

Interpretation of Road Network using QGIS

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ABSTRACT

Road networks are the key element for economic growth in every country. It is essential for project a strategic and sustained expansion and an adequate maintenance of these networks to guarantee quality connections between the different parts of a geographical territory. Road enables the supply of goods and services around the world and it connect the people to workplaces, schools, hospitals and some other places in the geographical area. Road infrastructure improves the effectiveness and efficiency of all the countries and increases the standard living of people, making their lives easier. In this paper we proposed to design the road network map for Erode district using QGIS (Quantum Geographic Information System). We identified and classified various type of road network for that particular area. In this map we include what kind of road network is available and also explained the purpose of the each type of road network.

Keywords: Vector data, QuickOSM, Quick map service, OpenLayers plugin, Printout layer.

1. Introduction

The map contains different types of road network in Erode district. There are number of inter district bus routes operated by the Tamil Nadu State Transport Corporations linking Erode and other prominent towns In Erode district with places of significance outside the district.

We classified the roads into 5 types such as primary roads, secondary roads, tertiary roads, residential roads and unclassified roads. Primary roads are the roads which are form the parts of main trunk line System and they directly connect three or more major cities and metropolitan Areas with a population of at least 1,00000. Secondary roads are the roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. Tertiary roads are outside urban areas, tertiary roads are those with low to moderate traffic which link smaller settlements such as villages or Hamlets. Residential road provide access to properties and through routes within a Residential area. As secondary connectors they are much less likely to be public transport routes. Unclassified roads are the road that cannot be given a grade because it is a basic standard. They are those in the least important categories, i.e. local distributor and access roads.

2. GIS Description

GIS is open source software that has been growing, and the development of sharing an open source applications in the environmental areas that have some significant benefits, namely the free distribution and the public availability of code, allowing users customization. The Free and Open Source Software (FOSS) for GIS application that has several advantages, Where the new applications can be developed under them by using open-source programming languages, such as Python and different libraries (for instance, QGIS software, QGIS Application Programming Interface (API) and Qt API are commonly used in the development of new applications).

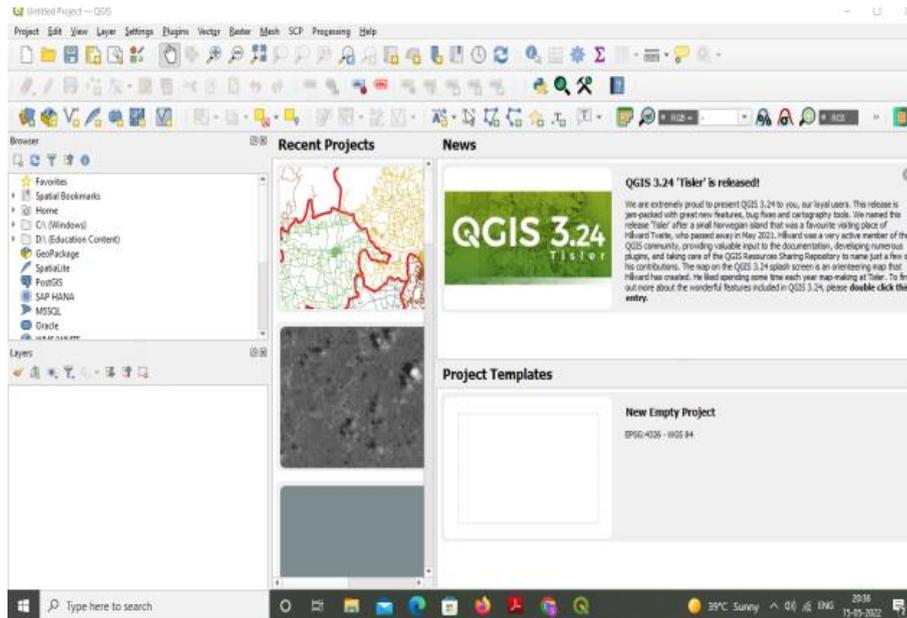


Fig.1. QGIS Mapping Tool

Several GIS applications have been developed in different contexts, such as forest fires, groundwater vulnerability evaluation, soil erosion, and others, combining different methodologies, making effective and improving the performance of the computing procedures. This trend was also, allowing the automatization of technologies and procedures into agriculture practice.

GIS software tools have been used in several studies to create the spatial variables required to predict agriculture production. The QGIS software is shown in the fig.1.

