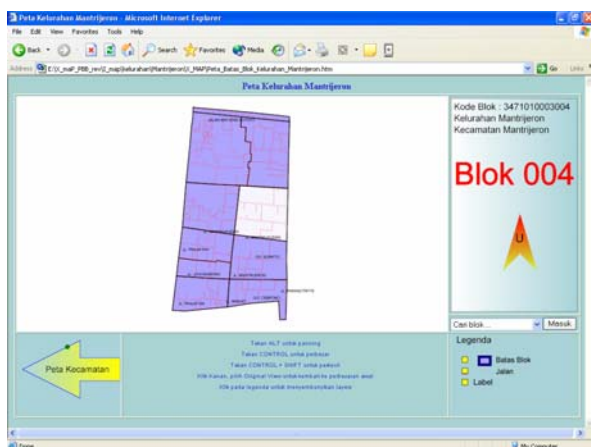

Figure 3: SVG map at sub district level

Figure 4: SVG map at village level

Figure 5: SVG map at block level

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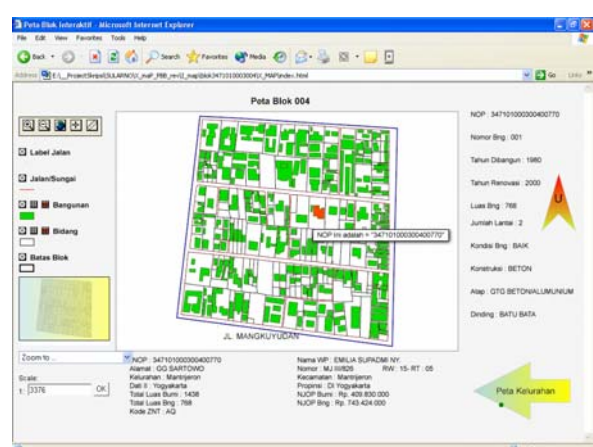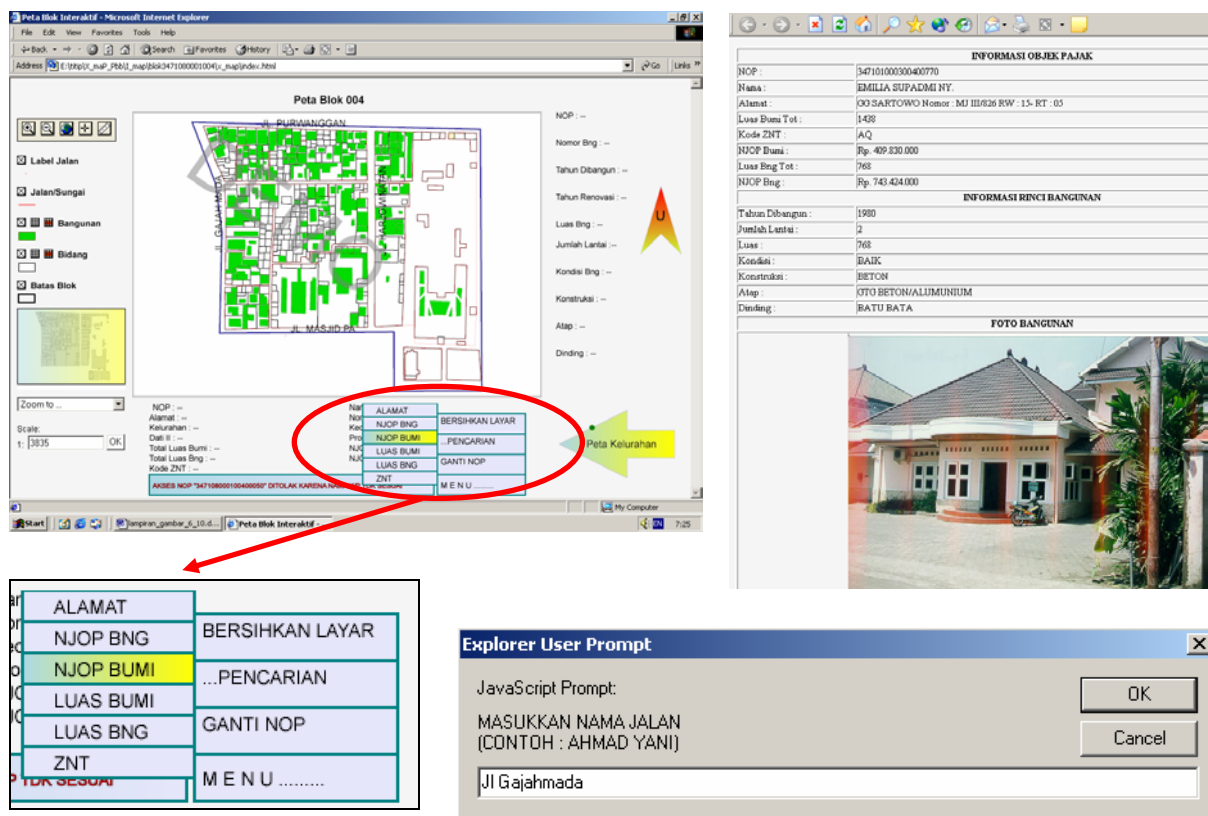
Information associated to a certain block will be visualized when the mouse cursor is moved over a certain parcel/building. It categorized in two types, parcel and building information, as listed in table 2

