International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

Deep Learning Model for Prediction of Socio-Economic Status Using Satellite Image

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Abstract – There is a great need to find socio-economic status and monitoring of remote areas. Here it is about the state of development or the state of socio-economy of that place. The main factors considered in such monitoring are these building construction i.e roof top of houses, agriculture, water resources and roads. In this paper, the model is proposed to predict development or socio-economic status of areas through analysis of their satellite images using CNN classification and image preprocessing strategies. CNN is proved for better accuracies with supporting to the deep learning methods. It is also complemented with the light weight library in python for image processing as OpenCV which help us to classify the image and improves the speed of execution. In this paper we have use basically three modules: preprocessing of image, CNN classification and predict the social economic status by using the four basic parameters agriculture land, water resources, roads and structure.

Key Words: **PyQT, NumPy, OpenCV, Satellite Image, LandSat 7, Google Earth, MySQL, socio-economic prediction**

1. INTRODUCTION

Social and economic research is the biggest task in any government. Economic research must be realistic and credible to development in any area, the government has taken a survey of that area that requires a lot of human efforts and paper work and also it is time consuming process. There are too many areas in the world where people live but do not have the resources to support themselves. They do not even have the basic necessities of life like water, food and so on. Some regions lack only one factor and some regions have all the features. One region has water but no electricity and another region has a home but has no other necessities. In such areas, some organizations are willing to assist themselves with government funding but due to a lack of communication from that region, the organization knows only the region's location. They do not even know what the basic needs of that region are In that case, the organization can use a satellite imagery in the region and try to determine the needs of that area. But just by looking at that region with a satellite image it can't measure the presence of features in that region.

Therefore to solve this type of problem we present an app to predict the socio-economic situation of the region. The system we are building has the potential to identify some of the regional basic needs and electricity, water supply, agricultural sector. The roof is the most important part of our system. By estimating the socio-economic situation, our system takes a satellite image and compares it with our trained model that contains all of the major factors within it and after comparing these factors we get prediction of the status of that satellite image in the form of percentage and then we are predicting socio economic status. This system can be used to detect the socio-economic status of an area and can be useful to government agencies to make decisions. Also, this approach can be further used to predict agricultural productivity of an area, drought possibilities of an area, road development status and structural development status.

1.1 LITERATURE SURVEY

[1] Multi-Task Deep Learning for Predicting Poverty from Satellite Images (2018)

We propose a two-venture way to deal predicting poverty in rural India from satellite images. First, we train a multi-tasking model to predict the three parameters of development - the main roof material, lighting source and drinking water source - from satellite imagery. Using only satellite imagery as an input, we are able to measure income and poverty near real values collected on the bottom of a handful of effort and financial costs.

[2] Infrastructure quality testing in Africa using satellite imagery and in-depth learning

Details of the quality results of infrastructure in developing countries are not available, and this work has examined the use of remote sensing data available worldwide to predict such results. Using Afro barometer research data, we have introduced a deep learning approach that demonstrates good forecasting ability. In all these endeavours, the data will create a major problem. The quality of the deep model depends largely on the available data, and the main focus should be on making better use of existing image and survey data, making powerful lists for listing and compilation. However, our results provide conclusive evidence that satellite imagery can be used to predict infrastructure quality.

[3] Predictability of Poverty by Public Landsat 7 Satellite Imagery and Machine Learning

Our results show that the current state of satellite-based poverty is committed to predicting a country-related resource where certain facts are found, but may face difficulties beyond national borders. Using a particular combination of night lights and speculation from the proposed models may indicate further improvement.

[4] Creating a famine map using Convolutional Neural Networks trained in high-resolution and medium-sized satellite imagery, and an application in Mexico presenting CNN forecasts of urban areas using a digital Globe or Planet image, using a 10% reserved confirmation sample. We present the R2 estimates that show the correlation between predicted poverty and measurement poverty as measured in the 2015 Intercampus. R2 is estimated at 0.61 using a Digital Globe image, and 0.54 using a Planet image. Keep in mind that we can only compare urban areas only due to the shortage of rural areas of the Digital Globe. Declining performance is modest but not difficult, especially considering that the image of the Planet offers levels of daily global warming. Poverty estimates in Mexico's urban areas are mapped.