3. Tools in QGIS

A. Vector Data

(1) Point features

The first thing we need to be realize when talking about the point of features that we describe as a point in GIS is a matter of opinion, and often dependent on the scale. Let's look at cities for example. If we have a small scale map, it may be make a sense to represent a city using a point of feature. However as we can zoom into the map, moving towards the larger scale, it can make more sense to show the city limits as polygon.

(2) Polygon features

Polygon features are enclosed areas like dams, islands and country boundaries. Like polyline features, polygons are created from a series for vertices that are connected with a continuous line. However because a polygon always describes an enclosed area, the first and last vertices should be always at the same place Polygons are often have shared geometry boundaries that are common with a neighbouring polygon.

Many GIS applications have the capability to ensure that the boundaries of neighbouring polygons exactly coincide. As with points and polyline, polygons have attributes. The attributes describe each polygon. For example a dam may have some attributes for depth and water quantity.

(3) Vector data in layers

Most of the GIS applications group vector features into layers. Features in a layer have same geometry type (they will all be points) and same kind of attributes (e.g. information about species a tree is for a trees layer) as shown in the Fig.2.

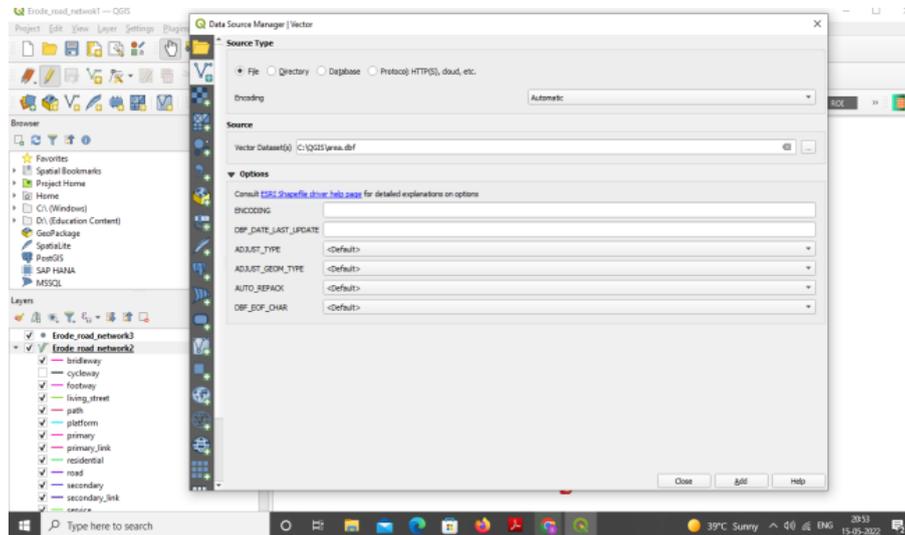


Fig.2. Vector data

For example if we recorded the positions all the footpaths in a school, we will usually store together on the computer hard disk and shown in the GIS as single layer. This is convenient because this allows us to hide or show all of the features for that layer in our GIS application with a single mouse click.

B. Vector Attribute Data

Features are the real world things such as roads, property boundaries, and electrical substation sites. That feature has a geometry which determines if it is a point, polyline or polygon and attributes which describes it feature.

(1) Attributes

Attributes form vector features that are stored in a table. A table is like a spreadsheet. Each column in the table is called as field. These records in the attribute table in GIS as each correspond to one feature. Usually this information in the attribute table is stored in some kind of databases. The GIS application link the attribute records with feature geometry so that we can find record in the tables by selecting features on map, and find features on the map by selecting features in the table. Each field in the attribute tables contains a specific type of data such as text, numeric or date as shown in the Fig.3. Deciding what attributes to use for the feature requires some thought and planning.

(2) Single Symbols

If this feature we symbolised without using any attributes table data, it can be drawn in a simple way as shown in the Fig.4. A GIS application will be normally allow us to set the symbology of a layer using a dialog box. In this dialog box we can choose colours and symbol styles depending on the geometry type of a layer.

