REPORT

on

“Metadata extraction & Hotspot Detection”

by

Yathin G Kummar
(yathingkummar@gmail.com)

GITHUB REPOSITORY

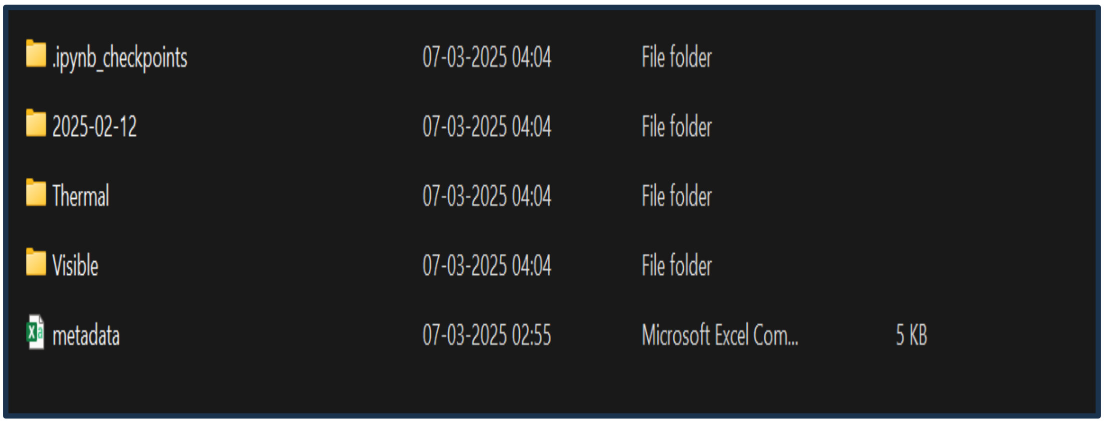
https://github.com/YathinGK/Hornbill_Transformer.git

Solution

Systematic Image Organization

To ensure efficient access and retrieval, images are systematically organized into:

- Classified Images/ → Categorized into:
  - Thermal/ (Infrared images for hotspot detection)
  - Visible/ (Standard RGB images for reference)
- Date_Wise_Images/ → Groups images by capture date for easy tracking.
- Geolocation-Based Naming → Images are renamed using latitude and longitude for quick identification.
- Metadata Storage (metadata.csv) → A structured file storing extracted metadata for reference.



.ipynb_checkpoints	07-03-2025 04:04	File folder	
2025-02-12	07-03-2025 04:04	File folder	
Thermal	07-03-2025 04:04	File folder	
Visible	07-03-2025 04:04	File folder	
metadata	07-03-2025 02:55	Microsoft Excel Com...	5 KB

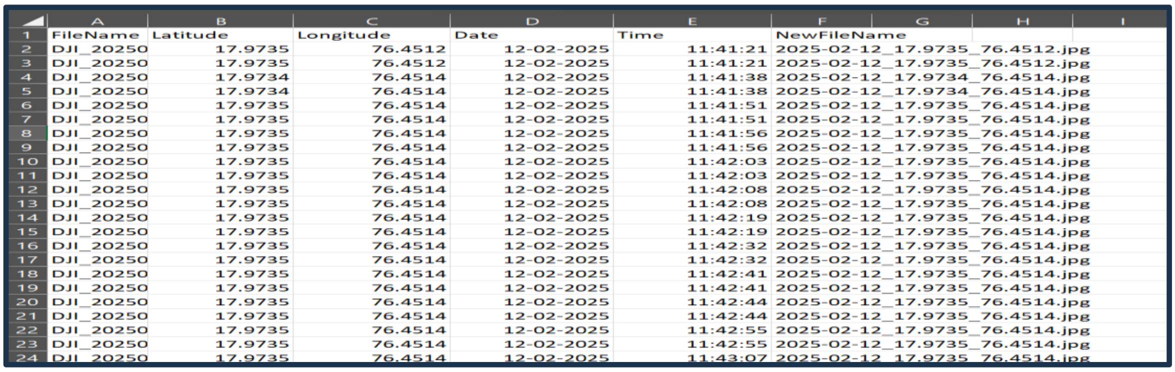
Fig 1 Output File Structure

Metadata Extraction Process

Metadata is extracted using **PIL (Pillow) and ExifTags**, retrieving:

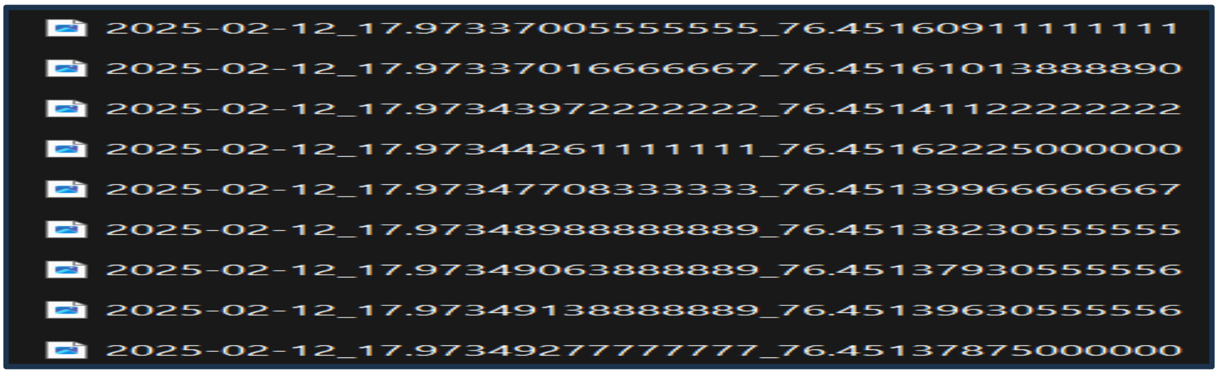
- **Date & Time** → Extracted from EXIF data.
- **GPS Coordinates** → Stored for location-based organization.
- **Filenames** → Renamed using metadata for consistency.
- **Image Category** → Classified as **Thermal or Visible** using AI.
- **Storage Paths** → Tracks image locations in structured directories.

Extracted metadata is stored in **metadata.csv** for easy tracking. **GPS coordinates** are converted to **decimal format** for accuracy, ensuring precise geolocation tagging.



	FileName	Latitude	Longitude	Date	Time	NewFileName
2	DJI_20250	17.9735	76.4512	12-02-2025	11:41:21	2025-02-12_17.9735_76.4512.jpg
3	DJI_20250	17.9735	76.4512	12-02-2025	11:41:21	2025-02-12_17.9735_76.4512.jpg
4	DJI_20250	17.9734	76.4514	12-02-2025	11:41:38	2025-02-12_17.9734_76.4514.jpg
5	DJI_20250	17.9734	76.4514	12-02-2025	11:41:38	2025-02-12_17.9734_76.4514.jpg
6	DJI_20250	17.9735	76.4514	12-02-2025	11:41:51	2025-02-12_17.9735_76.4514.jpg
7	DJI_20250	17.9735	76.4514	12-02-2025	11:41:51	2025-02-12_17.9735_76.4514.jpg
8	DJI_20250	17.9735	76.4514	12-02-2025	11:41:56	2025-02-12_17.9735_76.4514.jpg
9	DJI_20250	17.9735	76.4514	12-02-2025	11:41:56	2025-02-12_17.9735_76.4514.jpg
10	DJI_20250	17.9735	76.4514	12-02-2025	11:42:03	2025-02-12_17.9735_76.4514.jpg
11	DJI_20250	17.9735	76.4514	12-02-2025	11:42:03	2025-02-12_17.9735_76.4514.jpg
12	DJI_20250	17.9735	76.4514	12-02-2025	11:42:08	2025-02-12_17.9735_76.4514.jpg
13	DJI_20250	17.9735	76.4514	12-02-2025	11:42:08	2025-02-12_17.9735_76.4514.jpg
14	DJI_20250	17.9735	76.4514	12-02-2025	11:42:19	2025-02-12_17.9735_76.4514.jpg
15	DJI_20250	17.9735	76.4514	12-02-2025	11:42:19	2025-02-12_17.9735_76.4514.jpg
16	DJI_20250	17.9735	76.4514	12-02-2025	11:42:32	2025-02-12_17.9735_76.4514.jpg
17	DJI_20250	17.9735	76.4514	12-02-2025	11:42:32	2025-02-12_17.9735_76.4514.jpg
18	DJI_20250	17.9735	76.4514	12-02-2025	11:42:41	2025-02-12_17.9735_76.4514.jpg
19	DJI_20250	17.9735	76.4514	12-02-2025	11:42:41	2025-02-12_17.9735_76.4514.jpg
20	DJI_20250	17.9735	76.4514	12-02-2025	11:42:44	2025-02-12_17.9735_76.4514.jpg
21	DJI_20250	17.9735	76.4514	12-02-2025	11:42:44	2025-02-12_17.9735_76.4514.jpg
22	DJI_20250	17.9735	76.4514	12-02-2025	11:42:55	2025-02-12_17.9735_76.4514.jpg
23	DJI_20250	17.9735	76.4514	12-02-2025	11:42:55	2025-02-12_17.9735_76.4514.jpg
24	DJI_20250	17.9735	76.4514	12-02-2025	11:43:07	2025-02-12_17.9735_76.4514.jpg

Fig 2 Extracted Metadata in .CSV



```
2025-02-12_17.97337005555555_76.45160911111111
2025-02-12_17.97337016666667_76.45161013888890
2025-02-12_17.97343972222222_76.45141122222222
2025-02-12_17.97344261111111_76.45162225000000
2025-02-12_17.97347708333333_76.45139966666667
2025-02-12_17.97348988888889_76.45138230555555
2025-02-12_17.97349063888889_76.45137930555556
2025-02-12_17.97349138888889_76.45139630555556
2025-02-12_17.97349277777777_76.45137875000000
```

Fig 3 Image renames based on Date and GPS

AI Model for Image Classification

1. Model Architecture
A CNN (Convolutional Neural Network) was trained using TensorFlow/Keras to classify images as Thermal or Visible. The architecture includes:

- Convolutional Layers → Extracts key image features.
- Pooling Layers → Reduces complexity while preserving information.