2. PROPOSED SYSTEM

We implement a system for prediction of area and calculate economical area with better accuracy and additional parameters.
Following are the parameter of the system for Prediction:

- Agricultural Land
- Water Resources
- Road sources
- Structure

In the diagram Fig.1, there is flow of our project.

[1] The whole architecture is made by PyQT library used in python language. PyQT library gives all the necessary stuff related to GUI design. PyQT provides us display screen, buttons and so on. So, in this way PyQT helps us in design GUI.

[2] After designing of GUI, another task is to authenticate valid user for operating application. To deal with this task, we are using MySQL database to store data of username and password and through this, user can authenticate easily.

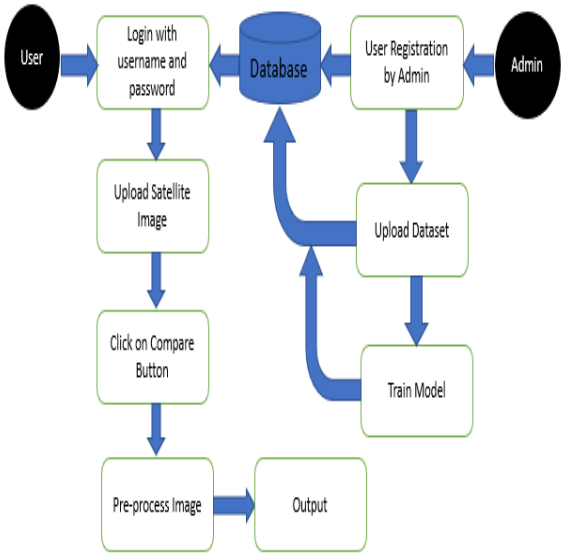


Fig.1:- System Architecture

[3] Another task is to pre-process the input image which can be done by OpenCV library of python. By using this library, image is converted into grayscale image, contour image and smoothen image.

[4] The major task of this survey paper is to collect datasets of satellite image and to achieve this result, we are working on google Earth images, LandSat 7 images and also take help of magic puzzle application on which, we are providing latitude and longitude of a particular area and as a result, we are getting satellite image of that area.
In this way, we achieve our all the tasks to achieve our project goal.

2.1 METHODOLOGY(CNN):

A Convolutional neural network is a neural network which has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data. A convolution is essentially sliding a filter over the input. Convolutional Neural Network is used to extract features such as edges, shapes, corners and pixel intensities. The output of the trained CNN model will be one of the four classes - agriculture, building, road, water.

Convolutional neural network is a structure profound learning and most normally applied to examining visual imgeries. CNNs utilize a variety of multilayer perceptron design to require minimal preprocessing. They are otherwise called move invariant or space invariant artificial neural networks (SIANN), in view of their common loads engineering and interpretation invariance qualities. Convolutional networks were enlivened by natural cycles in that the availability design between neurons takes after the association of the creature visual cortex. Individual cortical

neurons react to improvements just in a confined locale of the visual field known as the open field. The responsive fields of various neurons in part cover to such an extent that they cover the whole visual field. CNNs utilize generally minimal pre-preparing contrasted with other picture arrangement calculations. This implies that the organization learns the channels that in conventional calculations were hand-designed. This freedom from earlier information and human exertion in include configuration is a significant benefit. They have applications in picture and video acknowledgment, recommender systems, image classification, medical image analysis, and natural language processing. A CNN comprises of an input and output layer, just as various hidden layers. The hidden layers of a CNN typically consist of convolutional layers, pooling layers, fully connected layers and normalization layers.

