Project Synopsis
on

Satellite Image Processing

Submitted as a part of course curriculum for

Bachelor of Technology
in
Computer Science

Submitted by
Aayush Sharma (2000290120004)
Ajay Varshney (2000290120016)
Anubhav Yadav (2000290120033)

Under the Supervision of
Prof. Shivani
Assistant Professor

KIET Group of Institutions, Ghaziabad
Department of Computer Science
Dr. A.P.J. Abdul Kalam Technical University
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DECLARATION

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

Signature of Students:

Name	:	Aayush Sharma	Ajay Varshney	Anubhav Yadav
Roll No.	:	2000290120004	20002901200016	2000290120033
Date	:			

CERTIFICATE

This is to certify that Project Report entitled "**Satellite Image Processing**" which is submitted by **Aayush Sharma, Ajay Varshney and Anubhav Yadav** in partial fulfilment of the requirement for the award of degree B. Tech. in Department of Computer Science of Dr A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

Date:

Supervisor Signature
Prof. Shivani
(Assistant Professor)

ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the synopsis of the B. Tech Mini Project undertaken during B.Tech. Third Year. We owe a special debt of gratitude to Prof. Shivani (Professor), Department of Computer Science, KIET Group of Institutions, Delhi- NCR, Ghaziabad, for his/her constant support and guidance throughout the course of our work. Her sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his/her cognizant efforts that our endeavours have seen the light of the day.

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Last but not the least, we acknowledge our friends for their contribution to the completion of the project.

Signature:

Date	:			
Name	:	Aayush Sharma	Ajay Varshney	Anubhav Yadav
Roll No	:	2000290120004	2000290120016	2000290120033

ABSTRACT

In this project, we are trying to extract the buildings, roads and vegetation of an area etc. provided in the satellite images. For achieving this we are making a Machine Learning and Deep Learning models in which we use algorithms and methods of machine learning and deep learning. We first take our dataset which are the images from the satellite and a target image which helps to identify our targets we call this dataset training dataset, then we make some models for extracting the buildings, roads and vegetation of an area etc. Then when we trained our model, we test it and find out its accuracies and errors for any fixes in the model. When we done this, we will check with new images or with our testing datasets, Then when we found out our targeted findings we will highlight it. In this for our models, we will try UNet, ResNet50, PyTorch and some other algorithms according to our requirements if necessary. These libraries and models are proposed, may be different at the time of implementation.

Chapter 1: Introduction

1.1. Introduction

In this project, we will arrange the images from a satellite of some area with highlighted buildings and roads. Our project is all about making a machine learning (or deep learning) model to identify all those roads and buildings of that area via that satellite image. We are going to use firstly UNet, ResNet50 and DeepLab etc for training our model. We will feed the model satellite images and highlighted marks image on training set, then we test our model on testing dataset which contains the only images of satellite images and compare it with the actual highlighted images. This will be supervised learning model. According to us, this model will be very helpful for navigation for newly fed images, military purposes and much more.

1.2. Problem Statement

Our problem statement in simple words would be like:

- We are going to make a machine learning (or Deep Learning) model.
- This model will recognize the buildings, roads and vegetation etc.
- After recognizing it, it will also highlight it by suitable representation.

1.3. Objective

Our objective is to provide a machine learning model which do the following :

- Takes a satellite image of a particular area.
- Highlights the roads detected in that area.
- Highlights the buildings detected in that area.
- Highlights the vegetation in that area.
- And some similar operations like those

1.4. Scope

After discussion with the team and with our guide, we can consider the scope of this project as follows :

- We can create an app for highlighting the vegetation of that site with facts, figures and some information about it.
- Military can use this model to quickly get information about that area like roads and buildings.

