Extraction of Open Street Map to Produce Digital Maps

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Abstract. This study intends to be able to find out the results of a digital map format shape file using the Open Street Map tool in ArcGIS, to be able to produce a digital map is done by extracting data on the Open Street Map. How to extract is done by installing an additional ArcGIS Editor program for Open Street Map in ArcGIS 10.3 and extracting it so that it produces a digital map in the geodatabase format, then converts it to the shape file format using the conversion tool. There are two conditions in the selected area, namely the city area to represent densely populated villages and vice versa, as well as the mapped area coverage, both broad and narrow. The digital map of shape files produced consists of points, polylines, and polygons. Coverage of areas with a scale smaller than 1: 10,000 for urban areas cannot be extracted, whereas in rural areas it can. But on a scale of 1: 5,000 you can. Thus besides the area of building density also determines whether or not the area is extracted (mapped).

Keywords: shape file, geodatabase, extraction, OpenStreetMap.

1. Introduction

When a decade ago the making of digital maps (a collection of geospatial data) was carried out by biting satellite imagery into spatial databases (vectorization of raster data), and until now the way to produce digital maps is still done through digitization and re-registration to have a coordinate reference certain [1]. But starting a few years ago, now and in the future these methods have begun to be abandoned, especially after the OpenStreetMap. Large-scale engineering maps can be made by extracting OpenStreetMap web-based maps. Several companies have used open street map data for digital maps, such as Spatial Manager, Global Mapper, Geofabrik [2] and ArcGIS. This research uses ArcGIS Editor for OpenStreetMap. This technique is done by integrating open street map data into ArcGIS. With this tool it can be done to download, extract, and symbolize open street map data into geodatabase files. Integration with several base maps, in addition to OpenStreetMap [3], is Imagery, imagery with label, street, topographic, etc. as shown in Figure 1.
Even today many volunteers are developing Open Street Map because it is open source (Volunteer Geospatial Information) ArcGIS Editor [4] for OpenStreetMap is one extension that was installed on ArcGIS, starting with version 10.2 until now ArcGIS 10.6. With this extension installed, in ArcGIS an additional Toolbox will appear, namely the OpenStreetMap Toolbox [5], shown in Figure 2.

ArcGIS Editor for OpenStreetMap (OSM Editor) is a free, open-source, ArcMap to access, download, edit, analyze, and upload OpenStreetMap (OSM) data [6]. OSM is an open worldwide dataset that forms the backbone of many maps, apps, and services.
Open Source, meaning the software used to make the program freely and freely available for viewing, changing, and redistributing. Every software is said to be open source if the license that houses the software when used is called open source. Open-source software means that the program used to make the software is freely available, free to see, change, and redistribute.

Open-data, meaning that the data used can be for anyone (public-domain, private, non-profit research, commercial applications), which will be used anywhere and will be used again. Although the data is open, it is not necessarily easy to access, because the open data can still be stored in a proprietary format. Thus open data should be stored using open specifications or using existing standards, such as shapefile [7] and geodatabase [8]. Open-system or open-platform is a whole between program, operating-system, hardware, and data (software and hardware integrate), thus ArcGIS is open-system, not open-source.

2. Materials and Methods

2.1. Producing Digital Maps Shape File

In procedure the description of problem solving is shown by the flowchart in Figure 3.

![Flowchart](image)

**Figure 3.** Producing digital maps shapefile format

The first step is to download ArcGIS Editor for OpenStreetMap 10.3, the choice of this version adjusts the ArcGIS version used, then the installation process [8]. If the installation process is successful, there will be several sub-tools in the Arc Toolbox, one of which is Download, Extract and Symbolize OSM Data, shown in Figure 4.
The second step is to find the area you want to map, by activating the internet network, select Add Base map (figure 5a), then select the Open Street Map base map (figure 5b), until the open street map version of the world base map (www.OpenStreetMap.org) appears, shown in Figure 5c.

Followed by selecting the area you want to map by enlarging the area to the desired scale with the zoom + tool, as shown in Figure 6.
After that, activate the Download, Extract and Symbolize tool for OSM Data, so that the interface dialog appears as shown in Figure 7a, and after it is filled in as shown in Figure 7b.

If it does not work, then the current state of the map does not change, it is still like in Figure 6, but if the process is successful on the digital map, the points that appear on each polygon and polyline are shown or shown in Figure 8a to 8d.

The result is shown in Figure 9a for polyline, 9b. for polygon, 9c for points, and 9d for a
combination of the three themes.

