

Deep Geospatial Analysis for Land Use and Land Cover

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Abstract

From the last decades, the data with high dimensional geospatial visualization is more important. To analyse the urban growth patterns and characteristic of spatial changes that take place in area of metropolitan. Where urbanization has been a universal important, social and economic occurrence taking place all around the world. This process with no sign of slowing down could be most powerful and visible anthropogenic force that brought more fundamental changes in land cover and landscape pattern around the globe. Building detection from satellite multispectral or hyper spectral imagery data is being a fundamental but a challenging problem because it requires correct recovery of building footprints from high resolution images. But for analyse it, the methodologies use of machine learning is not convincing and thus it takes more time to switch the sub domain of machine learning called deep learning. The convergence of deep learning with geospatial data analytics shall prove to be a boon to those who actually has a need to predict specific outputs over geospatial data.

Keywords: Deep Learning, OSM, Urbanization, Big Data, Shapefile

Introduction

In previous few eras, urban development and urbanization has extremely quicker in several rising nations. At 2011, United Nations conferring, that in world's population 3.6 billion (52%) were urban residents. At 2050 the urbanization is projected to increase 67% in universally. In 2011, 47% of urban is raised to 64% in 2050 in the fewer developed areas. In all our the global the rapid growth of urban is attended by variation in land cover has convert a spectacle in worldwide and that is detected all over the globe. Numerous trainings take endeavoured to know the patterns of spatial-temporal of land cover variation and its energetic services. Here two extensive sets of changes in land methods established over the previous numerous eras. These remain vibrant imitation built techniques and statistical valuation techniques. Simulation built copies such as Cellular Automata (CA) tries to capture the patterns of spatial-temporal of variations of growth in urban by integrating acceptable variables in socioeconomic. Experimental method uses analysis in statistics to disclose the interface among variations in land cover and descriptive variables and have abundant improved interpretability than imitation methods. For instance, analysis of regression can aid to recognize the energetic factors of growth in urban and enumerate the donations of separate variables and the glassy of implication.

The satellite imagery detection [1] develops the difficult for several applications in urban: planning the city, state cadastral review, infrastructure expansion, facility of metropolitan facilities etc. planners of urban and state examiners are accountable for deliberate plan of urban and long term expansion to influence suitable sustainability and growth of city. In utmost of the nation's urbanization is acknowledged as an essential occurrence in growth of economic and changes in social as it suggestions enlarged

chances for occupation, specialism, construction and services and goods. This has originated a huge quantity of individuals to migrate from urban to rural region. As an outcome, municipalities are developing quicker than ever existence a vast centre for communications, residence, industry, infrastructure, social services trade and investment etc. Though this development also activates several difficulties. Pollution of environment and deprivation, enlarged environmental vulnerabilities such as drowning, population detonation, insufficient cleanness and supply of water, transport difficulties, poor housing situations, growing cost of existing and wealth dissimilarity and rise in corruption and damage of productive cultivated and everglades are roughly of the best projecting destructive properties of speedy urbanization and growth of urban.

Recently, deep learning is experienced as a well-known method which is machine learning sub field for finding accuracies it provides in tasks of object detection, feature extraction and many more. Deep learning is proven its proficiency in multiple domains like natural language processing, speech recognition are few areas to mention. In operational with image of satellite is one significant tender of learning the deep method is making numerical maps by mechanically extracting road linkages and footprints of building.

Applying an imagine to a trained method of deep learning [2] on a huge geographic region and received on a map holding total roads in the area, then consuming the capability to generate driving instructions by means of identified networks of road. This is mainly valuable for evolving nations that do not take high-quality digital maps or in extents wherever newer expansions have remained built.

Good maps essential new than objective roads, they essential buildings. Example segmentation methods such as CNN are mainly valuable for footprint of building segmentation and help to generate footprints of building deprived of any essential for physical digitizing.

Proposed method

Study Area

Here classified the Chittoor, Tirupati reasons which are in Chittoor district. It is situated in the region of Rayalaseema in Andhra Pradesh state of India. The headquarters of the district is positioned at Chittoor. According to 2011, 4,178,061 of population are present in this district. The city of Chittoor deceits on the River of Neeva at state of Andhra Pradesh in the part of southernmost. It is positioned on NH49 and NH69 involving key municipal towns of Chennai and Bangalore .

It is located between eastern longitude and northern latitudes of 78°33" and 79°55" and 37" and 14°8" respectively. It is restricted on the east district of Nellore in Andhra Pradesh and Vellorebysouth, districts of Tiruvallurin Tamil Nadu, on the Kolar by west and at Karnataka Chikkaballapur district, on by north district of Kadapa in Andhra Pradesh and on south by district of Krishnagiri in Tamil Nadu.