Chapter 2 : Literature Review

2.1. Neural Network for the Beginner

By Robin M. Synder

In this research paper, author tries to explain basics of neural and networks and also tells some of the references where we can go and implements neural networks. In the starting, author tells neural networks are motivated by the brain, neural networks are a right-brained approach to artificial intelligence that is used to recognize patterns based on previous training. In practice, one would not program an expert system to recognize a pattern and one would not train a neural network to make decisions from rules; but one could combine the best features of each in solving a problem. One of the simplest and most common neural network models is the fully connected three layer model that consists of the input layer, the hidden layer, and the output layer. Instead of programming a neural network, the neural network is trained by presenting a history of inputs and outputs to the network. Training can be difficult and time-consuming, but after training, the neural network can quickly recognize patterns. One of the easiest places in which to integrate neural networks into the curriculum is a follow-on to the study of regression. The goal of regression is to determine a functional relationship between a dependent variable and one or more independent variables. Neural network software is becoming more available and more affordable. An annotated bibliography of selected literature on neural networks and a brief history of neural networks follows the discussion in this paper. In conclusion, author says if there is no obvious solution to a problem, then various intelligent systems approaches can be used. If the problem involves some kind of pattern recognition, neural networks may provide a possible solution. If the problem involves some kind of process control, a fuzzy system may provide a possible solution. If there are facts and rules that can adequately describe the system, a traditional expert system may provide a possible solution. And, if the problem involves all of these and more, perhaps a fuzzy-neural-expert system may provide a possible solution.

2.2. Activation Functions and their Characteristics in Deep Neural Networks

By Bin Ding, Huimin Qian and Jun Zhou

In this research paper, author tells deep neural networks have gained remarkable achievements in my research areas, especially in computer vision, and natural language processing. The great successes of deep neural networks depend on several aspects in which the development of activation function is one of the most important elements. Being aware of this, a number of researches have concentrated on the performance improvements after the revision of a certain activation function in some specified neural networks. We have noticed that there are few papers to review thoroughly the activation functions employed by the neural networks. Therefore, considering the impact of improving the performance of neural networks with deep architectures, the status and the developments of commonly used activation functions will be investigated in this paper. More specifically, the definitions, the impacts on the neural networks, and the advantages and disadvantages of quite a few activation functions will be discussed in this paper. Furthermore, experimental results on the dataset MNIST are employed to compare the performance of different activation functions. Author also tells us in the last decades, deep neural networks have acquired rapid improvements, especially in computer vision or natural language processing. Along with the layers of network getting deeper, the

training efficiency and accuracy have received many concentrations which stimulates the developments of activation functions. The saturated activation functions, like Sigmoid, Hyperbolic tangent, are replaced by non-saturated counterpart, such as ReLU, ELU. In this paper, the definition, the pros and cons of several popular activation functions are reviewed. It should be acknowledged that some effective activation functions have not investigated in this paper, such as maxout, softplus. The aim of this paper is to make some contributions on the understanding of the development progress, attributions, and appropriate choice of activation functions. And further investigation and analysis are required to improve the views in this paper.

2.3. AI as a friend or assistant :The meditating role of perceived usefulness in social AI verses functional AI

By Jihyun Kim, Kelly Merrill, Chad Collins(2021)

People perceive functional AI more favorably than social AI. Perceived usefulness fosters positive attitudes towards AI and perceived realism of AI. It was developed to assist humans to complete tasks, but AI now takes on more social roles.AI is a field of study that focuses on use of machines that behave and think in either an ideal manner or in a similar manner to humans. The task oriented style is a behavioral approach wherein the tasks to be completed are prioritized while the relationship oriented style prioritizes people's esteem and well-being. Researches also documents varying perceptions of different orientations in interpersonal settings.

Communication orientation is valuable component in interpersonal communication and even more so as technology develops and relationships migrate to the digital realm. Voice AI assistants are used to complete clerical tasks particularly among users with mobility issues that struggle to use physical devices. Humans' interactions with technology is similar to interactions with humans in the natural world. There exists variety of AI or machines with various roles or goals. Social machines mainly focus on human machines and providing championship. Functional AI will elicit more positive perceptions such as attitudes towards AI and perceived realism of AI. New technologies have transformed how we currently view and use AI in various ways.

