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Identification of Rural Roadways Using Pre-existing Database

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Abstract:

Development of industries depends upon the availability of transport facilities which include all three air, land and water transports. Among all of these transports, roadways turn out to be more effective and cheap modes of transport. As roadways contribute in ease of travel it becomes necessary to understand the mapwork of every road.The pathways which connect rural and urban areas are required to understand the progress of basic road construction and their extensions. Differentiating kaccha roads from other man-made roads is still an unsolved issue. Using Satellite Imaging, we can segment roads using the data provided by ISRO's Bhuvan web-based utility. Thus, using the existing databases we can have an update on rural roadways.

Keywords — **Satellite Imagery, Road Extraction,Computer Vision,Deep Learning**

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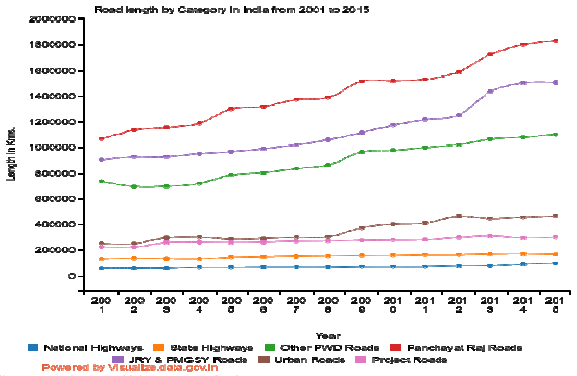
I. Introduction

For planning of road construction and expansion, interconnectivity in rural and semi-urban areas is necessary. Segmenting kaccha roads from satellite imagery remains an unsolved challenge. India may be a rapidly developing country, and Roadways play a really significant role within the development. Developments of sectors like Manufacturing industries, agricultural industries involve proper planning to support the supply of transportation facilities. The roadways are inevitable contributors. Thus Proper understanding of road networks becomes mandatory. Roadways in India are increasing exponentially as a necessity, and require faster ways of updating the existing databases and monitoring for changes with minimal or no human involvement is expected. Nearly 70% of Indians live in rural areas according to the census of 2011. It is mandatory to develop proper infrastructure for the whole population, which is administered using Pradhan Mantri Gram Sadak Yojana. A level of manual effort required for GIS update of road regions, for India (3.28 Million km2) continuous update of changes is difficult.



Source: https://data.gov.in/

Fig. 1 : Road length by Category in India

Roadways are very important for the immediate and first-level response for disaster management and recovery . It becomes important to spot existing functional routes after the disaster and identify the choice routes, to assist in rapid recovery actions.

In these scenarios existing GIS databases are of little or no use since changes in terrain and geographical features would have changed post calamity. So only means of immediate insights can be obtained if through satellite imagery.

II. Method

In this work, we used the pre-trained model on the U-Net segmentation architecture on the Mnih et. al. datasets for the task of road network extraction. We used a pre-trained U-Net model which achieves a mask accuracy of 95% on the test set. The network was trained on AWS P2.x instances. Inference time on a single K80 Tesla GPU(AWS P2.x instance) is 0.28 seconds and on CPU is 6 seconds. Data collection is done from some of the open source datasets.Most of the training data is taken from "The Massachusetts Roads Dataset".While the testing and validation is taken from combination of "The Massachusetts Roads Dataset",ISRO's "Bhuvan site",and "Spacenet dataset". This project requires Python 3.6 and Conda which is an open source package management system and environment management system that runs on Windows, macOS and Linux.

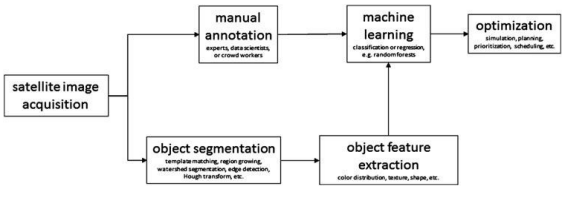
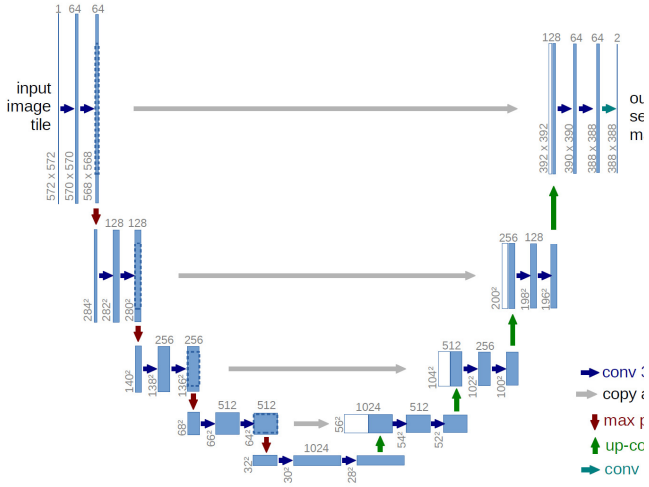


Fig. 2 : Block dig. Deep Learning Algorithm

U-Net architecture used in the image segmentation is the backbone of this project.As shown by many researchers,'U-Net' is the best performed model on image segmentation.



Source:University of Freiburg

Fig. 3 : U-Net Architecture

We use 'Google Colab' for running the model and use the free GPU provided by google for better speed.

Thus, after inputting satellite images we get the segmented images in which roadways are segmented and hence reduce the human effort and maximize accuracy.

III.

IV. Future Scope

In future consideration, different algorithms can be used to train road extraction models to achieve high accuracy.The road extraction model can replace the need of manual efforts for creation of maps and city planning.It ensures better utilization of vast data received from satellites nowadays.It makes it more cost effective.

V.

VI. Results

In this system, we have studied the different types of deep learning models that can be used to extract accurate roadways from satellite imagery.We used the model which had the highest accuracy in extraction of accurate roadways.We used satellite imagery provided by the ISRO's Bhuvan web-based Utility and various open source datasets.We concluded that using machine learning for extraction of rural roadways is much better and accurate than manual method which is currently being used.

VII. Conclusion

Social good projects in rural settings are hampered by lack of ground knowledge necessary for informed planning and deciding . This lack of data stems from the shortage of infrastructure to permit easy data gathering from remote rural locations, which is one among the explanations why social good projects are needed in the first place. Remote sensing provides an avenue to beat this barrier to rural development programs when paired with satellite image analysis and other advanced modeling. With the emergence of low-cost satellite imaging and subsequent mass generation of knowledge , we see remote sensing-supported planning playing an increasingly important role in rural development going forward. With all of these learnings in mind, we would still like to emphasize that existing image analysis techniques from the literature are usually sufficient to tackle selection problems in rural development when used properly, and thus shouldn't be a bottleneck in such projects.

The key's in determining and modeling the proper criteria, whether it's something simple, some sort of building material or something complicated just like the cost of the optimal grid topology. Though satellite imagery presents particularly a useful gizmo for tackling a replacement suite of developing world problems, the functionalities and dependencies are often outside of the innovator's set of expectations and must be in parallel.

VIII. References

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