In Chittoor district, Tirupati is one of the city in the Andhra Pradesh state in Indian. By southwest side around 750 km state's exclusive capital Visakhapatnam, the town is household to the vital Hindu memorial of Venkateswara Temple at Tirumala and these significant temples are denoted as "Andhra Pradesh is Capital for Spiritual ".

In south of Chittoor district Tirupati is situated at position with a latitude and longitude of 13.65°N 79.42°E respectively. It lies at Hills of Seshachalam foot at Eastern Ghats were shaped through era of Precambrian. One of its environs, Tirumala which is home to Sri Venkateswara Temple, and it is situated inside the hills.

About shape file

A shape file is a modest of no topological for storage the location of geometric and information of attribute with features of geographic [3]. Features of Geographic in shape file are accessible through points, polygons or lines. The workstation comprising shape files might hold tables of Dbase which can collect extra attributes that is joined to form a features of shape files.

The format of shape file can care line, point, and features of area. Features of Area are signified as sealed loop, polygons with double digitized.

An example of Shapefile layout has frequently remained used as exchange of data presentation from non-ESRI designs to ESRI applications. The design is beneficial for writing features simply and attributes rapidly as there are essential limits in the Shape file design associated together with attributes and geometry. As drawn away in this depiction, these boundaries might root damage of information when using shape files to comprise or discussion composite attributes or geometry. The Shape file design might be used as intermediate among data making requests and additional functionally skilled formats of GIS and submissions, although by noted limits in the Normal Dataset sector.

About OSM

OSM (Open Street Map) is made by a group of maps that donate and preserve information about cafes, trails, railway stations, roads and much more, all over the world.

Local Awareness

Open Street Map highlights knowledge of local data. Sponsors usage image of aerial, GPS in devices, and short tech area maps towards validate the OSM remains precise and up to date.

Community Obsessed

Open Street Map community is varied, ardent, and increasing each day. Our sponsors contain mappers enthusiast, professionals in GIS, OSM servers running by the engineers, mapping humanitarian's disaster affected regions, and several more. To study several around the community, get Blog of Open Street Map, diaries of user, blogs of community, and the Foundation website of OSM.

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Deep Learning methods

The techniques of machine learning subclass are Deep learning, where several films of processing the information phases in categorized supervised constructions are oppressed for learning features in unsupervised and design analysis. The deep learning principle is to calculate features of hierarchical or illustrations of the data observation, where features of high level or issues are definite from the lower level ones [4].

The best of model of deep learning includes dominion information as well experimental and fault. Though dissimilar models of deep learning or their mixtures container be strained and realistic for predicting difficulties, RNNs and CNNs are extensively used to detention the temporal and spatial dependences between the data of geospatial. The presentations of methods in deep learning might be contingent on the detailed difficulties. In the subsequent segment, we stretch an exact instance of deep learning methods used in the New York to pick-up/drop-off taxi predicting difficult.

Convolutional Neural network

(CNN) Convolutional Neural Networks [5] are intended for handling the images of two-dimensional (and further two dimensional illustrations), and the layer of convolutional purposes as an obscured layer, in which every collection of neurons (also known as filters) completes a complication in Figure 1. An instance of neural network in artificial. Every circle signifies a neuron. procedure in the image and every neuron in a mesh is associated to a dissimilar area of the image but share the neurons in similar weights. Since the image of input might consume a huge resolve, max pooling [6] is frequently recycled in CNNs to lessen the innovative size. Max pooling relates a filter of max towards regions of non-overlapping the original image. The procedure of relating max-pooling and convolution processes is showed in Figure 2.

