HX8001-PROFESSIONALREADLINESS FOR INNOVATION,EMPLOYABILITY AND ENTPRENEURSHIP

NATURAL DISASTER INTENSITY ANALYSIS AND CLASSIFICATION USING ARTIFICIAL INTELLIGENCE

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INTRODUCTION :

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 (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.

As the population is growing rapidly, people need to acquire land to live on, and as a result the ecosystem is disturbed horrifically, which causes global warming and increases the number of natural disasters. Populations in underdeveloped countries cannot afford damages disasters cause to infrastructures. The aftermath of disasters leaves the humans in miserable situations, and sometimes the devastating effects cannot be detected; additionally, rescue operations cannot take place in most of the places and victims are unable to be identified due to geographical factors of the different areas. Disasters such as forest fires spread rapidly in dense areas, so firefighting is difficult to carry out; in this case, development of the strategy to predict such circumstances is crucial so that such disasters can be prevented beforehand.

A deep learning method for the reconstruction of two-dimensional cardiac magnetic resonance images was proposed to enhance the image data acquisition process. Cascade deep convolutional neural networks use a 10-fold method to reconstruct the feature map for the MR images. In this way, feature extraction sequence becomes very fast and it takes less than 5 to 10 s to extract the feature matrix.

OVERVIEW:

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

Natural disasters are unpredictable events, Hartawan enhanced multilayer perceptron algorithm by including convolutional neural network implemented on raspberry pi to find out the victims of natural disasters using streaming cameras and to aid the evacuation team to rescue the disaster victims. proposed applying automatic natural disaster detection to a convolutional neural network using the features of disaster from resized satellite images of landslide and flood detections.

Aerial images are able to show more specific and wider surface area of the ground, which helps acquire a vast amount of information about the occurrence of disaster. Social media networks such as Twitter where people share their views and information have been used as data sources to carry out disaster analysis. S. It is used the information related to earthquake shared by users on Twitter as a dataset and input it to the real time event detection system based on convolutional neural networks.

REQUIREMENT:

Using the two-layer architecture of a convolutional neural network (CNN), an efficient feature extraction method was applied to the extended Cohn-Kanade dataset to compare three object recognition techniques: linear support vector classification, linear discriminant analysis and softmax. More than 90% performance rates, with low standard deviations, were achieved by BoonsuK.

The use of manpower is difficult in case of natural disaster occurrence in hilly areas, and continuous electric power supply is highly affected in these areas due to maintenance issues of transmission lines. Therefore, in this case autopilot aerial equipment is used to gather images, and hidden content from aerial images needs to be identified in case of natural disasters such as landslides and heavy snowfall. removed the noise from raw aerial images and extracted disaster characteristics using the interframe difference technique; they implemented a convolutional neural network to analyze the type of disaster. In some regions, disasters such as earthquakes are inclined to occur due to geographical factors.

To locate the victim in a short time is crucial; acquired aerial images, and locating the victims was made possible by using a dedicated ground station server and proposed victim detection framework based on convolution neural networks. A simulation of real calamities was developed to test the framework.

TECHNICAL ARCHITECTURE:

Implementation of a CNN module made it possible to successfully achieve the detection of an earthquake and its announcement by the government beforehand using information-based tweets. As the tweets provide a significant amount of information, Madichetty et al. [12] implemented a convolutional neural network to perform feature extraction on informative as well as noninformative tweets, categorizing dataset containing tweets by an artificial neural network.
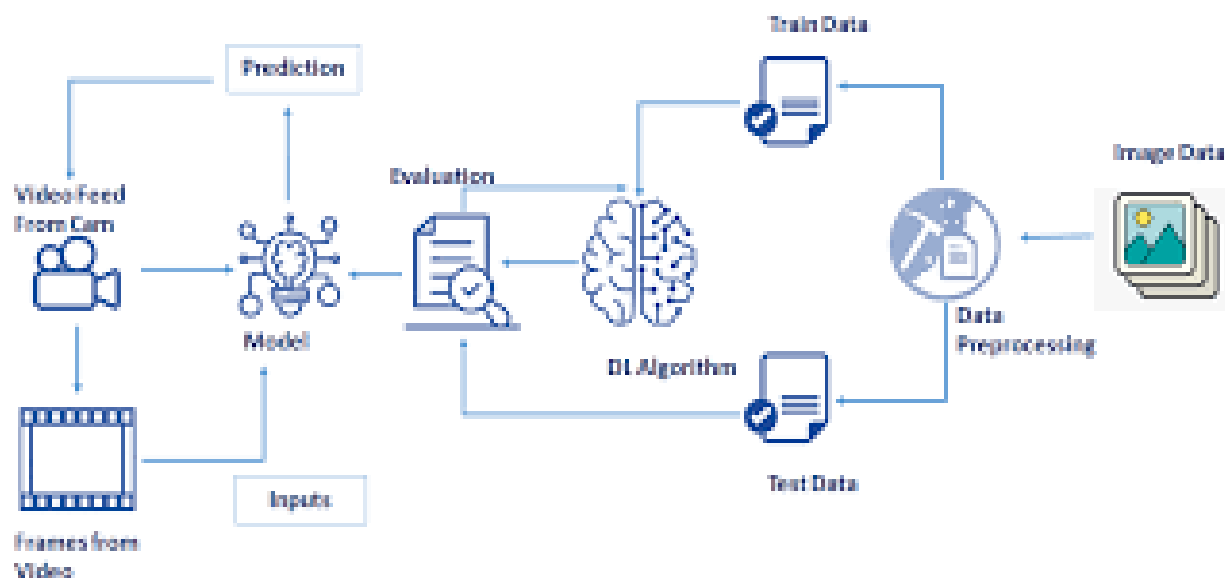
The accuracy of the proposed system is improved by feeding previous encoding outputs to the decoding layers and combining them. Several data mining application were implemented using contents of

