

DETECTION OF HURRICANE AND CYCLONE USING CONVOLUTION NEURAL NETWORK.

-by Abhishek Joshi

The following web application is developed on the principle of detection of hurricanes and cyclone using the convolution neural network. Microsoft Azure platform is exclusively used to integrate Frontend and Backend of the web app. Popular programming languages such as HTML, PHP, PYTHON are used to make this project.

The project works as follows:

The project has a graphical Frontend which is an HTML based website:

<https://detectstorm.azurewebsites.net/> the frontend data to a graphical interface for the user to view and interact with data through digital interaction.

The use of CSS and PHP has been included as CSS is used for describing the presentation of Web pages, including colors, layout, and fonts. It allows one to adapt the presentation to different types of devices, such as large screens, small screens, or printers.

PHP is used to develop Static websites or Dynamic websites or Web applications, in this case, all forms request are handled by the PHP. Execution of python scripts is also handled by PHP.

The Convolution neural network is based on popular Tensorflow libraries. The model used in this projects is the popular inception-v3 You can use this model by retraining the last layer per your classification requirements. The namesake of Inception v3 is the Inception modules it uses, which are basically mini models inside the bigger model. The same Inception architecture was used in the GoogleNet model which was a state of the art image recognition net in 2014.

The process is done is the following way:

1. The user selects the desired image from the website provided(<https://worldview.earthdata.nasa.gov/>).
2. Then the user uploads the image through the upload button on the website(<https://detectstorm.azurewebsites.net/>).
3. This generates a PHP request that runs a background PHP script that uploads the chosen file to the server database. (or uploads the selected image to the backend)
4. Then user goes back to the previous page and clicks PREDICT button which then generates another PHP request but this time it executes the python script in the backend which feeds the image to the Pre-trained CNN model.
5. In turn, the script responds with result string which is printed on the page.

The core of this project is the Convolution neural network and the Real-time data which we are feeding.

For training the neural network I have used IBTrACS Dataset. IBTrACS contains global tropical cyclone best-track data, collected from agencies in every ocean basin. The project has been endorsed by the World Meteorological Organization as the official archiving and distribution resource for best-track data. The data were collected and processed by the IBTrACS group at the NOAA National Centres for Environmental Information (NCEI) in Asheville, NC.

Currently, the neural network is trained with about 100 images for both positive and negative cases. And the hyperparameters are set as follows: -

steps of training are 100

input height=299

input width=299

input layer = "Placeholder"

The input image fed by the user is the image of the real-time satellite image of cloud formation obtained from the website(<https://worldview.earthdata.nasa.gov/>) This is an authentic website hosted by NASA to obtain real-time satellite images. These images are very power potential datasets which can be used further for training such types of neural networks.

Advantages:

- The convolutional neural network is used to forecast, track movement and intensity of the cyclones, by using the coordinates of the cyclones. **By this new technology, we can bring down average operational forecast error from 24 hrs to Real-time tracking.**
- Convolutional Neural network takes input data in the form of image and produces output in the form of result percentage without human intervention during processing which further increases Accuracy by reducing human error.
- As image fed is a Real-time satellite data the prediction of cyclone and hurricanes is possible at a real time. Which is very beneficial as seen from the point of disaster management. According to the disaster management cycle. The Mitigation, Preparedness and Response steps can be taken successfully if the prediction is based on the real-time event. This could save a lot of lives as a community under threat can be warned in a very short amount of time. This would take disaster management to a whole new level.
- As the following application is in the form of a web application is accessible to a large population. Which in future will enhance the accuracy of the neural network used in the core of this project, as more and more real-time data is updated the accuracy of neural will increase as the data will be supplied as the training set for the neural network.
- Lightweight on frontend hence faster response at the frontend.

Limitations:

As of now, the CNN is trained with only a 100 images, due to lack of computational power on the web server, hence accuracy of this is CNN reduces by 10 percent in some case. In future updates the CNN will be trained on a powerful web server which will further improve its accuracy.

The valuable user image input is not stored on the server for retraining of the neural network as multi-threading networking is not implemented. In the future, a multi-threading approach will be used which will enable the user image input data to be stored on the server.

THE CURRENT STATE AND FUTURE DEVELOPMENT

Current state.

Currently, the web application is just a prototype which basic prediction capability of the neural network, the accuracy of neural network drops by 10 percent or less in some testing images.

The further mono-threading approach is used to develop the networking hence speed limitation occur when a lot of users are demanding the resource.

The CNN is trained with very only about 100 images.

Future updates.

- The neural network will be used for predicting speed and path of the cyclone by using the coordinates of the cyclone. This will provide advance and real-time information which will be very effective in disaster management.
- Improved UI made with advanced XHTML techniques.
- Multi-threading approach for networking.
- User image data set storage.
- Faster response from the backend.
- Input data will be automatically acquired based on the location of the user.