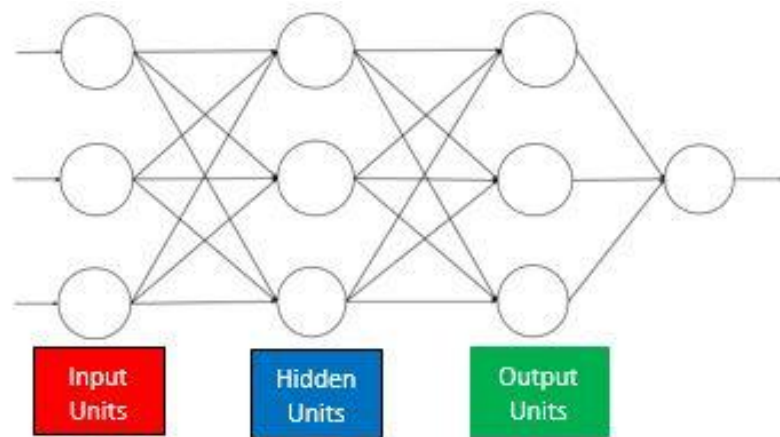


Figure 1. An illustration of AI

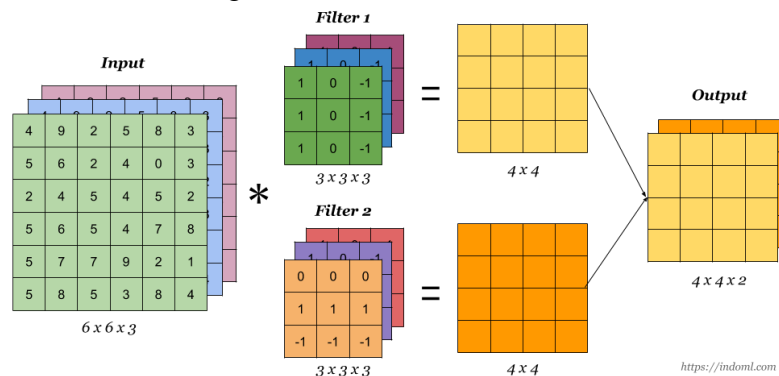


Figure 2. convolution and max-pooling operations

Recurrent neural network

Neural networks of RNNs [7] through loops. They container be qualified by the reverse style of automatic difference [8], or the algorithm of back propagation through “unfolding” the network concluded time and compelling some of the influences to continuously grip the similar weights [9]. LSTM (Long Short-Term Memory) networks [10] are RNNs to resolve the disappearing gradient difficult [11], when the inclines of approximated weights start to contract or expand the network of neural is stretched countless times. At LSTM, the layers of hidden is changed by recurring entries named disremember gates (Figure3). Associated to RNNs, LSTM is demonstrated to produce bigger outcomes in numerous difficulties.

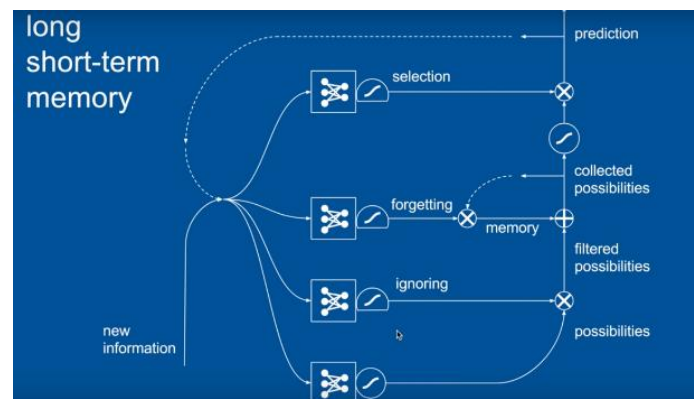


Figure 3. LSTM

Big data

The platforms of Big data are especially planned to knob profound measurements of information that originate into the scheme at velocities of high and extensive varieties. These stages of big data [12] regularly contain of variable servers, databases and commercial intellect techniques that permit data experts to employ data to discover tendencies and designs.

Big Data denotes to enormous compound organized and amorphous datasets that quickly produced and conveyed after a varied change of foundations. These qualities make up the big data 3Vs:

1. **Volume:** The enormous quantities of information being stowed.
2. **Velocity:** The quick haste at which information rivulets obligation is managed and analysed.
3. **Variety:** The dissimilar causes and procedures after which information is composed, in the form of video, numbers, images, text, text and audio.

MongoDB

MongoDB is a database of document through the flexibility and scalability that need with the inquiring and indexing that need [13]. The document type of MongoDB is modest for designers to study and usage, whereas quiet providing abilities desirable to encounter the maximum composite necessities of scales. The useful technique for MongoDB is a challenge, then desires approximately tooling to generate a connector to the ecosystem tech of GIS. In direction to tie the gap, we made a pipeline to fulfil with the construction of the GDAL (Geospatial Data Abstraction Library), the work of MongoDB is done with best general GIS tools like Open Layers, ArcGIS, Map server, QGIS, GeoServer and others with ease.

Experimental analysis

Initially, Chittoor shape file along with OSM file is loaded in MongoDB and then it is retrieved in python programming language. In that firstly selected Andhra Pradesh and then selected Chittoor District region for our classification as shown in figure 4, and then selected the particular region in the district here selected Chittoor and Tirupati region and by applying the algorithms with inbuilt packages like keras, geopandas, spatial etc., methods on the information to visualize the street networks models as shown in figure 5. Then initiated to calculate the stats to visualize street centrality as shown in figure 5&6.