2.4. The three ghosts of medical AI: Can the black-box present deliver?

By Thomas P. Quinn, Simon Coghlan , Vuong Le(2021)

Modern machine learning relies on powerful but intrinsically opaque models. Opaque models lack quality assurance, fail to elicit trust and restrict physician-patient dialogue. AI-based changes promise to transform clinical decision-making and clinician workflow, usher in direct-to-consumer medical services, and even provide robot-aided healthcare. When a patient visits a medical clinic, they are almost invariably examined, diagnosed, and treated without any support from AI. Modern machine learning makes use of large data sets to learn the predictive functions automatically. The MYCIN system, developed in the early 1970s, was the first major attempt to emulate clinical reasoning. However, knowledgebased systems soon proved ineffective for solving sufficiently complex problems. Deep learning has rekindled excitement in AI by solving many difficult problems, especially in image and language processing. Although deep learning models are powerful, they tend to lack transparency. The medical

profession is built on trust. For medical AI to be successful, it must be trusted by governments, health professionals, and the public. AI is an increasingly powerful tool that may indeed have the potential to "revolutionaize" healthcare one day. Deep learning has already achieved near-human performance in medical image classification, perhaps most notably in the diagnosis of diabetic retinopathy.AI is poised to have clinical impact on robotic health, Clinician workflow, clinical decision making, Direct – To – Consumer Services. Doctors and patients alike should have reason to trust a model. This requires a change in how we design and validate medical AI to better align with the standards already set for other medical interventions. Machine learning models can be designed to be intrinsically interpretable. Self-explanatory structures already accompany many models – including linear regression, decision trees , and shallow neural networks.

2.5. Pandemic coronavirus disease (Covid-19): World effects analysis and prediction using machine-learning techniques

By Dimple Tiwari, Bhoopesh Singh Bhati, Fadi Al-Turjman, Bharti Nagpal

Coronavirus, as deadly as it appears, genesis from SARs-CoV-2 in the seafood market near Wuhan in China during the end of the year 2019. And quickly spread across the world make it a dreadful issue. Due to sudden spread & lack of specific treatment were the major challenges. Although with the end of 2020 many countries had come up with few vaccines still a bit unsure about their effectiveness. The most affected countries are the USA, India, Brazil, United Kingdom, Russia, Turkey, France.

NL63, HKU1, OC43 & 229E are reported covid-19 viruses till now. With symptoms of respiratory illness from mild to moderate. It is observed that symptoms are more severe in old people and patients with Blood Pressure, Diabetes & other sick people. The life risk rate decreases along with the age of the COVID-affected person. In some research, it is also discovered that covid reduced the count of WBC, MOD & ARDS were the major cause of the fatality rate. Although, the fatality rate is much less than the virus transmission rate.

With the outbreak of a pandemic, without vaccines & specific treatments for the airborne, machine learning, data science has played a crucial role in the prediction of upcoming trends for safety measures, & implementation of various precautions that had been taken to combat covid on big scale. With this paper, we come up to conclude that the predicted outcomes of naïve bates are close enough to the actual confirmed cases. However, linear regression & SVM do not stand up to the marked line. And thus, naïve Bayes is more likely to be used in the future for prediction purposes. Platforms, and government documents, AI can learn to detect an outbreak.

2.6. Covid and data science: Understanding R_0 could change your life

By Jim Ridgway

To manage the outbreak, many precautions & measures were taken by authorities & its result to be very helpful but it could be better if only taken at right time & effectively applied to all. The better we can track the trends & predict, the better we can fight & win over. Thus, the SIR model *(susceptible, infectious, recovered*) is a kind of compartmental model, which explains the dynamics of infectious diseases when properly modelled and improved, where tested &

used to take appropriate action in the area of its positive impact. This includes assessing benefits and risks, continuing to monitor variations & trends, and identifying ways to support a safe application.
This paper concludes that interpretation of data & a better understanding R_0 can be life-changing even in crises and epidemics. By mathematical model, it is depicted that, Lower the basic reproduction number(R_0), the better i.e., if R_0 is smaller than 1, diseases will be bound to quit; otherwise, chances of an outbreak are higher.

