ಭಾರತೀಯ ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ ಸಂಸ್ಥೆ ರಾಯಚೂರು
भारतीय सूचना प्रौद्योगिकी संस्थान रायचूर
Indian Institute of Information Technology Raichur

Automated Cyclone Eye Localization: A Comparative Study

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CONTENTS

INTRODUCTION

- Tropical cyclones derive their primary energy from the evaporation of warm ocean waters .
- The storm is caused by the Coriolis Effect.
- Eyewall surrounds the calm, low-pressure "eye" seen in your satellite imagery.

USD 1.4 trillion

Economic losses caused by tropical cyclones during the 50-year period since 1970.

43 deaths

and USD 78M in damages caused by tropical cyclones and related hazards every day in the 50-year period since 1970.

200-500 km

The diameter of a tropical cyclone is typically around 200 to 500 km, but can reach up to 1000 km.

200%

Percentage of which the population of tropical cyclone-prone regions has increased.

AIM & OBJECTIVES

- Develop a robust HYBRID localization framework for cyclone eye detection
- Implement a multi-stage pipeline using Dynamic Normalization and hybrid segmentation.
- Conduct a comparative study between standalone DNN and hybrid-preprocessed models.
- Validate the proposed framework using unseen satellite datasets to ensure reliability.

METHODOLOGY

INPUT

output

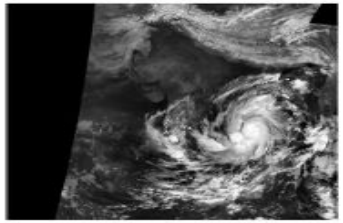
Raw Data Acquisition

Dynamic Normalization

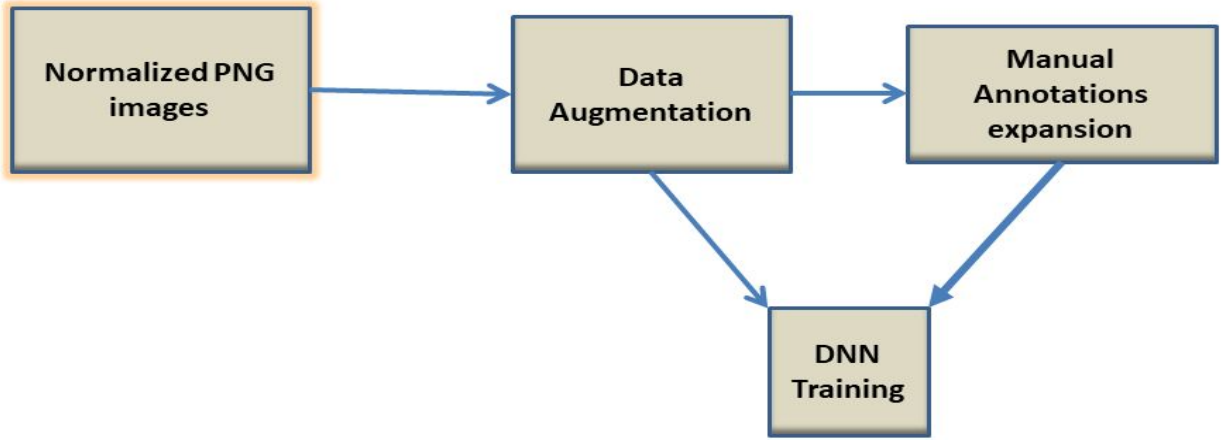
(0 to 10–255 Scaling)

Satellite TIFF images with temperature values

```
Image Analysis for: 20141009-194030Z-212000Z
▸ Minimum Intensity: 0
▸ Maximum Intensity: 255
▸ Zero Count (Black Pixels): 3,250,292
▸ Background Coverage: 16.54%
```