Then founded the route by giving two individual latitude and longitude points to find the distance between the two distant location. The two points location distance is found by evaluating the route properties like residential area, living street area, road area. secondary tertiary area, unclassified areas length, speed, travel time state is monitored as show in table 1. And visualized the two distinct location shortest route as visualized in figure 7, and also visualized shortest distance of as shown in figure 8.

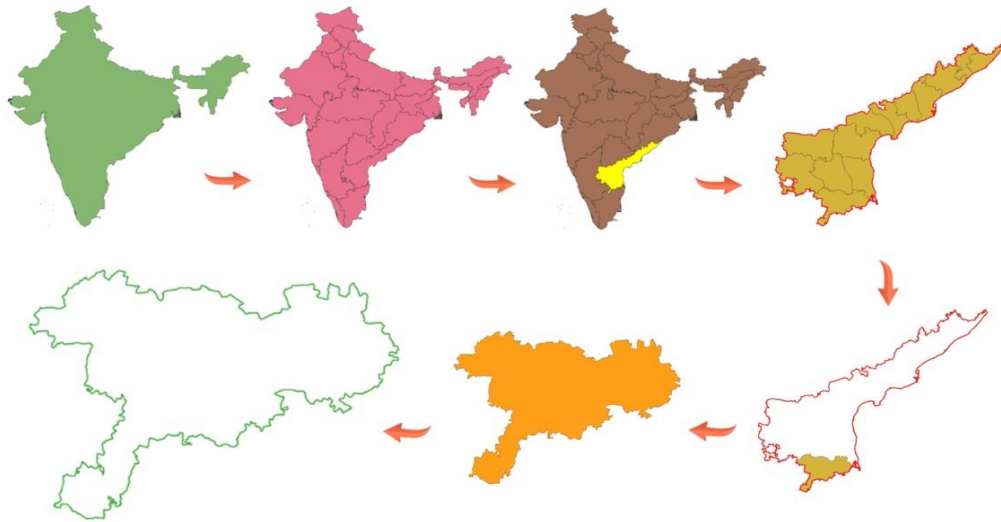


Figure 4. Chittoor district selection

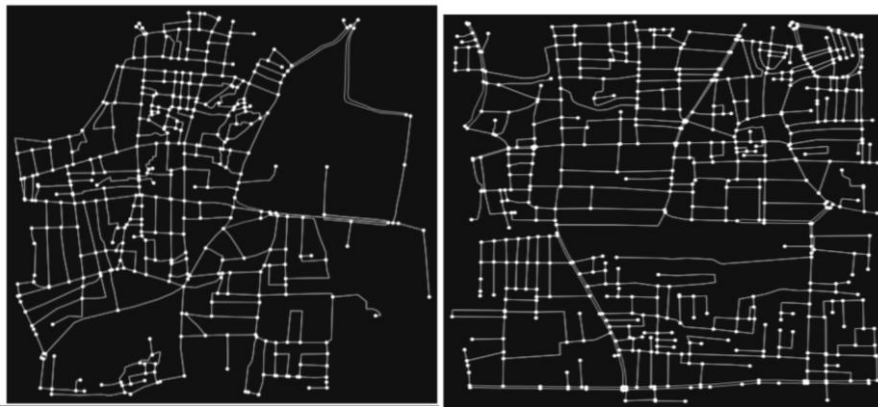


Figure 5. Visualization of Chittoor street

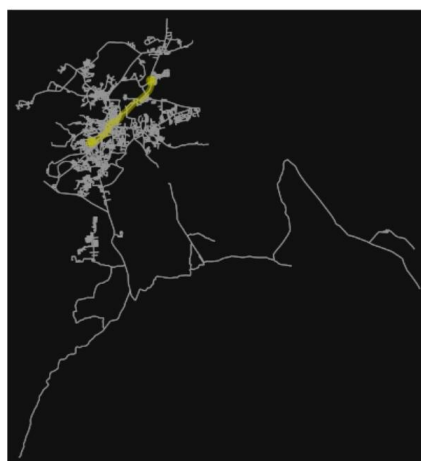


Figure7. Finding Shortest route

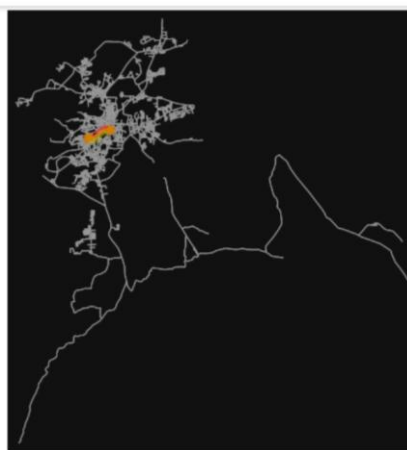


Figure8. Finding Shortest distance

Table 1. Table contains the distance properties

	length	speed_kph	travel_time
highway			
['secondary', 'residential']	745.8	47.5	56.5
['tertiary', 'residential']	381.9	47.5	29.0
['unclassified', 'residential']	189.7	47.5	14.4
living_street	53.1	47.5	4.0
primary	133.4	50.0	9.6
residential	83.0	40.0	7.5
road	195.3	47.5	14.8
secondary	107.8	47.5	8.2
secondary_link	101.6	47.5	7.7
tertiary	236.5	47.5	17.9
trunk	290.8	52.5	25.8
trunk_link	48.8	47.5	3.7
unclassified	158.6	47.5	12.0

Secondly, install the packages of GIS to visualize the building footprints as shown in figure 9, which is defined as the cartographers and planners which is a representation of roof moved to the base of the structure. It delivers the schema of building drained beside the external walls through an explanation of the precise size, location and shape of its basis.

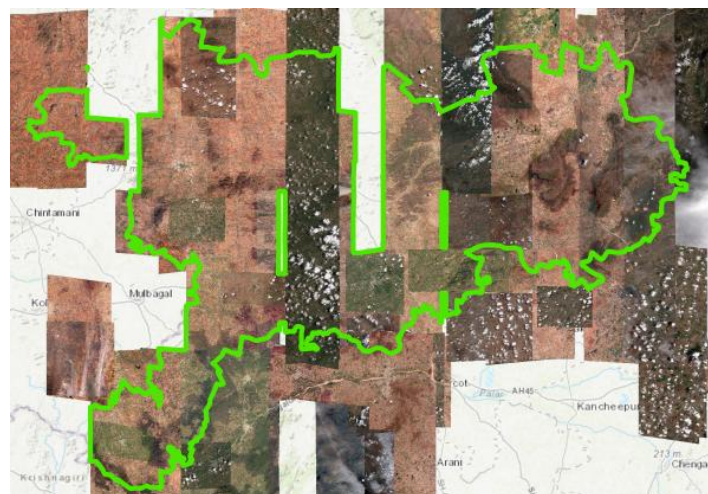


Figure 9. Building footprint of chittoor distict

To find the building footprints firstly take the OSM file and using ArcGIS it is converted in to ESRI shape file for our classification. There are enamours ways to create building footprints. These includes manual digitization using tools to draw outline of each building. For that training data is loaded into MongoDB and then retrieved into python programing language and initialized the packages and export data to train the sample models. Get the prepared data function to train data with specific transformation and it automatically connect the global data with their GIS connection API and then trained while training model it shows the batch file of images as shown in figure 10 but while executing it may appear in different forms when we increase the batch size.