2.7. Role of data science in managing COVID-19 pandemic

By Nikita Saxena, Priyanka Gupta, Ruchir Raman, Anurag S. Rathore

Data Science has played a vital role in the fight against the recent deadly pandemic known as SARS-CoV-2. From categorizing the covid zones based on the density of the infected patients to deciding the dose & medicine for the patient on the severity of the infection. Statical analysis, mathematical models are key toward the Data science field is categorized into data management, data visualization, and statistical machine learning, which can be used for organization, sorting, processing, and real-time data analysis.
The Data Science expert must build their model, keeping in mind its shortcomings too. They have to consider their models with some reservations. The catch is that these models are just helping hands towards the successful treatment of COVID-19 infection.

2.8. Intelligent heart disease prediction in cloud environment through ensembling

By Nishant Gupta, Naman Ahuja, Shikhar Malhotra, Anju Bala, Gurleen Kaur

Cloud computing has emerged as a strong alternative to using costly locally managed computing resources in recent years. It is an on-demand service in which data can be processed and managed remotely. And a very convenient essential for health care industries, to provide uninterrupted service with less downtime. In the prediction of cardiac disease, open-source datasets are used. The datasets are implemented & analysed by pythons programming with various machine learning algorithms i.e., Logistic Regression, Naive Bayes, Support Vector Machine, K-Nearest Neighbours, Decision Tree, Random Forest, Artificial Neural Network with Hidden layer, which shows the best degree of accuracy of heart disease among these algorithms.
This work depicts that Naïve Bayes having the highest accuracy fits best for prediction of the heart disease model in terms of execution times and accuracy in the cloud; Minimum execution and maximum accuracy. This model is proposed to predict cardiac disease to reduce mortality due to heart disease.

2.9. Transforming healthcare with big data analytics and artificial intelligence

By Nishita Mehta, Anil Pandit, Sharvari Shukla

Data and information have always been crucial in each & every field. Now with digitalization & technologies are adding up to it and generates a significant portion of big data relevant to public healthcare. That is why knowing about it and assessing what can be achieved using this data are mandatory. So, to provide relevant ways for improving the health sector, healthcare providers are required to be fully equipped with the required infrastructure to generate and analyse big data.

With high hopes of extracting new and actionable knowledge to improve the status of healthcare services, researchers are plunging into biomedical big data despite challenges. Thus, in conclusion, it is essential for technologists and professionals to understand this evolving situation and this big data will facilitate healthcare by introducing prediction of health crises, providing early warnings, and helping in the discoveries & intervention strategies for an improved quality of life.

2.10. Scaling Up Machine Learning: Introduction

By Ron Beckerman

Distributed and parallel processing of very large datasets has been employed for decades in specialized, high-budget settings, such as financial and petroleum industry applications.

The current rise in interest in scaling up machine learning applications can be partially attributed to the evolution of hardware architectures and programming frameworks that make it easy to exploit the types of parallelism realizable in many learning algorithms.