Table 2: Information in block map

Parcel	NOP, Tax payer's name, Width of parcel, Width of building, Address, NJOP parcel, NJOP building, ZNT code
Building	Building number, Date of construction, Date of renovation, Width of building, Number of storey, Building condition, Types of construction, Type of roof, Type of wall

JavaScript code was used to create the following additional menu to enhance functionality and interactivity, includes:

- Dialog box to change NOP, if further data searching is needed by user. The procedure of further searching is given in figure 2.
- Menu for finding object location based on street address.
- Menu for finding object location based on estimated selling value of the tax object (NJOP).
- Menu for finding object location based on width of parcel or building.
- Menu for finding object location based on code of land value zone (ZNT).
- Menu for clear the selected object.

Figure 6: Examples of additional menu created using JavaScript.

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4.3 Comparison of Different Graphic Format

The comparison was made to see the characteristic of 6 graphic formats, JPG, GIF, PNG, TIF, BMP and SVG. Three characteristic were compared, file size, interactivity, and visual appearance. District map was used as basis. The JPG, PNG, TIF, PNG and BMP were made using MapInfo facility. The SVG file was made using SVGMapper. Those six types of graphic format were embedded in a HTML page, in six tables. The dimension of each table is 317 x 216 pixels.

Table 3: Hasil perbandingan antara berbagai format gambar

Graphic format	File size (Kb)	Interactivity	Visualization
JPG	126	X	Dashed line, bright color
GIF	10	X	Dashed line, bright color
BMP	1962	X	Dashed line, bright color
TIF	1964	X	Dashed line, bright color
PNG	12	X	Dashed line, bright color
SVG	50	√	Dashed line, smooth color

GIF format has smallest size, the biggest is TIF. The size of SVG file is bigger than PNG and GIF, but smaller that 3 others. 5 other graphic format, visualize sub-district boundary with bright color and dashed line. SVG visualization shows the boundary with clear line.

5. DATA SECURITY

Original SVG file has many facilities, like zooming, back to original view, copy and save file, and facility to view source code of SVG program. Due to the sensitivity of tax map, only facilities for zooming and back to original view were activated. Both can be accesses using right-click of the mouse.

As the data in PBB map is sensitive, a security procedure was tried to be developed. The idea is that any user (tax payers) could access information regarding his/her own tax objects. Access to others must not be allowed.

Therefore user name and password system should be existing. At first the system directly uses tax payer's name as user name, and NOP as password. Tax payer's name should exactly be the same as indicated in tax document, in other words it should be case sensitive. NOP contain 18 digit of unique number. It was expected that this system could prevent un-authorized user look for others tax information.

At later stage, it was realized that although 18 digit of NOP is unique, it has a certain pattern. First 13 digits in fact are related to area where a certain parcel exists. The first 2 digits are provincial codes, digit number 3 & 4 are district codes. Digit number 5 – 7, 8 – 10, and 11 – 13 belong to sub-district, village and block, respectively. All parcels situated in one block will have the same 13 NOP code. Therefore, it is possible for neighboring people to make a guess of others' NOP. He/see, subsequently, can see others' tax information.