Figure 10. Training batch file

The above process is done for both Chittoor and Tirupati regions and loaded that to train the model using deep learning with CNN the buildings are predicted and the model is as shown in figure 11.& 12.



Figure 11. Building foot print of Tirupati



Figure 12. Building foot print of Chittoor

In the same way road ways are also found for the Chittoor and Tirupati regions as shown in the figure 13 & 14. in same manner using these OSM we can find railway lines, particular buildings etc.,



Figure 13. Roadways of Chittoor



Figure 14. Roadways of Tirupati

Conclusion

The growth of urban and use of land variation study requires the detailed geographic scales and exact datasets and applicable approaches for their interpretation, modelling and analysis. The access of remote sensing information appropriate for analysis of urban has expressively improved in current ages. Such information can deliver distinctive visions of urban variation in terms of temporal and spatial determination based on extremely comprehensive, reliable mapping produces over huge areas and extensive time stages. It is possible to capture the varying subtleties with growth of urban pattern can successfully take from urban and at disaggregate regions of urban level. To analyse these shape file and OSM files are taken and are loaded in Mongo dB due to size of the files is huge. And then it is loaded in python programming with installed packages of deep learning called keras, then analysed the data to visualized the Chittoor, Tirupati areas street view, the routing speed, building foot print, street network orientation, plotting routes folium etc. by observing at these analysisurban scale the town has knowledgeable fragmented process of urban growth, mainly at the border regions with considerable built-up rises though the town is moderately dense in development of exposed space.

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