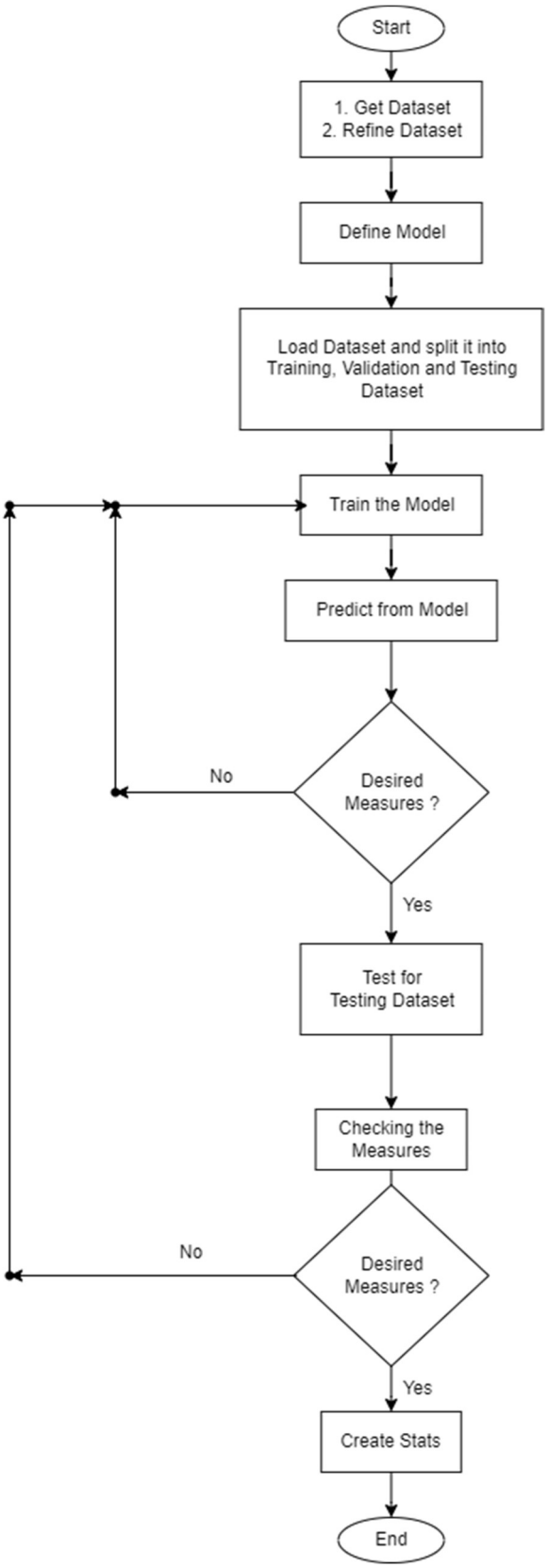
Several platforms make it convenient to implement concurrent processing of data instances or their features. This allows straight forward parallelization of many learning algorithms that view input as an unordered batch of examples and aggregate isolated computations over each of them.

Increased attention to large-scale machine learning is also due to the spread of very large datasets across many modern applications. Such datasets are often accumulated on distributed storage platforms, motivating the development of learning algorithms that can be distributed appropriately.

Finally, the proliferation of sensing devices that perform real-time inference based on high-dimensional, complex feature representations drives additional demand for utilizing parallelism in learning-centric applications.

Chapter 3 : Proposed Methodology

3.1. Flowchart



3.2. Algorithm Proposed

1. Collect our dataset.
2. Refine it and handle the nulls and other error data.
3. Make visualizer for data.
4. Visualize the data as image and mask appropriately.
5. Define some augmentation.
6. Define the model (UNet/ResNet 50)
7. Split training data into training and validation data.
8. Train the model.
9. Predict the data.
10. Check for measures and repeat step 7 till desired output measures.
11. Load the testing dataset.
12. Checking the measures on it.
13. If not desirable, refine the model from step 7 again.
14. If desirable, predict for further new data and check for real live problem.
15. Create statistics about above methods on each step to keep track of everything.