full_id	osm_id	osm_type	highway	alt_ref	location	public_tr	name_fr	shelter	bin
1	w22837057	22837057	way	primary	NULL	NULL	NULL	NULL	NULL
2	w22837151	22837151	way	primary	NULL	NULL	NULL	NULL	NULL
3	w22837183	22837183	way	primary	NULL	NULL	NULL	NULL	NULL
4	w22837216	22837216	way	primary	NULL	NULL	NULL	NULL	NULL
5	w22837242	22837242	way	primary	NULL	NULL	NULL	NULL	NULL
6	w22837285	22837285	way	primary	NULL	NULL	NULL	NULL	NULL
7	w22837336	22837336	way	trunk	NULL	NULL	NULL	NULL	NULL
8	w22837470	22837470	way	tertiary	NULL	NULL	NULL	NULL	NULL
9	w22837509	22837509	way	trunk	NULL	NULL	NULL	NULL	NULL
10	w22837747	22837747	way	tertiary	NULL	NULL	NULL	NULL	NULL
11	w22837749	22837749	way	unclassified	NULL	NULL	NULL	NULL	NULL
12	w22977036	22977036	way	trunk	NULL	NULL	NULL	NULL	NULL
13	w26238467	26238467	way	primary	NULL	NULL	NULL	NULL	NULL
14	w26274261	26274261	way	trunk	NULL	NULL	NULL	NULL	NULL
15	w26274262	26274262	way	trunk	NULL	NULL	NULL	NULL	NULL
16	w28621021	28621021	way	tertiary	NULL	NULL	NULL	NULL	NULL

Fig.3. Attributes

(3) Unique Value Symbols

Sometimes the attributes of features are not numeric, but instead strings are used. ‘String’ is a computer term meaning a group of letters, numbers and other writing symbols. Strings attributes are often used to classify things by name. We can tell the GIS Application to give each unique string or number its own colour and symbol. Road features may have different classes and each drawn in the map view of the GIS with different colours or symbols. Within the GIS Application we can open/choose to use Unique Value symbology for a layer. The GIS will scan through all the different string values in the attribute field and build a list of unique strings or numbers. Each unique value can then be assigned a color and style as in Fig.4.

Value	Symbol	Color
brideWay	brideWay	Random colors
bicycleWay	bicycleWay	Random colors
footway	footway	Random colors
living_street	living_street	Random colors
path	path	Random colors
platform	platform	Random colors
primary	primary	Random colors
primary_link	primary_link	Random colors
residential	residential	Random colors
road	road	Random colors
secondary	secondary	Random colors
secondary_link	secondary_link	Random colors
service	service	Random colors
steps	steps	Random colors
tertiary	tertiary	Random colors
tertiary_link	tertiary_link	Random colors
track	track	Random colors
trunk	trunk	Random colors
trunk_link	trunk_link	Random colors
unclassified	unclassified	Random colors
all other values		Random colors

Fig.4. Categorized symbol

C. Data Capture

There are two key concepts to vector data, namely geometry and attributes. The geometry of a vector feature describes its shape and position, while the attributes of a vector feature describe its properties such as colour, size, age etc.,. Word processors, spreadsheets and graphics packages are all programs that let us create and edit digital data. Each type of application saves its data into a particular file format.

Table 1. Extension of file format

Extension	Description
.shp	The geometry of vector features are stored in this file.
.dbf	The attributes of vector features are stored in this file.
.shx	This file is an index that helps the GIS Application to find features more quickly.

There are a number of different file formats for GIS data, but the most common one is probably the ‘shape file’. The name is a little odd in that although we call it a shape file (singular), it actually consists of at least three different files that work together to store our digital vector data, as shown in the table 1.

(1) Creating an empty shape file

Once we have planned what features we want to capture into the GIS, and the geometry type and attributes that each feature should have, we can move on to the next step of creating an empty shape file. The process usually starts with choosing the ‘new vector layer’ option in our GIS Application and then selecting a geometry type which means choosing either point, polyline or polygon for the geometry. The shape file format allows us to store the numeric field information as either a whole number (integer) or a decimal number (floating point) The final step for creating a shape file is to give it a name and a place on the computer hard disk where it should be created which is shown in the Fig.5.