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If the systems will be operationalized, then another password system should be used. An alternative is an email system, where the user can define his/her own password. In the PBB system there should be a method for validation when someone requests a user name and password. Validation scheme may include an online form with some verification question, such as NOP, residence ID card number (KTP), and birthday. The procedure to get tax object information is given in figure 2.
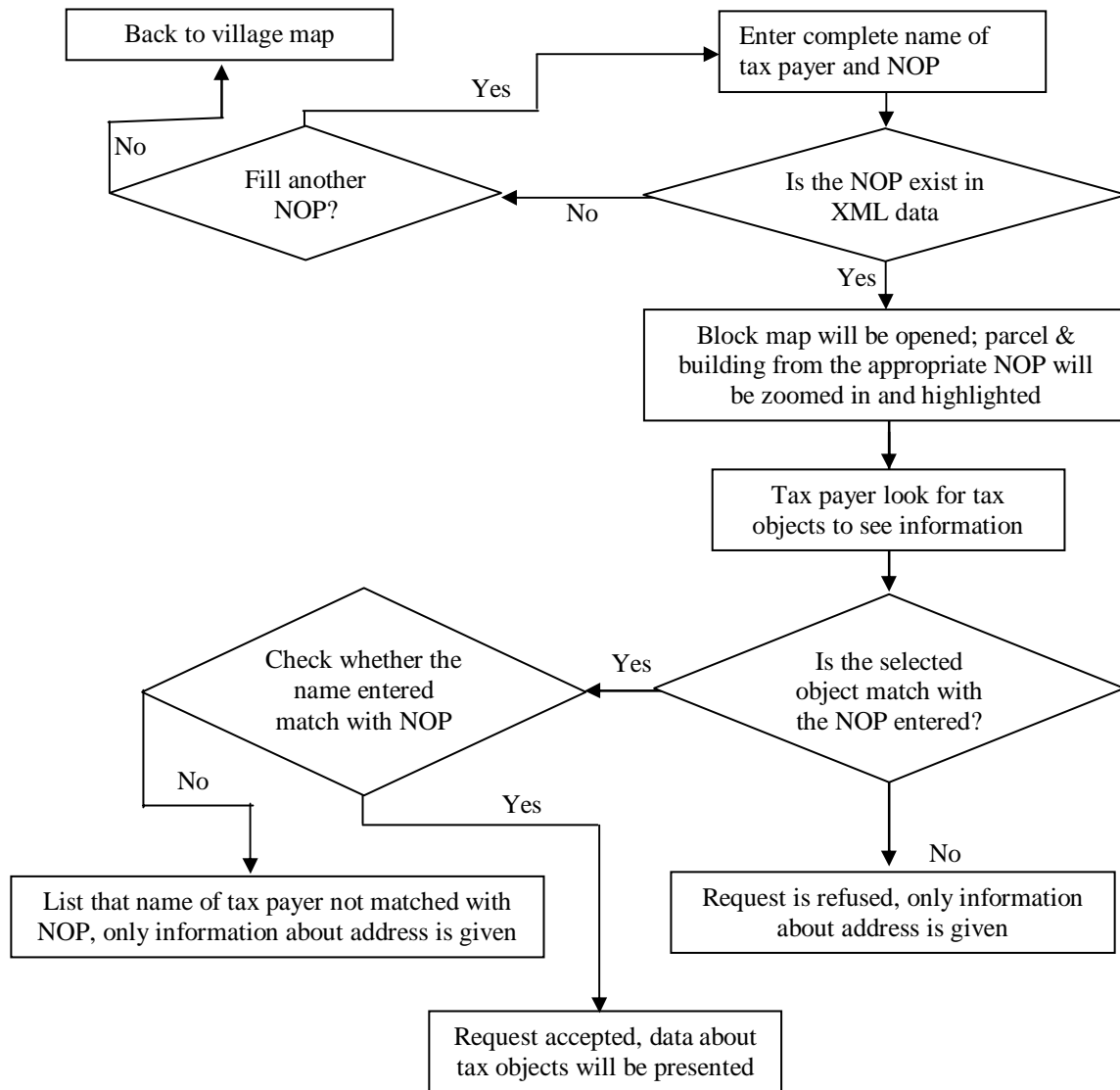
Figure 2: Procedure to get tax information

6. CONCLUSION AND RECOMMENDATION

This paper investigates the possibility of publishing land and building tax objects, and its associated information, over the internet. The result was a prototype of SVG map. At the current state, it was found that the SVG map has successfully been generated from the land and building tax objects map. The information of the tax objects, such as tax payer's name &

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address, selling value of tax objects, etc., can be easily attached to and accessed from the map.

Interactivity is one important aspect which can attract tax payers to use the systems. This aspect can be achieved, and the users have full interaction with it. To prevent unauthorized users trying to explore others' information, a password mechanism have been implemented. Only the tax payer him/herself who could see his/her tax objects' information. At this current state, the system is still separated with the original database which is in Oracle 8i.

Further testing in real web application has to be done to make sure the reliability of the proposed system. Three main tests under consideration are accessing time, security aspects, and direct connection to database systems. For the last, the CGI *script*, *Java applets*, *Java servlets and* ASP (*Active Server Pages*) are considered.

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BIBLIOGRAPHICAL NOTES

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