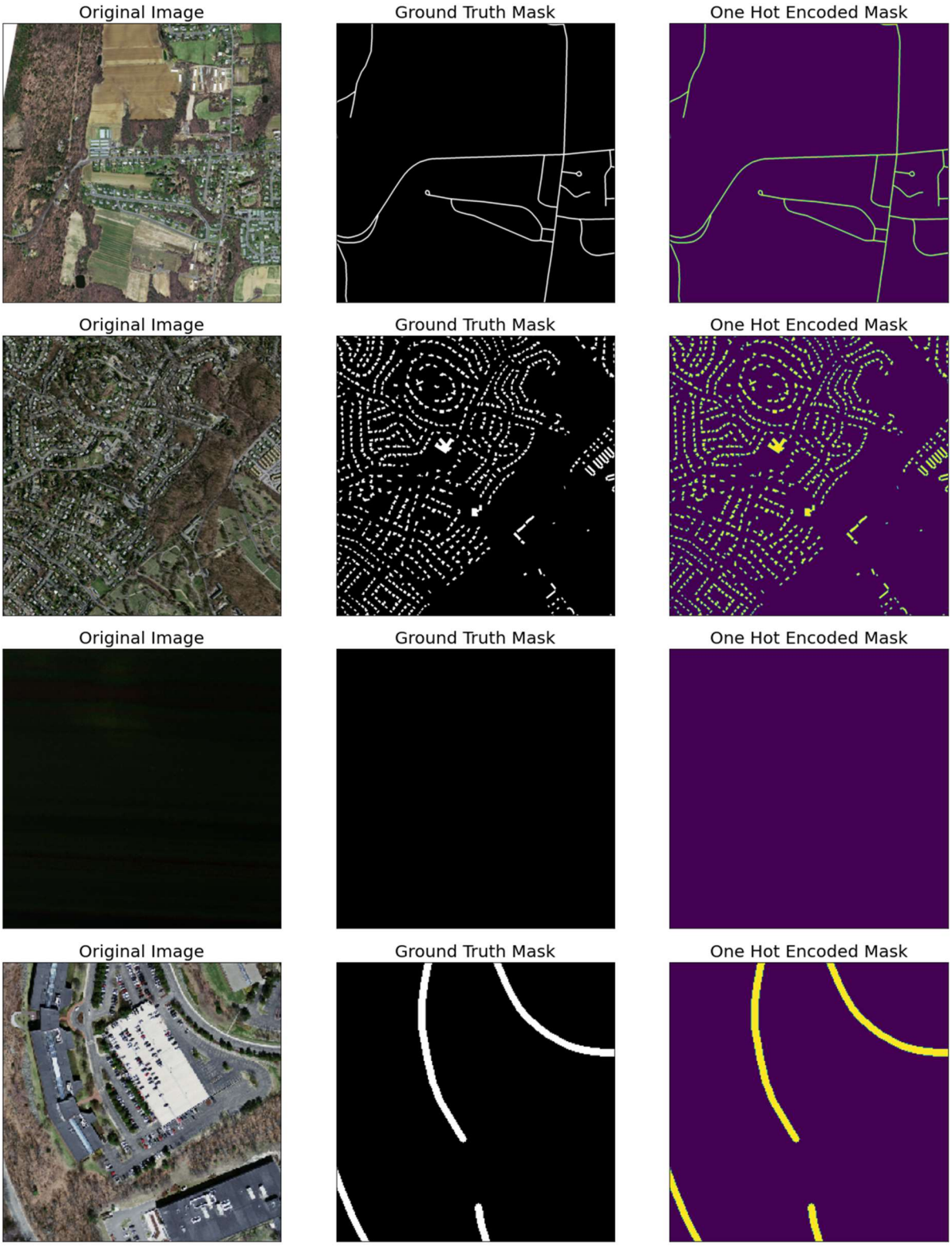
Chapter 4 : Technology Used

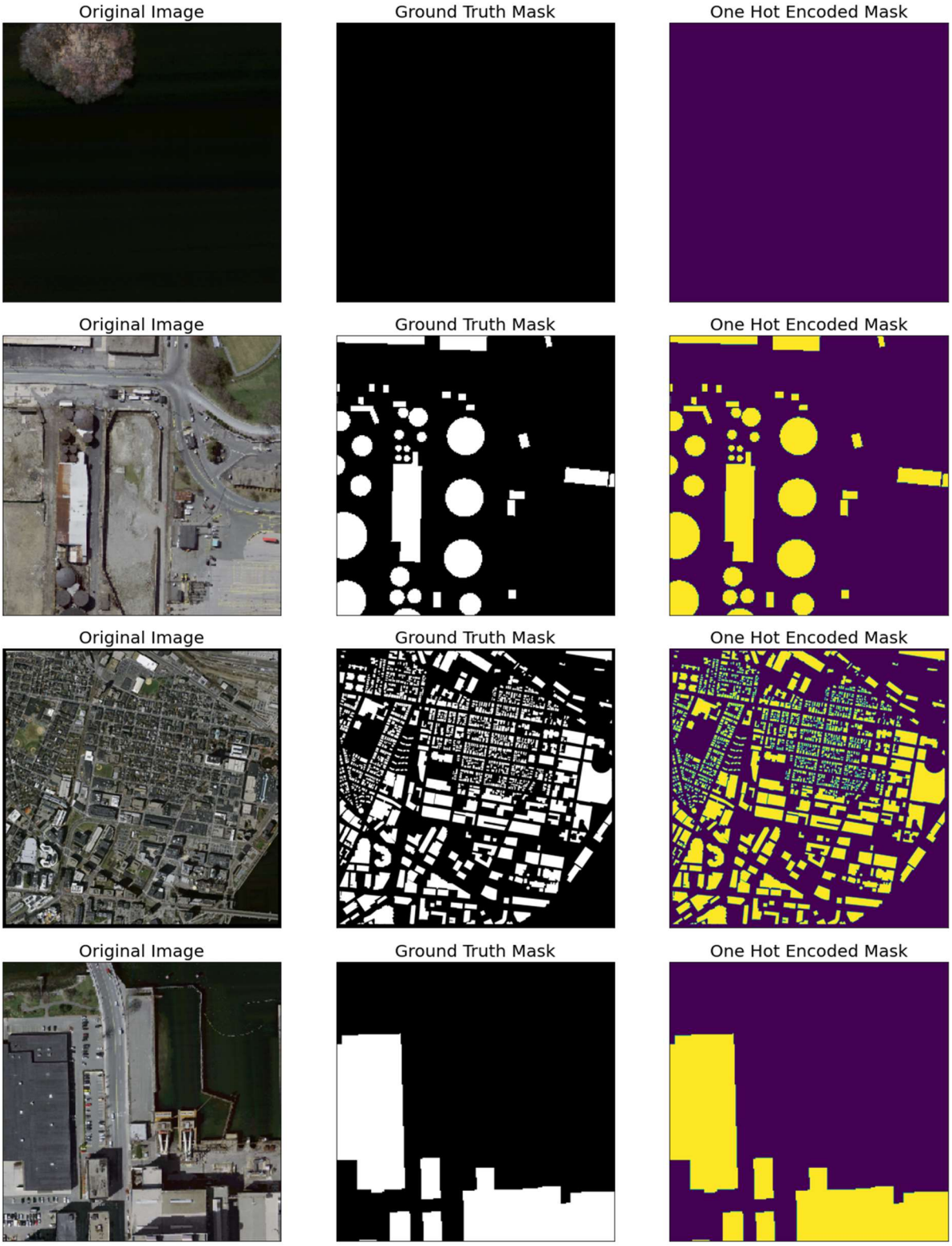
After taking some consideration, finding from the web, talking with guide and other experts, we decided to use the technology mainly based on Deep Learning and Machine Learning with the following algorithms and techniques :

