

Natural Disasters Intensity Analysis and Classification using Artificial Intelligence

ABSTRACT :

Natural disasters not only disturb the human ecological system but also destroy the properties and critical infrastructures of human societies and even lead to permanent change in the ecosystem. Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. Many deep learning techniques have been applied by various researchers to detect and classify natural disasters to overcome losses in ecosystems, but detection of natural disasters still faces issues due to the complex and imbalanced structures of images. To tackle this problem, we developed a multilayered deep convolutional neural network model. The proposed model works in two blocks: block-i convolutional neural network (b-i cnn), for detection and occurrence of disasters, and block-ii convolutional neural network (b-ii cnn), for classification of natural disaster intensity types with different filters and parameters. The model is tested on 4428 natural images and performance is calculated and expressed as different statistical values: sensitivity (se), 97.54%; specificity (sp), 98.22%; accuracy rate (ar), 99.92%; precision (pre), 97.79%; and f1-score (f1), 97.97%. The overall accuracy for the whole model is 99.92%, which is competitive and comparable with state-of-the-art algorithms.

PROJECT DESCRIPTION :

Natural disasters not only disturb the human ecological system but also destroy the properties and critical infrastructures of human societies and even lead to permanent change in the ecosystem. Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. Many deep learning techniques have been applied by various researchers to detect and classify natural disasters to overcome losses in ecosystems, but detection of natural disasters still faces issues due to the complex and imbalanced structures of images. To tackle this problem, we developed a multilayered deep convolutional neural network model that classifies the natural disaster and tells the intensity of disaster of natural. The model uses an integrated webcam to capture the video frame and the video frame is compared with the Pre-trained model and the type of disaster is identified and showcased on the OpenCV window.

TECHNOLOGIES USED :

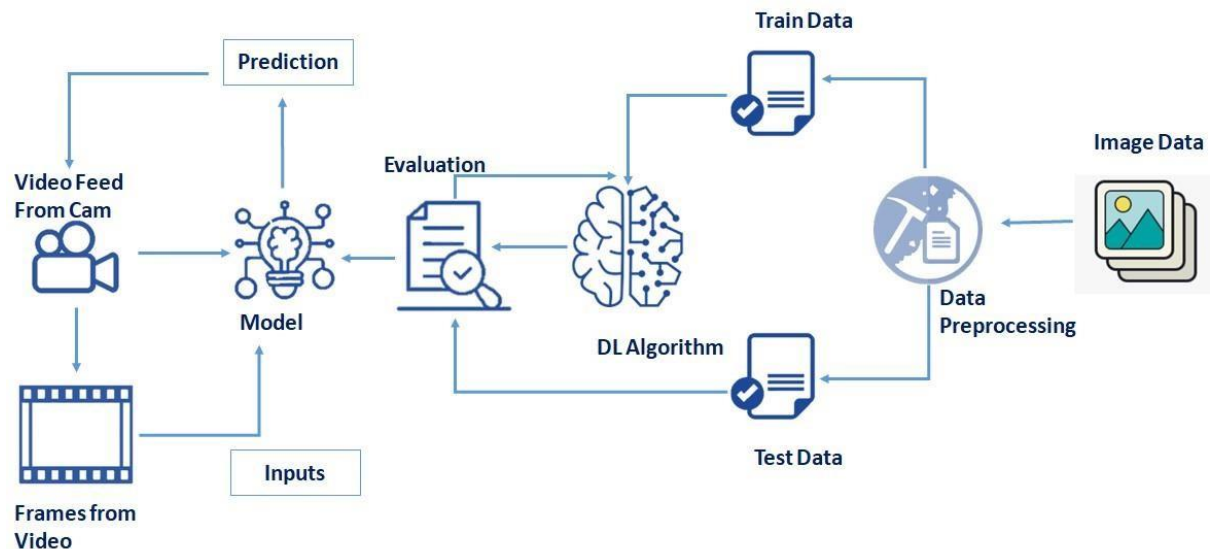
Python, CNN, IBM Cloud, IBM Watson Studio, IBM Cloudant DB, Deep Learning, PythonFlask.

