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Natural Disaster Possibility Prediction using Image Processing

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Abstract - *Natural disaster are very abrupt and sudden and can destroy large areas within fraction of seconds. Rapid urbanization, climate change and extreme rainfall have resulted in growing number of cases of natural hazards. To reduce the impact, short term forecasting s used for prediction of future incidents. Forecasting weather condition are examined using satellite imaging using algorithms. Our idea is designing a web software to detect natural disaster. We are providing a software platform for natural disaster prediction using the concept of image processing. Using image processing we are finding the soil color, vegetation index and slope of the geographical area. This software help user to search a particular location and check whether the land is prone to natural disaster. Scanned location is analysed using the satellite image with some algorithms for slope, NDVI and soil color.*

1. INTRODUCTION

The main objective of our project is to predict the occurrence of natural disaster. Last few years we are facing tremendous natural calamities like flood, soil erosion, etc. The poor forecasting system cannot predict the calamities as soon as possible. In recent days the forecasting system improves well but evacuation takes much time so the life cannot be saved. With the problems that we have seen, we are providing a software platform where we could process images from satellite and analyse factors like slope NDVI and water sources. In certain condition it is difficult to capture a well defined image of a remote area. It offers government and constructors to locate a safe area for construction and farming. To make the process simpler we are using the location API and cloud architecture. The growing trends shows that people always look for the application and process which saves time and effort.

This application helps constructors and engineers to locate a safe area for construction. Using satellite image they can analyse whether the land is prone to any natural disasters. In addition they can also locate nearby water bodies to analyse the geographic nature of the location. This application also helps government sectors to take necessary steps before any unauthorized construction. This application also allows the rescue department to understand more about environment and its instability. It gives the rescue department a safe path to travel in order to reach the affected areas.

2. EXISTING SYSTEMS

In the paper 'Landslide Detection Using Random Classifier' [1], the author Meylin Herrera aims to develop an automatic landslide detection method from satellite image in combination with machine learning. The method consist of cloud-free images and determination of suitable feature for image segmentation and image classification. For image segmentation the method uses two approaches, first approach involves over segmentation of dataset and second involves algorithm using NDVI. The use of platforms such as Google Earth Engine (GEE) allows public access to dataset .The method uses entirely open source technology allowing its applicability and reusability.

In the paper 'Developing a Hybrid Model For Disaster Prediction Using Machine Learning' [4], the author develop a hybrid natural disaster predicting model to predict the upcoming disaster scenario. The model uses artificial neural network (ANNs) as a machine learning technique for prediction purposes. The training dataset of ANNs includes historic natural disaster record and meteorological data. To build the model appropriate data mining and machine learning techniques are tested to enhance the accuracy and reliability of the prediction.

In the paper 'Average Rolling based Real-time Calamity Detection using Deep Learning' [9], the author develops a natural disaster detection system using satellite images and generate an alert automatically. The system can be implemented first, to process satellite image to prediction purposes and second to process satellite images for quick detection of affected regions during natural calamities. The system use satellite camera to predict the disaster. The proposed system can help the rescue community to predict the disaster in advance and to detect natural calamity such as landslides, flood etc. This system helps the research community to predict disaster in advance and to optimize the damages during disaster.

3. PROPOSED METHOD

The main intention is to detect natural disaster from satellite image. The process involves testing and validation of dataset. This includes image pre-processing, image segmentation and image classification. The pre-processing involves extraction of terrain image using Google Earth Engine. The image segmentation is implemented using k-means and classification algorithms. The image classification involves training dataset and testing.

Chart -1: Overall Design

The entire project is divided into mainly three sections, where we could process images and analyse these factors for prediction.

3.1 NDVI-Normalised Difference Vegetation Index

NDVI is used in monitoring vegetation and it provides better sensitivity than individual spectral band for green vegetation identification. In order to map forested and non-forested area, normalised difference vegetation index method has been used. NDVI is useful for describing temporal and spatial dynamics of vegetation. Higher the NDVI value, better be the photosynthesis activity and greater the vegetation cover. NDVI value ranges from -1 to +1. When you have a negative NDVI value its highly likely that its water bodies. On the other hand, if you have a NDVI value approximately to +1, it is likely that its dense green leaves with healthy vegetation. When NDVI is close to zero, it would be bare ground and there is no green leaves.

3.2 Avalanche Factor Estimation

The terrain parameter like slope, elevation, aspect, groundcover and curvature are the major factors responsible for avalanche release because variation in environmental stability depends upon small slopes. An elevation of the area varies from 1100m to 5000m and the slope inclination varies up to 550m. Avalanche incident shows a distinct distribution pattern across all slopes. Mostly avalanche analysis is carried to minimise the occurrence of slope failure or landslide. Avalanches are also greatly affected by ground cover type either forested or non-forested. Densely forest covered zone offers the best protection against avalanche failure. Hence this will reduce the impact of avalanche disaster in future.

