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DISCOVERY AND ANALYSIS OF EXIF DATA IN IMAGES

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Abstract: *With the rapid expansion of cybercrime, it has become important and urgent to begin conducting studies and research specialized in evaluating information saved and how is used in digital media metadata. The paper reviews how in many cases when a computer, phone, or mobile device is seized for evidence, the system will have graphic images that might be used as evidence. Digital images have stamps recorded as metadata written by its source. This could be a phone, camera or written on computer. Most digital devices "stamp" information on these graphic images that can tell us a lot about the who, what, when, and where the pictures were taken. This information is known as EXIF data and can very often be useful to the forensic investigator. The coordinates from the geolocation of the digital image can be reversed to display on maps.*

Keywords: *EXIF data, digital images, GPS, image forensics, image processing, image forgery detection, image metadata*

INTRODUCTION

In cases when a computer, phone, or mobile device is seized for evidence or is being stolen, the system will have graphic images that might be used with (Wang, J., Liu, G., Zhang, Z., Dainad, Y., & Wang, Z., 2009). Obviously, in some cases these graphic images may be the evidence. In other situations, the graphic images may 'share' information about where and when the person was somewhere specific (Boutell, M., & Luo, J., 2004).

Most digital devices "stamp" information on these graphic images that can tell a lot about the who, what, when, and where the pictures were taken (Safonov, I., Kurilin, I., Rychagov, M., & Tolstaya, E., 2018). This information is known as EXIF data and can very often be useful to the forensic investigator (Ali, S., Ganapathi, I., Vu, N., Ali, S., Saxena, N., & Werghi, N., 2022).

Exchangeable image file format (EXIF) is a standard that specifies formats for images, sounds and/or tags used by digital cameras, canners, smartphones, drones and other systems handling images and sounds recorded by digital cameras. The specification uses the existing encoding formats with addition of specific metadata tags.

EXIF is supported by all camera manufacturers. The metadata tags defined in the standard can be (Vailaya, A., Figueiredo, M., Jain, A., & Zhang, H., 2001):

- Camera settings, which includes information such as camera model, orientation, shutter speed, ISO speed and other information
- Image metrics, such as pixel dimensions, resolution, file size
- Date and time information, when the picture is taken
- Location information
- Description with user defined information
- Copyright information

As of 2014, many cameras and phones (smartphones) have built-in GPSD receivers that store location data, which can be extracted and used in malicious actions (Zhao, Q., Zuo, C., Pellegrino, G., & Zhiqiang, I., 2019). The pros and cons of the EXIF metadata tags are given in Table 1.

Table 1. Positives and negatives from the use of EXIF metadata tags

PROs	CONs
Carries copyright information even without watermark	Reveals camera settings and equipment used
Allows others to understand how the image was created	Can expose your location if photos are taken at your home
Shows the location of where the picture was taken	Increases file size, which can affect the website speed

EXPOSITION

ExifReader

Exif Reader is image file analysis software for Windows (EXIF Data Viewer, 2021). It analyses and displays the shutter speed, flash condition, focal length, and other image information included in the Exif image format which is supported by almost all the latest digital cameras. Exif image files with an extension of JPG can be treated in the same manner as conventional JPEG files.

Exif Reader can analyse some maker-specific formats such as Makernote. This software can display the image information in more details than any other Exif analysis software (EXIF Data Viewer, 2021).

Experimental Results

This section of the paper presents the methodology for the conducted experiments and the results that were obtained. Three images were used for the experimental evaluation of the presented Exif metadata:

- **DJI_0761.jpg** (Fig. 1) – with resolution of 4000 x 3000 pixels, saved GPS information, shutter speed, Date and time, manufacture and model;
- **IMG_20221026_103810.jpg** (Fig. 3) – with resolution of 4480 x 2016 pixels, saved GPS information, date and time, manufacture and model;
- **20221026_103550.jpg** (Fig. 5) – with resolution of 5312 x 2988 pixels saved GPS information, date and time, manufacture and model;

Depends from the manufacture, different information about the location can be extracted.