METHODOLOGY :

This section defines the overall method for natural disaster intensity analysis and classification based on multispectral images using a multilayered deep convolutional neural network. Moreover, this method consists of two blocks of a convolutional neural network. The first block detects a natural disaster occurring and the second one defines the intensity type of the natural disaster. Additionally, the first block consists of three

miniconvolutional blocks with four layers each, including an image input and fully connected layers. On the other hand, the second block also consists of three miniconvolutional blocks with two layers each and includes an image input layer and fully connected layer.

PROJECT ARCHITECTURE :



LITERATURE SURVEY :

1. Natural Disasters Intensity Analysis and Classification Based on Multispectral Images Using Multi-Layered Deep Convolutional Neural Network

Natural hazards pose significant risks throughout the world. They are among the deadliest disasters. These events cause significant economic damage as well, with losses from a large tropical cyclone impacting a developed nation approaching or, at times, exceeding U.S. \$100 billion.

Risk analysis is, in broad terms, a systematic process aimed at understanding the nature of risk in a given situation and expressing the risk together with the underlying knowledge base. The primary focus is on artificial intelligence, machine learning, and statistical methods. The proposed model works in two blocks: Block-I convolutional neural network (B-I CNN), for detection and occurrence of disasters, and Block-II convolutional neural network (B-II CNN), for classification of natural disaster intensity types with different filters and parameters.

2. Tropical Cyclone Intensity Estimation Using Multidimensional Convolutional Neural Network From Multichannel Satellite Imagery

Tropical Cyclone is a severe storm that occurs over the tropical ocean. TC intensity is one of the key parameters for TC prediction and disaster prevention. Accurate estimation of TC intensity is important to theoretical research studies and practical applications. Inspired by the success of deep learning technology in various fields, recent attempts for TC intensity estimation focus on designing effective convolutional neural network (CNN).

3. Designing Deep-Based Learning Flood Forecast Model With ConvLSTM Hybrid Algorithm

Early detection of natural disasters such as floods can greatly assist humans in reducing the extent of the damage caused by such events. In the Fiji Islands, where this study is focused, recent flood events resulted in major damages amounting to millions of dollars. The loss of at least 225 lives during the 1931 flood event in Fiji was primarily due to the unavailability of efficient flood warning systems.

One simple, yet a robust mathematical tool used to determine the flood state at a particular time for a given area is the Flood Index (IF). A model is developed Develop multi-step predictive model using ConvLSTM, as an objective model, with alternative methods of LSTM, CNN-LSTM and SVR that can also determine the flood state.

4. A Conformal Regressor With Random Forests for Tropical Cyclone Intensity Estimation

Tropical Cyclone is an intense vortex system that originates over the tropical ocean and is one of the most destructive natural disasters. TC intensity usually refers to the maximum wind speed near the TC center. TC intensity is an important indicator to quantify the destruction potential.

The basic idea of using satellite data to estimate the intensity is that the cloud pattern strongly correlates with the TC intensity in the image. It is considered an excellent way to extract features from satellite images to estimate TC intensity. The most common technique is the Dvorak technique. The Dvorak technique tried to estimate the TC intensity using visible or infrared images based on the cloud structure.

Various machine learning models have also been applied to TC intensity estimation. Among them, the most widely used was the linear regression model.

5. Rainformer: Features Extraction Balanced Network for Radar-Based Precipitation Nowcasting

Precipitation nowcasting task is one of the basic challenges in meteorological research. It aims at predicting the rainfall intensity in the future 0–2 h by using specific meteorological information. It has an enormous application range related with human beings. Precipitation nowcasting methods can be roughly divided

Into numerical weather prediction (NWP) and extrapolation-based methods. NWP relies on vast complex meteorological data as input data and requires an expensive computing resource. At this point, radar extrapolation-based methods may be a good choice. It does not need other meteorological information and only uses several radar maps/frames to predict future radar maps.

Convolutional long short-term memory (ConvLSTM) is the first ConvRNN-based method applied to the precipitation nowcasting field to the best of our knowledge. Due to the structure of long short-term memory (LSTM), the ConvRNN-based methods can memorize the past information and effectively capture the movement trend and rainfall intensity variation of rainfall. Although many prior works are superior to traditional algorithms, several issues remain.

RESULT AND DISCUSSION :

The proposed multilayered deep convolutional neural network was simulated on the computer system with Core i7, Central Processing Unit (CPU) 2.8 Ghz with 16 GB RAM in MATLAB 2018a and different types of results were calculated.

References :

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