Natural Disasters Intensity Analysis and Classification using Artificial Intelligence

Abstract

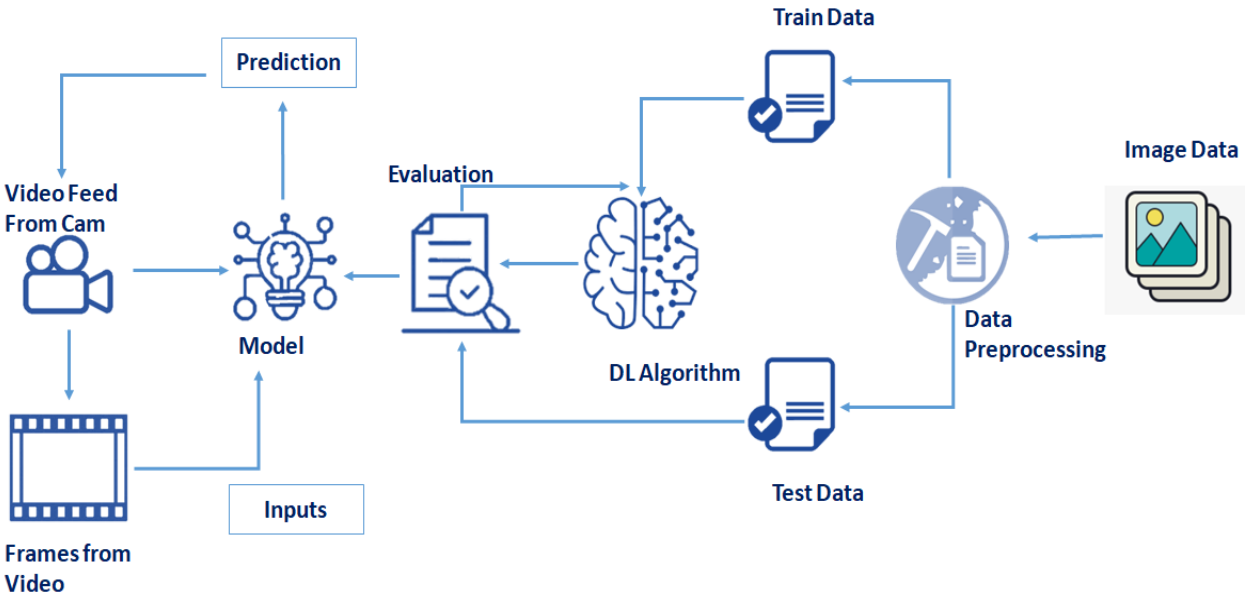
Natural disasters not only disturb the human ecological system but also destroy the properties and critical infrastructures of human societies and even lead to permanent change in the ecosystem. Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. 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 propose a multilayered deep convolutional neural network. The proposed model works in two blocks: Block-I convolutional neural network , for detection and occurrence of disasters, and Block-II convolutional neural network, 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 , 97.54%; specificity, 98.22%; accuracy rate (AR), 99.92%; precision (PRE), 97.79%; and F1-score, 97.97%. The overall accuracy for the whole model is 99.92%, which is competitive and comparable with state-of-the-art algorithms.

Introduction

Problem

Earthquake prediction ,the gail of Siesmology,is,in this context continues exiting discoveries,an obvious choice for deep learning exploration. We reviewed the literature of artificial neural network (ANN) applications for earthquake prediction (77 articles, 1994-2019 period) and found two emerging trends: an increasing interest in this domain over time and a complexification of ANN models toward deep learning

System Architecture



Methodology

Artificial neural network(ANN),Neural Network,Particular machine learning

The methodology of Natural Disasters Intensity Analysis and Classification using Artificial Intelligence is based on the video between two frames .That which taken before and after the natural disasters.Then the videos are compared with current satelite frames.The next stage of video will be considers as a model by prediction.By taken inputs from video,model will be move to evaluate.

evaluation of the frames will be tested by deep learning (DL) algorithm.