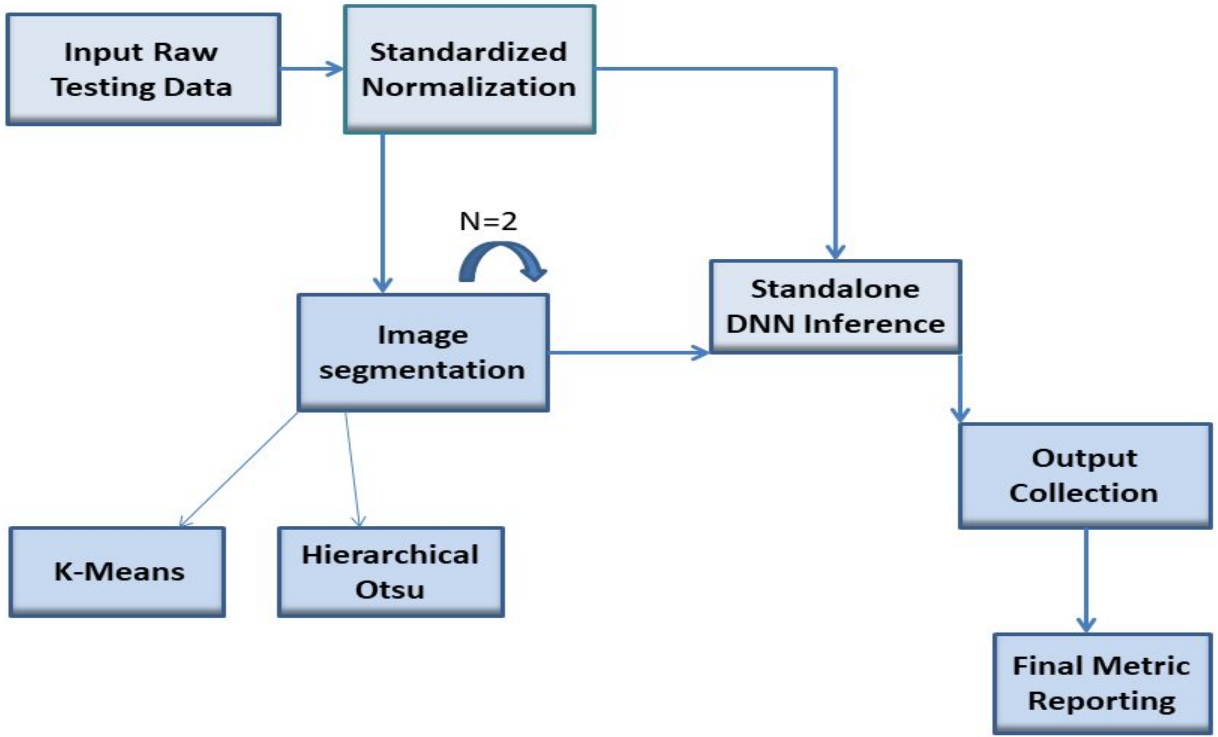


TRAINING PIPELINE



After the annotations were generated
Then the model will be trained along
With the images.

METHODOLOGICAL EVALUATION

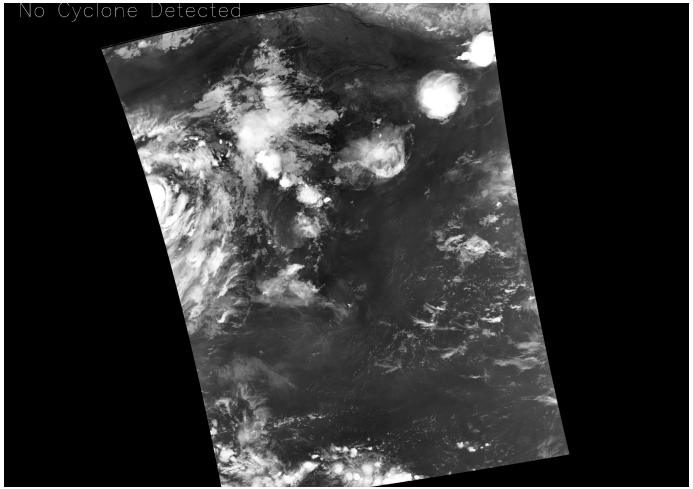


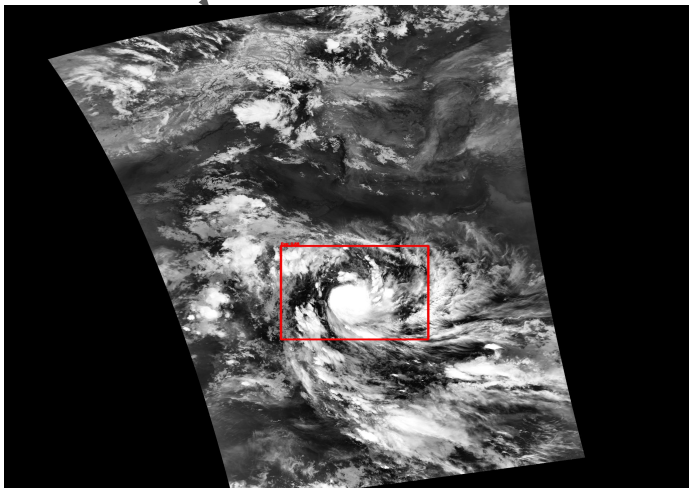
RESULTS

Inference on unseen data

If no

If yes





RESULTS

Method	**IOU(0-1) (mean ± SD)**	**CDE (Mean ± SD)**	**mAP@50**
DNN(YOLOV8)	0.469 ± 0.094	990.8 ± 969.7	0.533
DNN + Hierchical OTSU	0.569 ± 0.168	2227.7 ± 1593.5	0.500
DNN + k-means	**0.648 ± 0.247**	**1400.7 ± 2220.1**	**0.700**

- DNN (YOLOv8) baseline is satisfactory
- DNN + k-means architecture has performed the best among all tested variants

CONCLUSION

- This research successfully demonstrates that a Hybrid Deep Learning Framework significantly outperforms standalone deep neural network.
- in the localization of tropical cyclone eyes. By integrating K-Means(15.4% improvement) and Hierarchical Otsu preprocessing, we effectively eliminated land-based thermal interference, leading to more robust feature extraction by the YOLOv8 model.

REFERENCES

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Thank you..