social media; user generated content helps in disastrous events to gain vast amount of information. The CNN model is used to extract flood images from raw images and color filters are used to refine the desired detection. In the work of Layek et al. [25], the proposed system's efficiency and accuracy were tested on several datasets and it outperformed other methods to give the highest results. The proposed multilayered convolutional neural network in this research is used to detect and classify the natural disasters, as explained in the methodology section. Moreover, a comparison of the some of the state-of-the-art methods.

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.
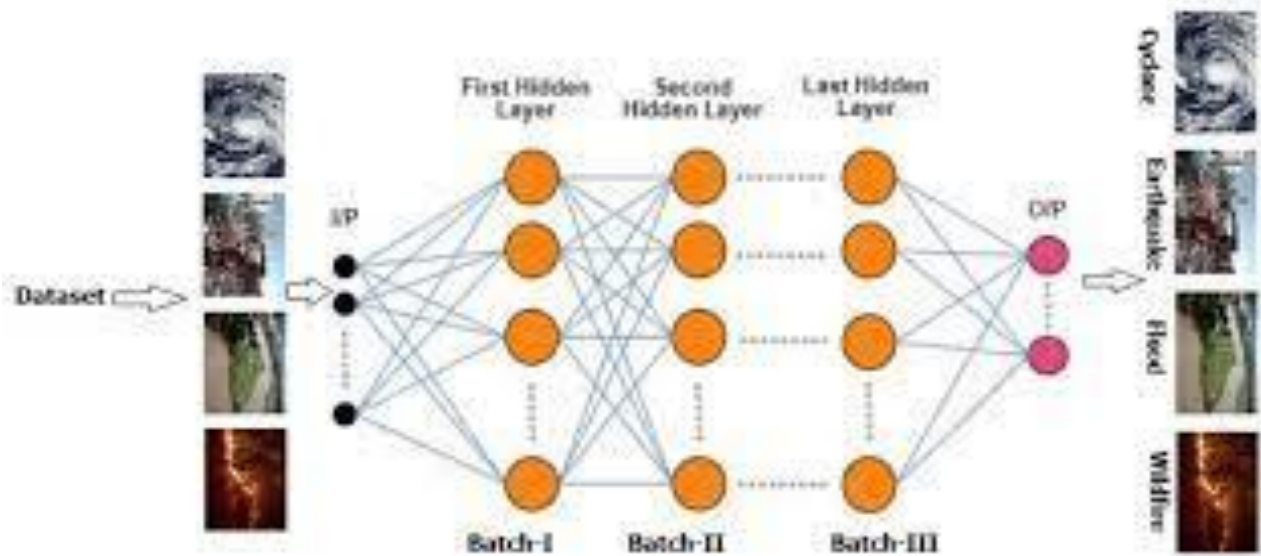
Figure 1. Diagram and architecture of multilayered deep convolutional neural network.

Reference	Methodology Name	Outcomes	Weakness
[26]	Signal processing, image processing and statistical technique	More accurate prediction of natural disasters	Limited statistical parameters for prediction
[27]	Particle swarm optimization	Predict magnitude of earthquake	Work only for prediction on seismic dataset
[28]	Neural network	Predict magnitude of earthquake	Limited parameters used for prediction
[29]	Text mining, regular log mining technique	Detect earthquake with speed and accuracy on seismological data	Depends on public feedback to detect earthquake
[30]	Decision tree	Utilize some parameters to access the model for flood damage area detection	Parametric limitation for the detection of flood damaging regions
[31]	Artificial neural network, genetic algorithm and wavelet transfer technique	Sum-up good results as compared to the already existing techniques in the southeast Asia	Work for monsoon floods in June and September for specific regions in India for time series data
[32]	Support vector machine, naïve Bayes	Classify the natural disasters on various parameters	Limited for only early stages of natural disasters

BLOCK-I CONVOLUTIONAL NEURAL NETWORK:

According to block-I of the convolutional neural network, only a detection process occurred in this phase. However, this block also consists of three small batches having four layers each. Moreover, an image input layer and fully connected layers are present. Additionally, some parameters are also defined with learning rate 0.001 and epoch size 40.
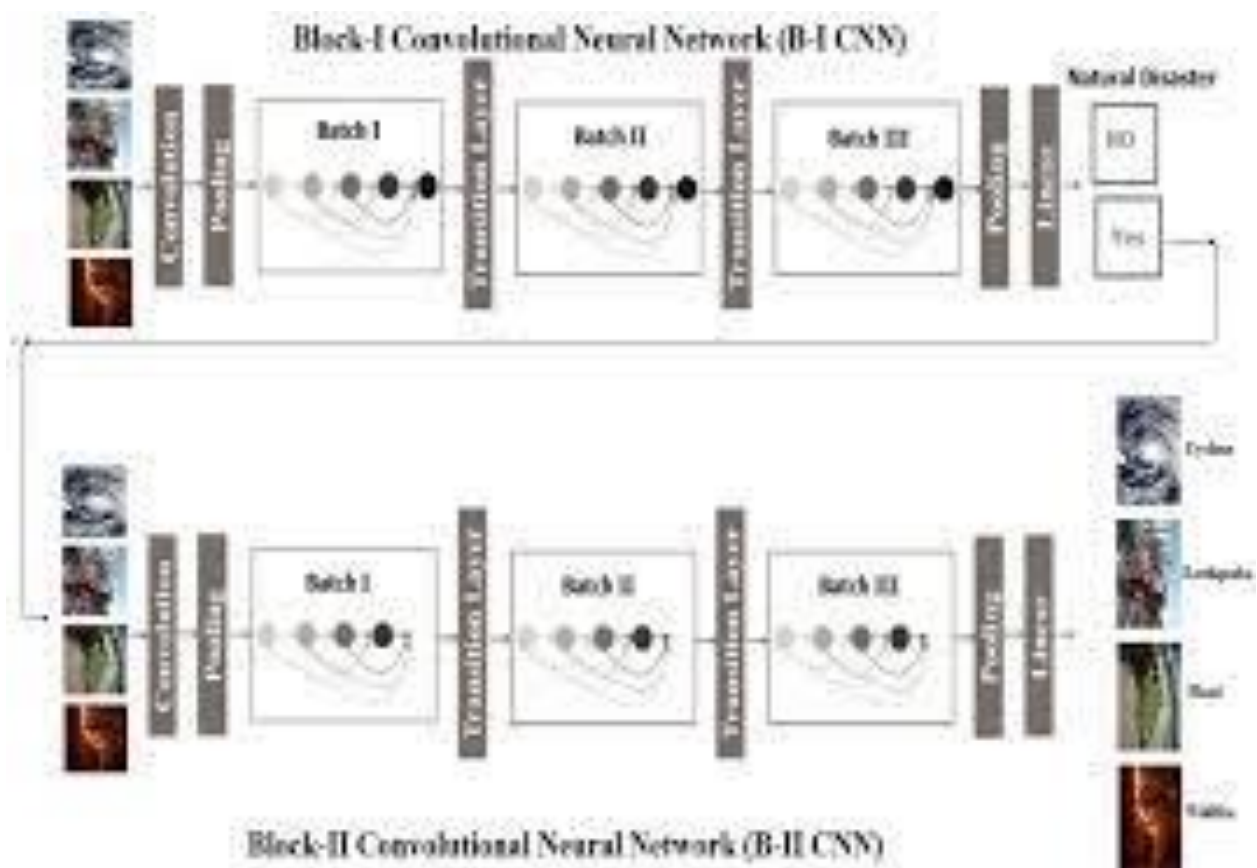
BLOCK-II CONVOLUTIONAL NEURAL NETWORK:

              The block-II convolutional neural network takes the output from the first block and finds the types of natural disaster with intensity. Moreover, this block also consists of three minibatches having three layers each with two extra layers such as image input and fully connected layers. Additionally, the same parameters as block-I have been defined for this block also.

APPLICATION OF AI:

DATASET:

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.

Confusion Matrix

The proposed model shows better accuracy as compared to the recently developed techniques. The reason for this is that the proposed technique works in two parts: one for natural disaster occurrence detection and the second one for natural disaster classifications. The overall proposed model works on an image dataset to detect and classify the natural disasters.

As the model is evaluated on a simple central processing unit (CPU)-based system, it only detects disaster types and then classifies them into cyclone, earthquake, flood and wildfire classes. However, if this

model is run on a graphic processing unit (GPU)-based system in the future with real time sensors and monitoring power, then the proposed model will be used as a real time natural disaster detection model and provide some upcoming predictions for future disasters.

The main purpose of this model is to detect and classify the type of disaster with a high accuracy rate. To prevent natural disasters in the future, said model can be used to predict future disasters and take some action against heavy loss of human ecological systems and property.

CONCLUSION:

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.