ITSP Final Documentation

**** This will be considered as your final documentation and will be made available for online usage.***

Street Smart - Planning Streets and Beyond!

Team VASU

ITS21010

Keywords (Include 7 or more keywords which will help others find your documentation easily)

YOLO, AI, City Planning, Machine Learning,Deep learning, Transfer learning,Reinforcement Learning

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Inspiration for Idea

Through our model we plan to design a model which will take input of an underdeveloped city and it will return a suited road network on the basis of the various developed cities we train it on. Inspiration towards the idea was mainly the ever-increasing traffic and the problems caused due to inefficient management.

Link to the Abstract:
https://docs.google.com/document/d/1Ho3wNuawWfSNjWigqY5ThsFR6C3-IvMoRxut2SA4Kt0/edit?usp=sharing/

Problem Statement

We aimed to build a machine learning based city planning model to predict the road distribution in a developing city using the data of existing developed city and analysing their traffic flow distribution using YOLO models.

Existing solutions in the Market

While there have been startups such as CHAOS, which have tried to predict Living Conditions in various urban areas as well as Housing Prices, there have been no solutions to solve the problem of Public Transport Optimization.

Proposed Solution

Predicting population distribution with the help of image processing will help us get an updated picture of city growth and population distribution quickly and will make city development efficient.

Brief Description

The project StreetSmart aims to create a Machine-Learning based model that will be able to suggest possible methods/modes/routes to help suggest a public transport infrastructure for an under-developed or proposed city in the most efficient way possible using libraries, conventional and non-conventional algorithms. The idea is to help in planning out a better and more optimised transport network which includes various aspects like traffic control and subway-routes among many. We plan to implement YOLO, Convolutional Neural Network, Graphs, Algos like Ford-Fulkerson's, DInic's, Cycle Cancelling.etc and Image processing to come up with a model which suggests ideas within the specified budget to develop the transport infrastructure and hence contribute towards the overall development. We are planning to explore new areas and develop an out of the box solution, which would be economically feasible and easy to implement.

Progress

How the work was done:
…….

Work flow:

a) Week 1:
   - Collecting/Creating Data: which would be used to train the ML part: This will be done using Google Maps/Earth with which we could take screenshots and get an idea of the traffic the building clusters tend to create on various intersections.
   - Implementing the Image-Processing part (using OpenCV Library!), which takes in an image, and then using K-means as well as other Supervised Learning Methods(Mostly Convolutional Neural Networks and YOLO!) to get weights for different roads as well as identifying the intersection of various roads.

b) Week 2:
   - Implementing Flow Algorithms (We'll be learning as much as we can about Flow Algorithms during the Learning Phase and figure out the best way to

use variation of Conventional and Standard Algorithms like Ford-Fulkerson Algorithm to have maximum flow of Traffic at minimum cost.)
- Trying out different Models as well as the best values of the Hyper-parameters to get to the Ideal Model.

c) Week 3:
- Building the Model as a whole, debugging as well as Working on UI

Work distribution:

Vidit Goel :

Completed the relevant parts and Assignment of Deep Learning Courses
Analyzed the YOLOv3 model for Image Labelling
Collaborated with Utkarsh on Inferring Traffic for buildings in new cities.
Worked on the Programs to identify roads and their traffic from Google Maps data.
Made Sure the the part on inferring traffic data from Google Maps works

Aryan Gupta:

Completed the relevant parts and Assignment of Deep Learning Courses
Data Collection from Satellite Imagery
Worked on Improving the Road Prediction from Google Earth Data
Worked on postulating initial system of roads in new cities
Made sure, the road postulation part works (independently)

Shubh Kumar :

Explored various Options like OpenCV for CNN, finally chose an adaptation of the model from an article (1) , and the in-general architecture.
Implemented Iterative improvement of Road-Postulation in an RL-like method
Maintained Documentation for everything that's done
Trained the YOLO Model and checked integration