3.3 Identification Of Water Sources

Identification of water bodies from satellite imagery has been widely explored in the recent past. Image processing method helps to identify the water sources using the data from satellite. Satellite data provides the best delineation of water bodies over varied size, but its time consuming, especially when training with high resolution data. Water area appear in RGB scale in input satellite image. To perform operation the image is converted into grey scale image and water area has different pixel intensity value than surrounding objects. The proposed method uses image segmentation to extract water areas from satellite images.

The proposed model is beneficial to disaster management authorities to understand the underlying mechanism for the occurrence of natural disasters and their by minimise the loss of damage caused to human life.

4. EXPERIMENTAL ANALYSIS

Natural disaster prediction of our proposed system consist of 2 phases; training phase and testing phase. The aerial images of pre-disaster and post-disaster is taken from Google Earth engine is taken as input images.

4.1 Training Phase

In this phase we create training datasets of pre-disaster, post-disaster and ground images. Dataset of pre-disaster and post-disaster are compared with ground images. The figure represents the satellite image of disaster affected area. The pre-processing of images are done before training to increase variation and reliability of disaster prediction. We label the training dataset as 0 or 1. 0 means no chance to occur natural disaster and 1 represent chance to occur disaster.

Fig -1: Before Disaster

Fig -2: After Disaster

4.2 Testing Phase

In this phase we evaluates the trained dataset and predicts the possibility of occurrence of disaster in particular area. The RGB channel of pre-disaster and post-disaster are merges into one image. Then evaluates the image for best prediction of natural disaster occurrence. The highest prediction value with label 1 is extracted and a polygon will be drawn. The drawn region refers to the disaster occurrence region.

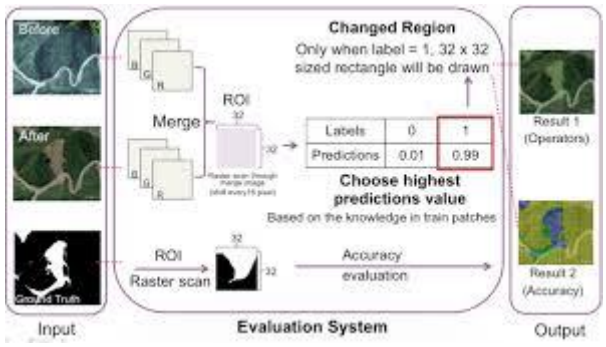

Fig -3: Test Phase Evaluation

5. SOFTWARE IMPLEMENTATION

• Django: Front End

User is requesting the image of the location. Based on the entered location the satellite image is collected for prediction.

• Tensor flow: Back End

The fetched image is analysed based on the factors slope, NDVI, etc. and these images are processed for further scanning for predicting the output. It is passing back the API into Django.

• SQLite: Database

The image analysis and prediction is managed by the database. It involves analysis of database and updation of database. Using the satellite image analyse the database based on API and allows data handling among several datasets.

• Google Earth Engine (GEE)

The Google Earth Engine is used to pre-process the dataset. It is a cloud based platform and and its parallel processing capacity makes it efficient to run spatial reduction over large image collections. It also helps in analysis of image sets of pre and post events.

• Python

It is used for the processing and visualization of the data. It is used for initial segmentation and generation of attribute tables for data processing.

6. HARDWARE IMPLEMENTATION

• 1 TB Hard disk
• 8 GB RAM
• Processor Intel i5 or above
• CPU speed 2 GHz

7. RESULT

The graph represents the accuracy over epochs trained. We use cross validation for training dataset. The occurrence of natural disaster like flood, soil erosion can change the overall composition of the soil and our system provides a better way to predict the occurrence of disaster.

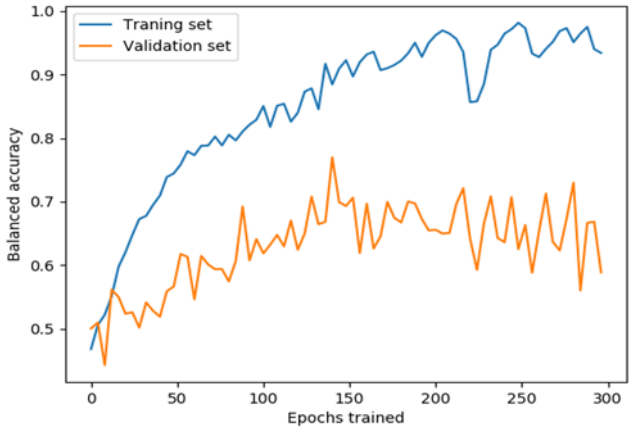

Chart -1: Training and Evaluation Accuracy

8. CONCLUSION

The proposed system helps to reduce the impact of hazards occur during natural disaster. This provides an efficient way to warn and educate people about disaster prone areas. Natural disaster possibility prediction helps to minimize loss of lives and loss of damages to mankind and the nature.

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