**Gambar 8b.** Feature class to shapefiles

**Gambar 8c.** Tool conversion to shapefile

**Gambar 8d.** Input file .gdb
The result is shown in Figure 9a for polyline, 9b. for polygon, 9c for points, and 9d. for a combination of the three themes.

Gambar 9a. Theme polyline

Gambar 9b. Theme polygon

Gambar 9c. Theme point

Figure 9d. Combination of three themes
3. Results and Discussion

When extracting and symbolizing osm data, sometimes it works and sometimes fails, this situation is caused by the area and the density of buildings and roads in the region, the more crowded and wide areas always fail. For urban areas the most successful scale of 1: 4329 is shown in Figure 10, while in rural areas, for example the village of Kalibening, Dukun sub-district, Magelang district, using a scale of 1: 8,796 can be successfully extracted, see figure 11. With circumstances as this proves that even though the area is large, as long as the number of houses is small, it can still be extracted. Thus the ArcGIS Editor for OSM Data program is more suitable for large-scale maps.

![Figure 10. Gowongan kidul area](image)

![Figure 11. Kalibening village scale 1: 8,796](image)

All extraction results have been in the form of geodatabase files, this is already a significant technological leap, which is usually through a digitization or extraction process, but the results are in the form of coordinate numbers in the form of Excel.xls tables. Another advantage is that all georeferenced maps of latitude and longitude, georeferenced state is proven by overlaying all files with the world digital map, and it is true that the digital maps are located on the island of Java, Indonesia. To clarify the results shown in Figures 12.
The table structure in each theme, both point, polyline, and polygon is not different, shown in figure 13.

| Shape   | Polygon        | Shape   | Polyline                  | Shape   | Point                     |
|---------|----------------|---------|---------------------------|---------|---------------------------|
| Highway | Highway        | Building| Building                  | Natural | Natural                   |
| House   | Amenity        | Landuse | Landuse                   | Place   | Place                     |
| Waterway| Waterway       | Railway | Railway                   | Boundary| Boundary                  |
| Power   | Power          | Leisure | Leisure                   | Man made | Man made                  |
| Shop    | Shop           | Route   | Route                     | Historic | Historic                  |
| Tourism | Tourism        | Aerialway| Aerialway                 | Barrier  | Barrier                   |
| Shop    | Shop           | Route   | Route                     | Historic | Historic                  |
| Oilmid  | Oilmid         | Oilmid  | Oilmid                    | Oilmid  | Oilmid                    |
| Ominera | Ominera        | Ominera | Ominera                   | Ominera | Ominera                   |
| Omvisble| Omvisble      | Omvisble| Omvisble                  | Omvisble| Omvisble                  |
| Omversion| Omversion   | Omversion| Omversion                | Omversion| Omversion                |
| Omchanges| Omchanges   | Omchanges| Omchanges               | Omchanges| Omchanges               |
| Omtimeota| Omtimeota    | Omtimeota| Omtimeota             | Omtimeota| Omtimeota             |
| Om支援   | Om支援           | Om支援  | Om支援                      |

Figure 13. Polygon, line, point data structure resulted from ArcMap.

The location of the points follows the nodes in each polygon, while the polyline points occupy the beginning and end nodes as well as the vertices that exist between the initial node and
the end node. These points are located on the polyline (river, road), polygon (house, building, garden yard), river points located on the river vertex, polygon point on the road is located on the corners of the highway, or the winding road. While the points on the polygon are located at the ends of the building (the house), all three are shown in figures 14a, 14b, and 14c

![Gambar 14a. Points on the river](image1)

![Figure 14b. Points on the road](image2)

![Figure 14c. Points on building](image3)

For the addition of data that will be used, needs that are not in the database structure, such as street names, editing is needed for the names of the paths, each street name starts and ends at the node, between these two nodes there cannot be vertices for the path straight, but on a winding road, between these two nodes there will be vertices following the curve of the path.
4. Conclusion
From the discussion it can be taken some conclusions:
When downloading, extracting and symbolizing the data can be successful if the map on OpenStreetMap is enlarged to a large scale, scale 1: 2000 or greater for areas of heavy building (houses, hotels, restaurants, schools, places of worship, shops and others) or up to a scale of 1: 10,000 for rural areas with less number of buildings.
- There is no digitization process, there is an editing process.
- Digital map extracted from latitude coordinates has georeferenced.
- Points are displayed on each corner of the building and coincide with nodes and vertices, on the road placed on each corner, while the river is placed on the curve of the river and coincides with vertices in the river.

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