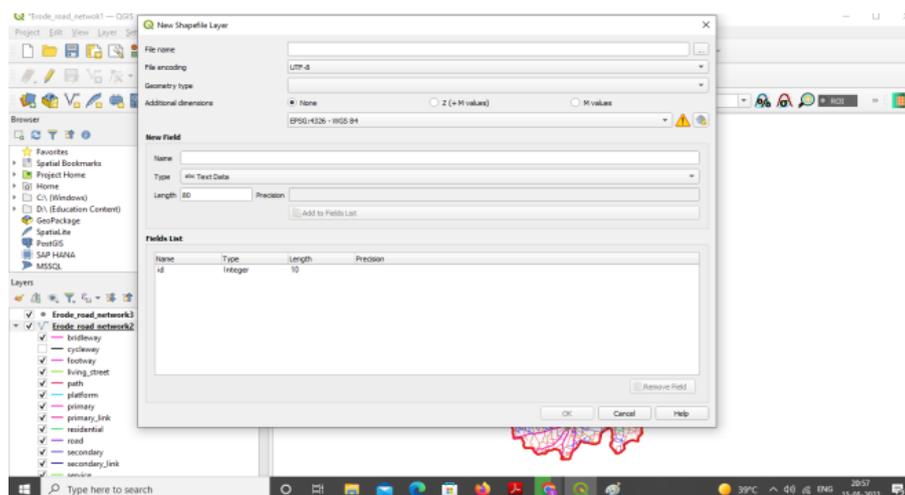


Fig.5. Creation of new shape file

D. Map Production

Map production is the process of arranging map elements on a sheet of paper in a way that, even without many words, the average person can understand what it is all about. Maps are usually produced for presentations

and reports where the audience or reader is a politician, citizen or a learner with no professional background in GIS. Because of this, a map has to be effective in communicating spatial information. Common elements of a map are the title, map body, legend, north arrow, scale bar, acknowledgement, and map border which are shown in the Fig.6.

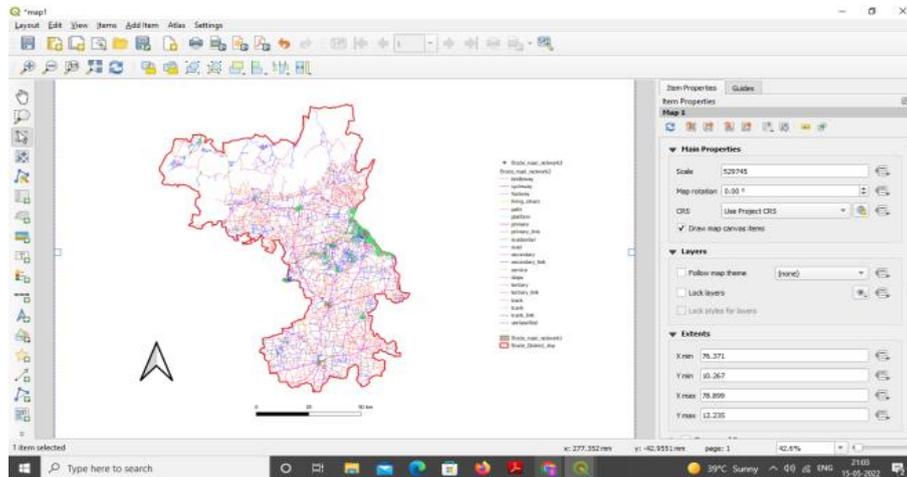


Fig.6. Printout layer

(1) Map title

The map title is very important because it is usually the first thing a reader will look at on a map. It can be compared with a title in a newspaper. It should be short but give the reader a first idea of what the map is about.

(2) Map Border

The map border is a line that defines exactly the edges of the area shown on the map. When printing a map with a graticule (which we describe further down), we often find the coordinate information of the graticule lines along the border lines.

(3) Map Legend

A map is a simplified representation of the real world and map symbols are used to represent real objects. Without symbols, we wouldn't understand maps. To ensure that a person can correctly read a map, a map legend is used to provide a key to all the symbols used on the map. It is like a dictionary that allows us to understand the meaning of what the map shows. A map legend is usually shown in a little box in a corner of the map. It contains icons, each of which will represent a type of feature.

(4) North arrow

A north arrow (sometimes also called a compass rose) is a figure displaying the main directions, North, South, East and West. On a map it is used to indicate the direction of North. For example, in GIS this means that a house that is located north from a lake can be found on top of the lake on a map. The road in the east will then be to the right of the water body on the map, a river in the south will be below the water body and if we are searching for a train station to the west of the lake we will find it on the left side on the map.

(5) Scale

The scale of a map is the value of a single unit of distance on the map, representing distance in the real world. The values are shown in map units such as meters, feet or degrees. The scale can be expressed in several ways, for example, in words, as a ratio or as a graphical scale bar. Expressing a scale in words is a commonly used method and has the advantage of being easily understood by most map users. Another option is the **representative fraction (RF)** method, where both the map distance and the ground distance in the real world are given in the same map units, as a ratio. A scale expression as a graphic or bar scale is another basic method of expressing a scale. A bar scale shows measured distances on the map.