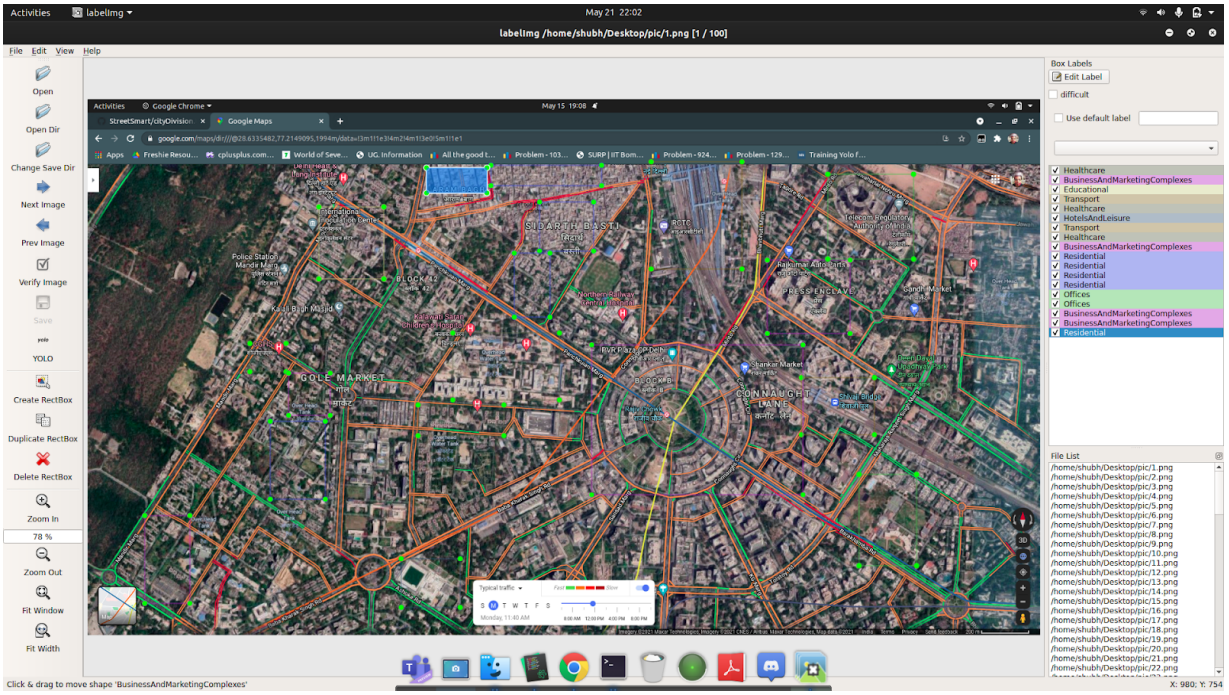
Utkarsh Ranjan

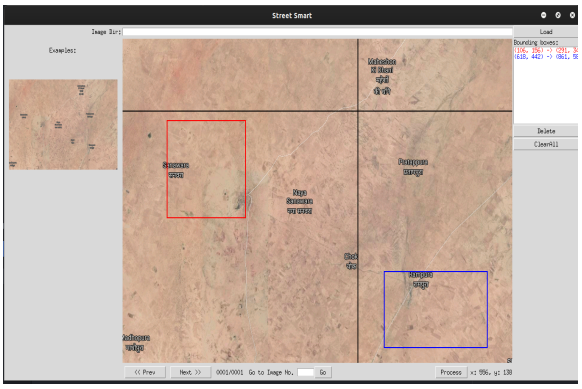
Completed the Relevant parts and Assignments from Deep Learning Courses
Made the programs for Road Identification and Parsing.
Collaborated with Vidit on Inferring
Worked on GUI and final integrations.

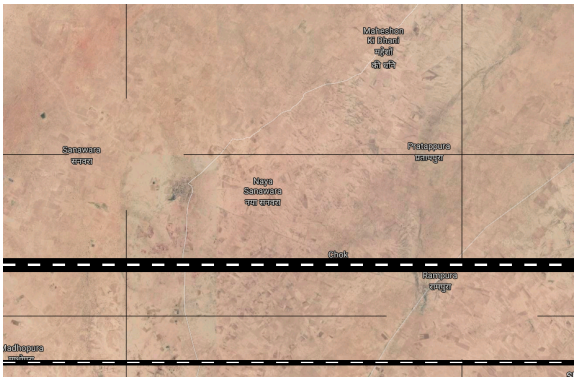
Challenges:

1) Unavailability of GPU: Required at least 11 GB of GPU for training for only 1.5 GB.
   a) Tried contacting ITC at first
   b) But then, we simply made the DarkNet Architecture less dense by reducing the number of filters per CNN layer, and it worked just as well
2) Unavailability of a Proper Dataset: We weren't able to find a proper dataset of satellite imagery in the Indian Context.
   a) Solution: We manually took screenshots from Google Maps with Traffic Data enabled and labelled it using fast open-source tools.
3) No Other Problems faced after that

Results







Github repo link:
https://github.com/thevaliantthird/StreetSmart/

Final Presentaion Link:
https://docs.google.com/presentation/d/19FNZhfABMVCTZKHaqphk0YsD8XqdYG5eMGg7sBj942Y/edit?usp=sharing/

Simulation video:
https://drive.google.com/file/d/1-5mSA1PYVnwlLepfw5R41ChMR1YjBpcc/view?usp=sharing/

Project video:
https://docs.google.com/document/d/19oifAypqevd8kJ1hh8ZisCUtkNd1GFjuPoO6MwbMVTs/edit?usp=sharing/

Learning Value

- All of us got the chance to get our hands dirty with Andrew Ng's Deep learning specialization course.
- All of us got completely familiar with numpy library and developing applications in python.
- Some of us got the chance to learn about YOLO and see transfer learning in action .
- Some of us got the chance to explore the tkinter library in order to build the GUI.
- Some of us also had the chance to explore RL in depth and in action.
- Above all we learnt the skill of working and coordinating in a team.

Software/ Hardware used

Software used for labelling Satellite Images: LabelImg (Open Source)
Courses Used : Andrew Ng's Deep Learning Specialization (Course 1) & Machine Learning (Course 2)
Machine Learning Library : PyTorch
For Satellite Imagery and Traffic Data: Google Maps

Suggestions for others

To start on with the project Andrew ng's deep learning specialization is a must. Further for data collection some tools on github like labelimg is also helpful. ...

Contribution by each Team Member

Vidit Goel :

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References and Citations

Course 1 (Machine Learning)
Machine Learning by Stanford University

Course 2 (Deep Learning Specialisation)
Deep Learning by deeplearning.ai

Article 1 :
Training Yolo for Object Detection in PyTorch with Your Custom Dataset — The Simple Way

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Nil

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