2. Training and Performance

- Training → 10 epochs using the Adam optimizer.
- Accuracy → Over 95% on validation data.
- Deployment → Classifies newly uploaded images, automatically sorting them into Thermal or Visible folders.

Hotspot Detection in Thermal Images

Hotspot Detection Algorithm
To detect overheating or faults in transmission towers, a hotspot detection algorithm was implemented using OpenCV:

- Grayscale Conversion → Enhances heat variations.
- Gaussian Blur → Reduces noise.
- Thresholding → Isolates bright (hot) regions.
- Contour Detection → Identifies hotspots and marking

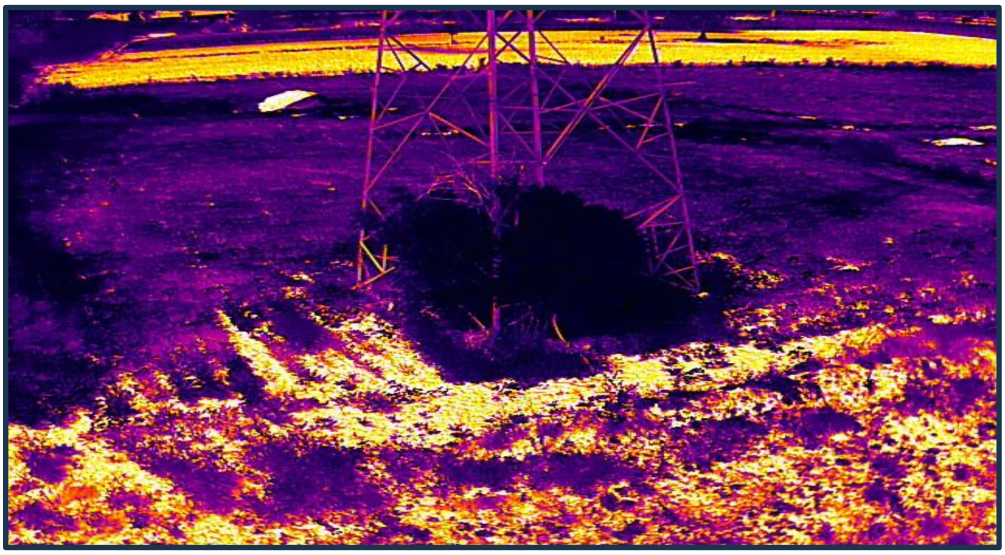


Fig 5 Image Before Hotspot Algorithm was applied

OUTPUT

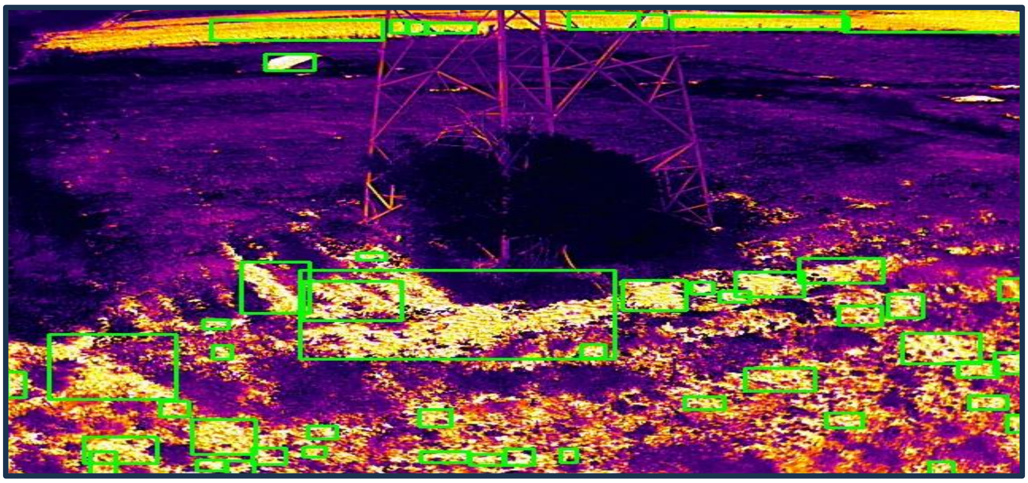


Fig 6 Hotspot Detection Using Algorithm

Optimizing the Workflow

The workflow was fully automated, handling metadata extraction, image classification, organization, and hotspot detection without manual intervention. The script ensures seamless processing, accurately storing images in structured directories while minimizing errors. This automation significantly enhances efficiency, making it ideal for large-scale datasets.

To improve accuracy and scalability, the AI model was trained with optimized hyperparameters, and image preprocessing techniques like Gaussian blur, adaptive thresholding, and morphological operations were applied for better hotspot detection. Future enhancements include cloud integration (AWS, Google Cloud), real-time API processing, parallel computing, and GPU acceleration to further boost speed and scalability for industrial applications