Organization: Indian Space Research Organization (ISRO)

NOWCASTING OF METEOROLOGICAL SATELLITE IMAGES USING AI/ML TECHNIQUES

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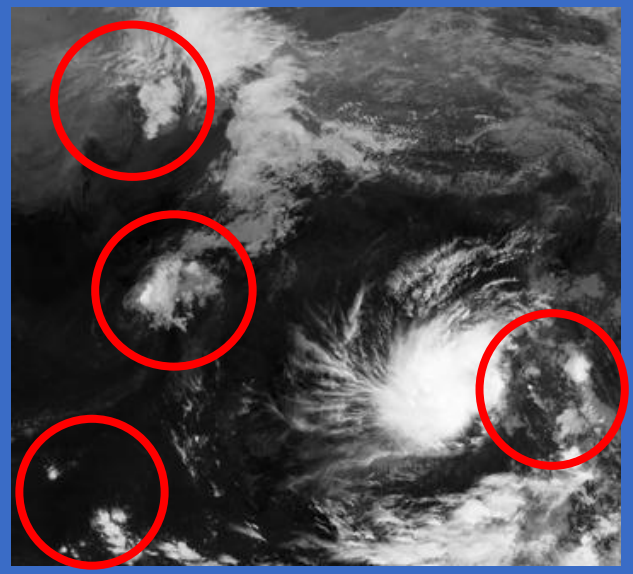
Category : Software

Domain : Miscellaneous

“Nowcasting of meteorological images will help in forecasting images for next 3 hrs. Develop an AI/ML based software to generate nowcasted satellite images and its animation loop for next 3 Hrs. at an interval of 30 Min. using data from INSAT-3D and INSAT-3DR.”

❖ Nowcasting of meteorological images

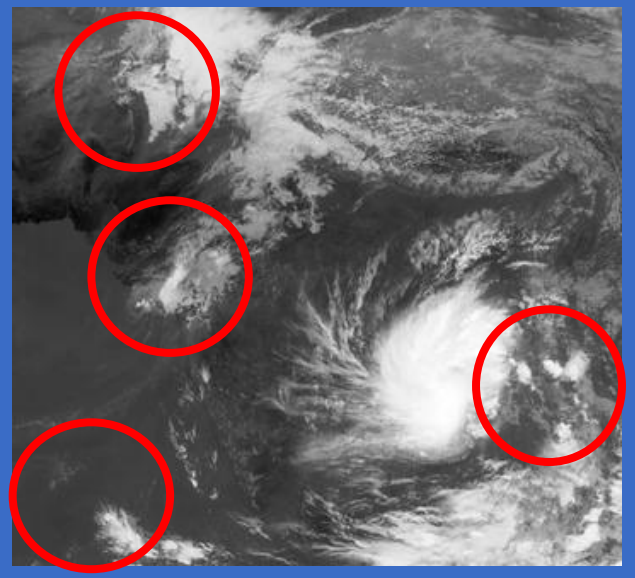
- Nowcasting is forecasting on a very short-term period of 3-6 hours
- It provides location-specific forecasts of weather events
- Allowing preparations specific for an emergency in a specific location
- Nowcasting can be achieved by solving complex Physics equations or extrapolation techniques
- Looking towards this problem from machine learning perspective which has yielded promising results