4. Methodology

A. Download shape file

First, we had to download the India district boundary map as a shape file with the extension of .shp. The resources are available in the various website and save it in on our PC. Now we open the QGIS application which has various panels. Go to browser panel, drag and drop the India district boundary shape file which is already downloaded. Select the particular district which we plan to design the road network .Crop the particular area by using clip vector and save it as Working Area in the format of shape file.

B. Import vector data

Install the plugin which are needed such as QuickOSM, Pre-processing plugin. Go to vector and choose QuickOSM which contains some collected geo-information. In QuickOSM we have to select the layer extent with selected area. We can send the request for desired information using query with key and value and then it will return required data. but this information are temporary. To make it permanent, we have to save the layer in our PC. Otherwise it leads to loss of information By using QuickOSM we import the information about the road network and crop network for that particular area and save it as Road Network in the format of geo package.

C. Classification of road network

The layer panel list all the layers in the project and help us to manage their visibility. By using this we can edit the property, symbols, attribute, and labels and so on of that layer. Select the Road Network layer and right click on it. Select the properties which contain various features. From that, select symbology in which we can categorize the different road network by choosing categorized option from the list, After that the road network had been classified. The categorized networks are shown in the layer panel. We can edit the color, size and shape of the symbol for each label. We can import the places by using QuickOSM as similar way which is used to import the road network.

D. Printout layer

After completing the map, we will go to printout layer which present in the project tool. In the print out layer we can design our map according to our wish. First we have to add the map, then we can add legends which are used in the map. We edit the format and size of symbol and letters with required space. It is also possible

to modify the space between the legends. We can include the north arrow to identify the direction and scale to represent the distance. Finally the designed map and obtain the map either in the format of pdf or image as shown in the Fig.7.

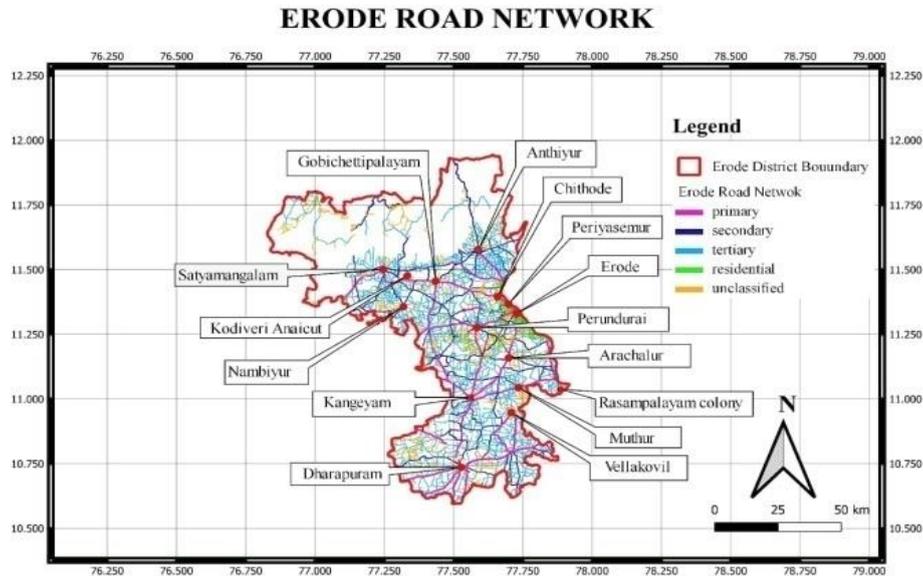


Fig.7. Shows the Classified road network

5. Conclusion

In this paper, we identified and classified the various road network for erode district using vector data which can be obtained from QuickOSM. The road networks are categorized into primary roads, secondary roads, tertiary roads and residential roads by using unique value symbol. The individual colour represents the individual road type. With the help of printout layer, we add legends in the map to understand the classification of the road network. In addition to that we include north arrow, scale and grid. We also included the longitude and latitude for that map. It is common concept in road network planning is the structuring of roads depending on the function of the road. In network planning transport planners therefore determine the form of a network not only by adding new network elements but mainly by assigning a function to a road which then influences the road design.

Declarations

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Consent for publication

Authors declare that they consented for the publication of this research work.

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