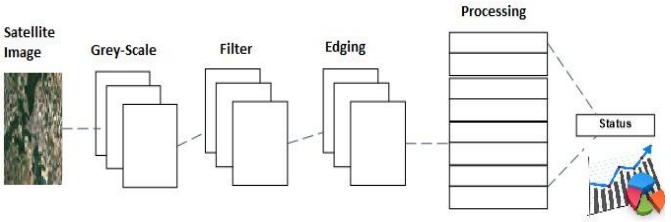


Fig2. Simple ConvNet

There are four main operations in the ConvNet shown in fig. above:

1. Convolution
2. Non Linearity (ReLU)
3. Pooling or Sub Sampling
4. Classification (Fully Connected Layer)

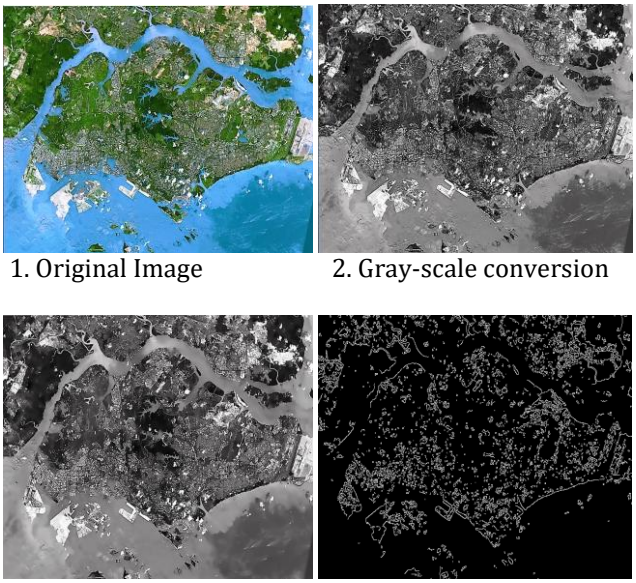
CNNs have an input layer, and output layer, and hidden layers. The hidden layers usually consist of convolutional layers, ReLU layers, pooling layers, and fully connected layers.

- Convolutional layers apply a convolution operation to the input. This passes the information on to the next layer. A filter passes over the image, scanning a few pixels at a time and creating a feature map which predicts what category the feature belongs to.
- The reason to do so is because of course photos are non-linear. When you search any image you can find that it includes loads of non-linear features (e.g. pixel transition, borders, colors, etc.). The rectifier helps to further disrupt the linearity even further so as to form up for the linearity that impose a picture once put it through the convolution operation.
- Pooling combines the outputs of clusters of neurons into a single neuron in the next layer.
- Fully connected layers connect every neuron in one layer to every neuron in the next layer.

3. RESULT

In the proposed system, we will be using supervised CNN approach which further will improves the accuracy of the prediction. CNN is proved for better accuracies with supporting to the deep learning methods. It is also complemented with the light weight library in python for image processing as OpenCV which help us to classify the image and improves the speed of execution. System has used various parameter likes Agricultural Land, Water Resources, Road sources and structure to calculate economical area with better accuracy.

Following images are pre-process images of satellite image.



1. Original Image 2. Gray-scale conversion

3.Bilateral Filter 4.Canny Image

Fig. Image Pre-processing

Comparative results of existing and proposed system is as follow,

Parameters	Existing System	Proposed System
AI based approach	No	Yes
Use of satellite image	No	Yes
Use of OpenCV	No	Yes
CNN	No	Yes
Improved speed	No	Yes

Table 1. Comparative Table

3.1 ACKNOWLEGEMENT

I would like to extend a big thank you to all who helped us directly or indirectly in making this paper. Finally I would like to thank all our friends for supporting us in completing this paper successfully. I am especially grateful to our guide Prof. Mangesh Manake for his time to time, very much needed, and valuable guidance. Without the full support and cheerful encouragement of our guide, the paper would not have been completed on time.

4. CONCLUSION

Socio-economic status prediction using satellite imagery. For this type of application, we first collect a set of satellite images and then make a desktop application so that the user can predict the social and economic situation or status of that area. Predicting the status of satellite imagery, we use preprocessing of an input images so that features can be easily accessed and to achieve this we use the opencv library. In this way, we are successfully implemented all the tasks of the survey paper.

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