T(n-5)th Frame

Six such input images in sequence to predict

Spatio-temporal Pattern



T(n+6)th Frame

Future six image frames as output

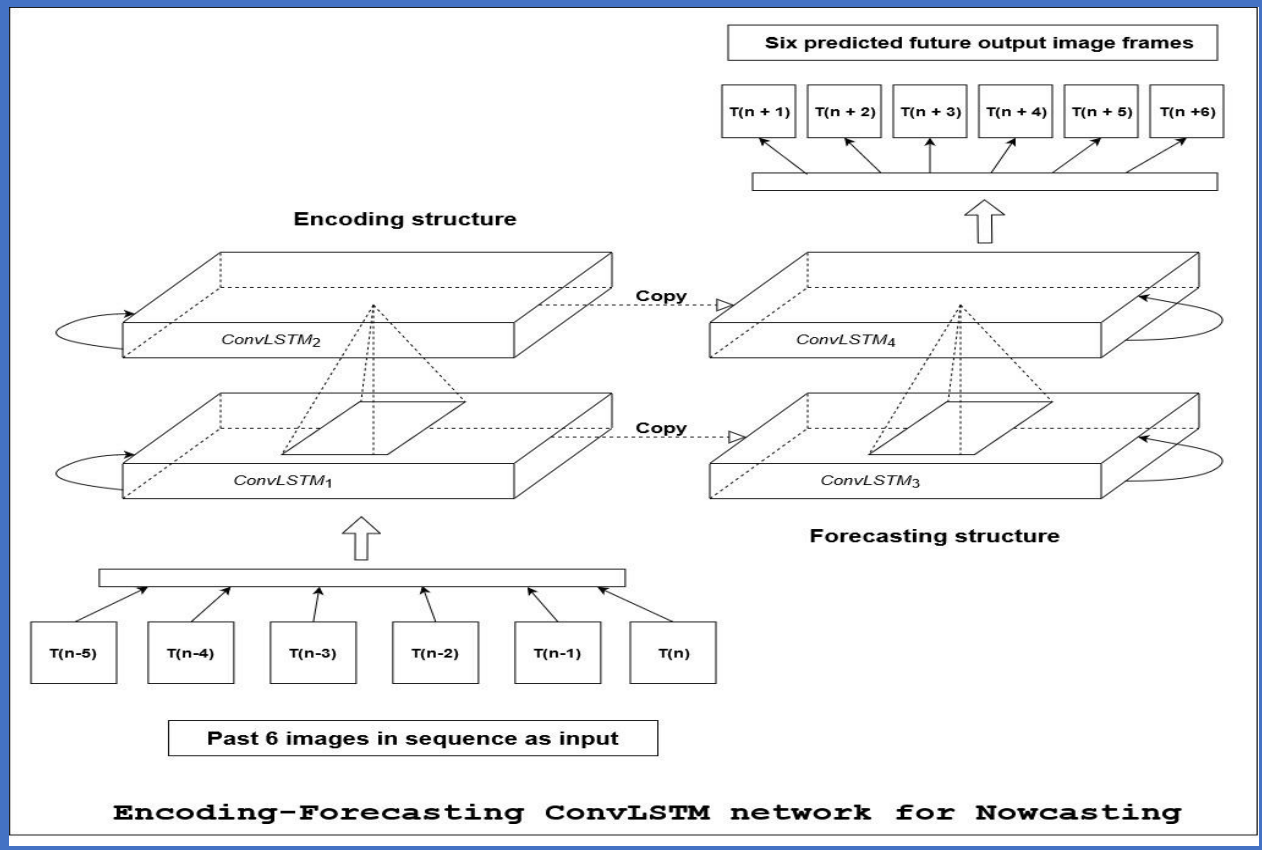
❖ IDEA

- Nowcasted data contains Spatio-temporal patterns, i.e. change in patterns w.r.t. time and space
- Nowcasting techniques are mostly applied on radar data and ConvLSTM technique has shown better results than CNN and FC-LSTM [1]
- ConvLSTM is an extension to LSTM which internally contains convolution operations.
- So the aim is to apply this concept on satellite images by building a deep learning model for predicting satellite image sequences up to lead time of 3-6 hours.

❖ SOLUTION

- ConvLSTM is superior in capturing spatio-temporal pattern.
- To capture this patterns effectively, an encoding-forecasting structure can be formed by stacking multiple ConvLSTM layers for prediction up to lead time of 3-6 hours.
- The model will take 6 present images as input to predict 6 future images as output.
- Mathematically it can be formulated as,

$$T[n-5,n] \longrightarrow T[n+1,n+6]$$



❖ TECHNOLOGY STACK

- Python will be used for pre-processing the data and building deep learning based model.
- Flask web framework will be used to encapsulate the model to provide dynamic functionality to its users.
- ConvLSTM a deep learning method is used for capturing spatio-temporal pattern and learning long-term dependencies.

❖ USE CASES

- Predict road conditions
- Weather guidance for aviation
- Urban rainstorm warnings
- Heat and cold waves

❖ SHOW STOPPER

- For spatiotemporal forecasting we utilized a new extension of LSTM called ConvLSTM
- ConvLSTM is suitable for spatiotemporal data due to its inherent convolutional structure
- ConvLSTM produces better results with fewer parameters compared to FC-LSTM network

❖ REFERENCES

1. Xingjian Shi, Zhourong Chen, Hao Wang, Dit-Yan Yeung, Wai-kin Wong, and Wang-chun Woo. Convolutional LSTM network: A machine learning approach for precipitation nowcasting in twenty-ninth conference on Neural Information Processing Systems(NIPS),2015