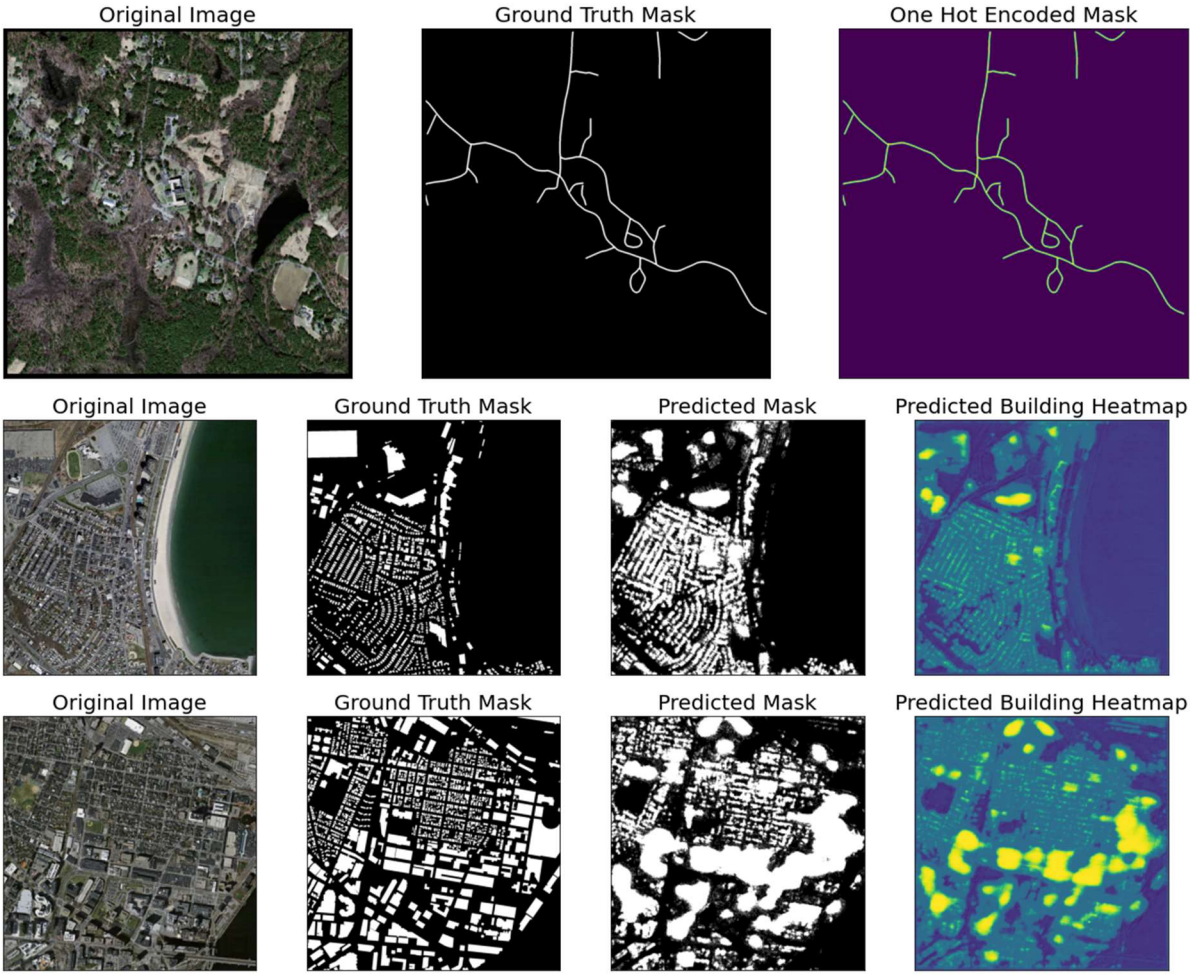
- UNet
- ResNet 50
- DeepLabs
- OpenCV
- Tensorflow

More technologies can be used if required.

Chapter 5 : Diagrams




Original Image
Ground Truth Mask
One Hot Encoded Mask
Original Image
Ground Truth Mask
One Hot Encoded Mask
Original Image
Ground Truth Mask
One Hot Encoded Mask
Original Image
Ground Truth Mask
One Hot Encoded Mask


Original Image
Ground Truth Mask
One Hot Encoded Mask
Original Image
Ground Truth Mask
Predicted Mask
Predicted Building Heatmap
Original Image
Ground Truth Mask
Predicted Mask
Predicted Building Heatmap

Chapter 6 : Conclusion

In conclusion of this project, we would conclude that this project will provide a great help to future as already discussed in the future scope section.This project will mainly based on the Deep Learning algorithms. We are using our dataset from the internet, mainly from Kaggle. Our main objective is to take a satellite view of a area, then process it to highlight the buildings and roads so that the path tracing will be easy to trace. This project will be great help in military area. This project can provide educational content to concerned people.

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4. Thomas P. Quinn, Simon Coghlan , Vuong Le(2021) “The three ghosts of medical AI: Can the black-box present deliver?”
5. Dimple Tiwari, Bhoopesh Singh Bhati, Fadi Al-Turjman, Bharti Nagpal “Pandemic coronavirus disease (Covid-19): World effects analysis and prediction using machine-learning techniques”
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8. Nishant Gupta, Naman Ahuja, Shikhar Malhotra, Anju Bala, Gurleen Kaur “Intelligent heart disease prediction in cloud environment through ensembling”
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