The output of the DL algorithm test gives the result of data preprocessing.The data preprocessing is consider as the image data.

The output(image data) is used to calculate the intensity of natural disaster.

Features

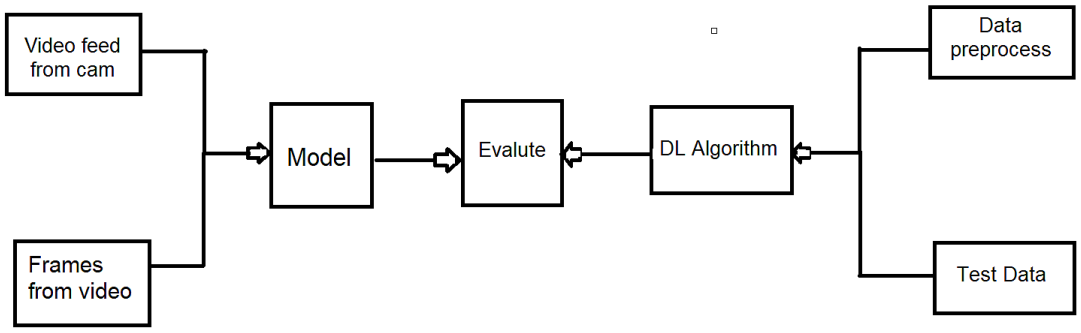
Using this methodology we can predict the intensity of natural disaster

Software requirements

- Python
- CNN
- IBM Cloud
- IBM Watson Studio
- IBM Cloudant DB
- Deep Learning
- Python-Flask

Project usecase

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. The overall flow of methodology is shown in figure and explained below.



Existing solutions

Awareness, education, preparedness, and prediction and warning systems can reduce the disruptive impacts of a natural disaster on communities. Mitigation measures such as adoption of zoning, land-use practices, and building codes are needed, however, to prevent or reduce actual damage from hazards.

Technical papers

In our research, the dataset used was collected from PyImage Search readers, who used Google Images to collect the total number (4428) of images in different classes. The dataset was separated into four classes: cyclone, earthquake, flood and wildfire, with 928, 1350, 1073 and 1077 images, respectively. The dataset was preprocessed to remove the noise by using an adaptive histogram equalizer. The whole dataset was divided into three groups: training, testing and validation. In total, 60% of the dataset was used for training, 23% for testing and 17% for validation. These percentages of the dataset were used to inform the machine on the percentage values of the dataset to be used for testing, training and validation purposes. The validation set was used to count the number of epochs for the whole training process

Research publications

Studies analyzing the intensity of natural disasters have gained significant attention in the current decade. A. Ashiquzzaman et al. Utilized a video source for fire detection; processing video sources is a feasible task due to convolutional neural networks (CNNs), which require high performance computational resources including graphics hardware, and thus a smart and cost-effective fire detection network is proposed based on architecture of convolutional neural networks.

In convolutional neural networks, a model to detect wildfire smoke named wildfire smoke dilated dense net was proposed by Li et al. Consisting of a candidate smoke region segmentation strategy using an advanced network architecture. Mangalathu et al. [8] performed an evaluation of building clusters affected by earthquakes by exploring the deep learning method, which uses long short-term memory.

Conclution

Many researchers have attempted to use different deep learning methods for detection of natural disasters. However, the detection of natural disasters by using deep learning techniques still faces various issues due to noise and serious class imbalance problems. To address these problems, we proposed a multilayered deep convolutional neural network for detection and intensity classification of natural disasters. The proposed method works in two blocks—one for detection of natural disaster occurrence and the second block is used to remove imbalanced class issues. The results were calculated as average statistical values: sensitivity, 97.54%; specificity, 98.22%; accuracy rate, 99.92%; precision, 97.79%; and F1-score, 97.97% for the proposed model. The proposed model achieved the highest accuracy as compared to other state-of-the-art methods due to its multilayered structure. The proposed model performs significantly better for natural disaster detection and classification, but in the future the model can be used for various natural disaster detection processes