Extracting GPS data – DJI_0761.jpg

Fig. 4. Source image DJI_0761.jpg

Data extracted with ExifReader:

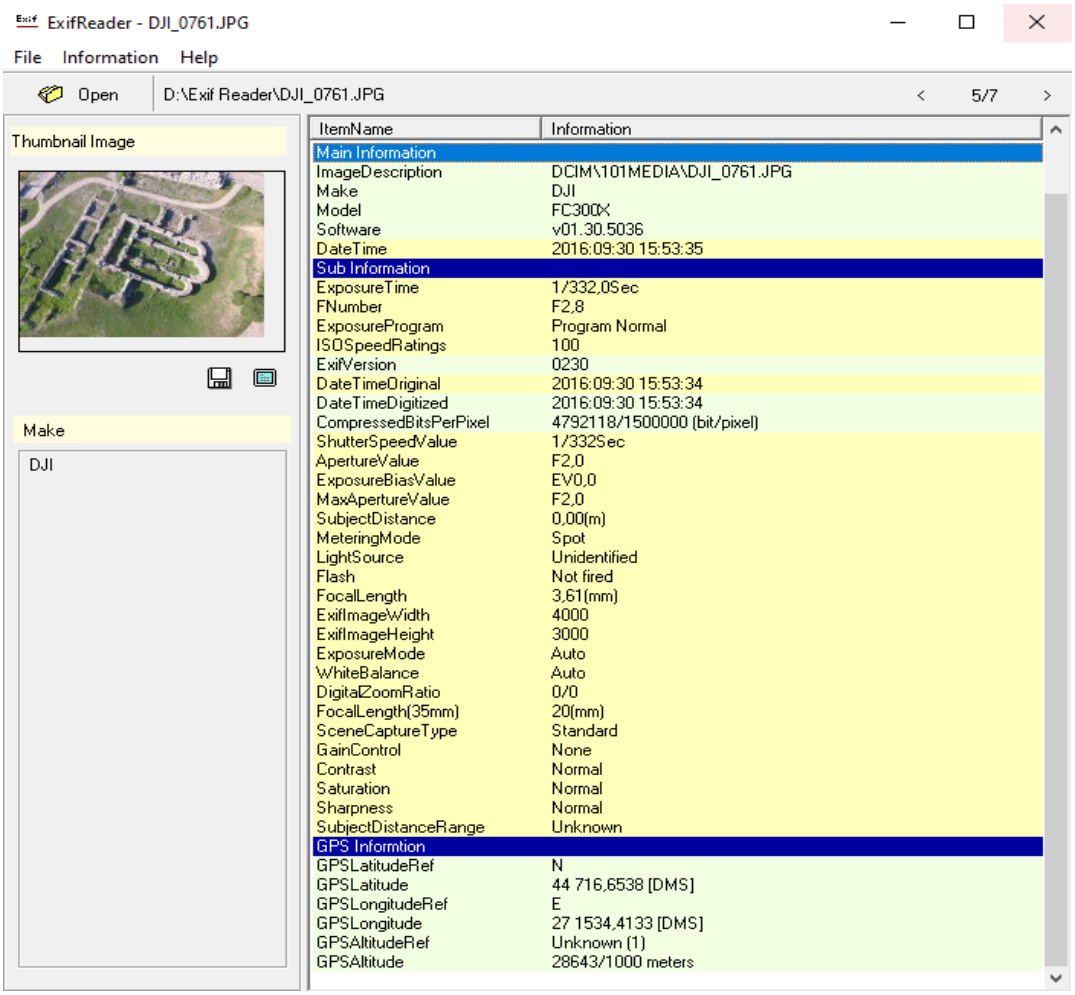

Fig. 5. Extracted information from DJI_0761.jpg

Extracted information from the image:

Main information:
- Manufacture → DJI
- Model → FC300X
- Date and time → 30. 09. 2016 15:53

Sub information:
- Resolution
- Shutter Speed
- Exposure
- Flash (active or not)

Location information:
- GPS Latitude: 44 716,6538 [DMS]
- GPS LatitudeRef: N
- GPS Longitude: 27 1534,4133 [DMS]
- GPS LongitudeRef: E
- GPS Altitude: 28643/1000 meters
- GPS AltitudeRef: Unknown (1)

Extracting GPS data – IMG_20221026_103810.jpg

Fig. 6. Source image IMG_20221026_103810.jpg

Data extracted with ExifReader:

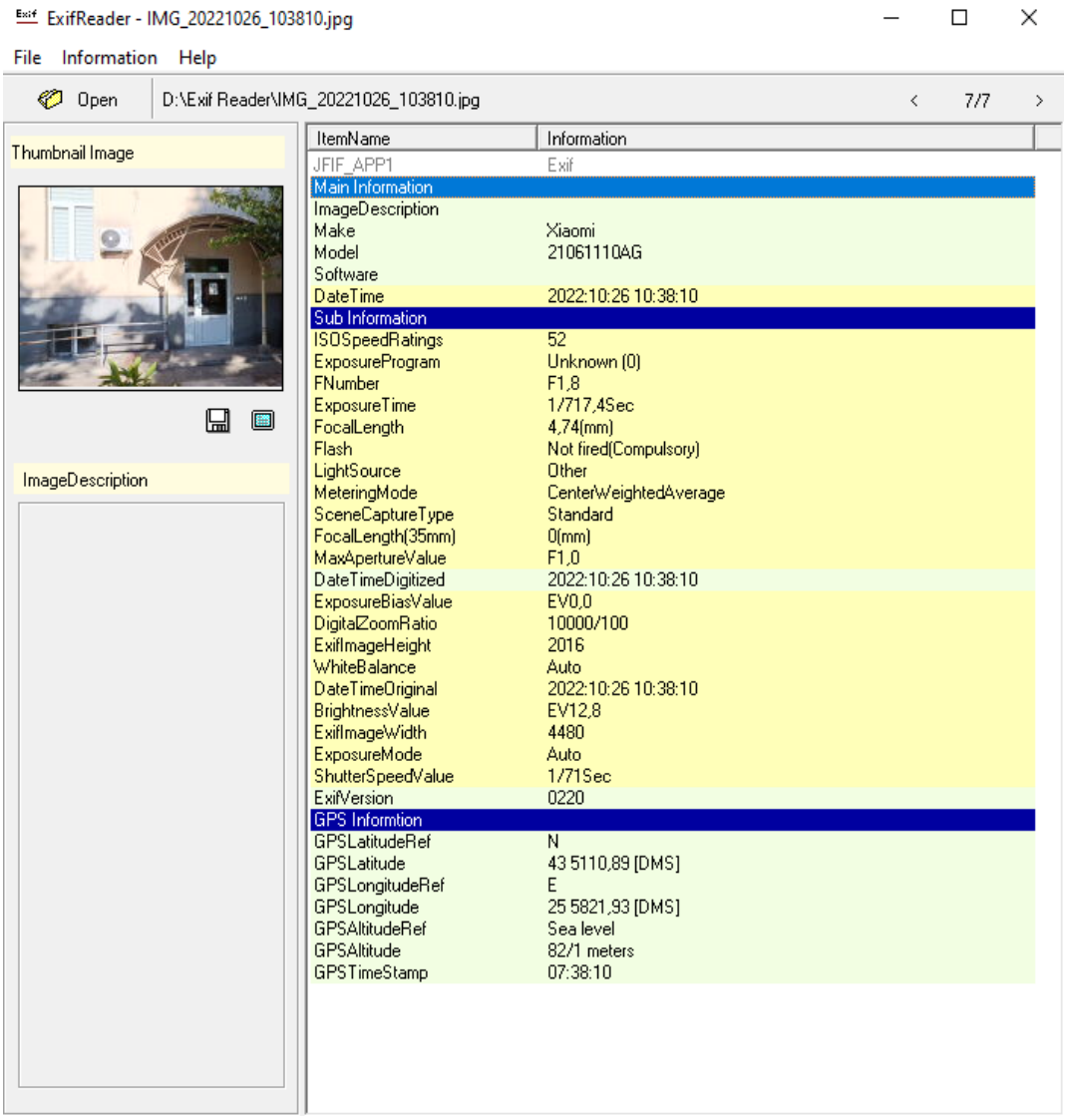

Fig. 7. Extracted information from IMG_20221026_103810.jpg

Extracted information from the image:

Main information:
- Manufacture → Xiomi
- Model → 21061110AG
- Date and time → 26. 10. 2022 10:38

Sub information:
- ISO speed
- Shutter Speed
- Exposure
- Flash (active or not)

GPS (Location) information:
- GPSLatitude: 43 5110,89 [DMS]
- GPSLatitudeRef: N
- GPS Longitude: 25 5821,93 [DMS]
- GPS LongitudeRef: E
- GPS AltitudeRef: Sea level
- GPS Altitude: 82/1 meters
- GPS TimeStamp: 07:38:10

Extracting GPS data – 20221026_103550. jpg

Fig. 8. Source image 20221026_103550. jpg

Data extracted with ExifReader:

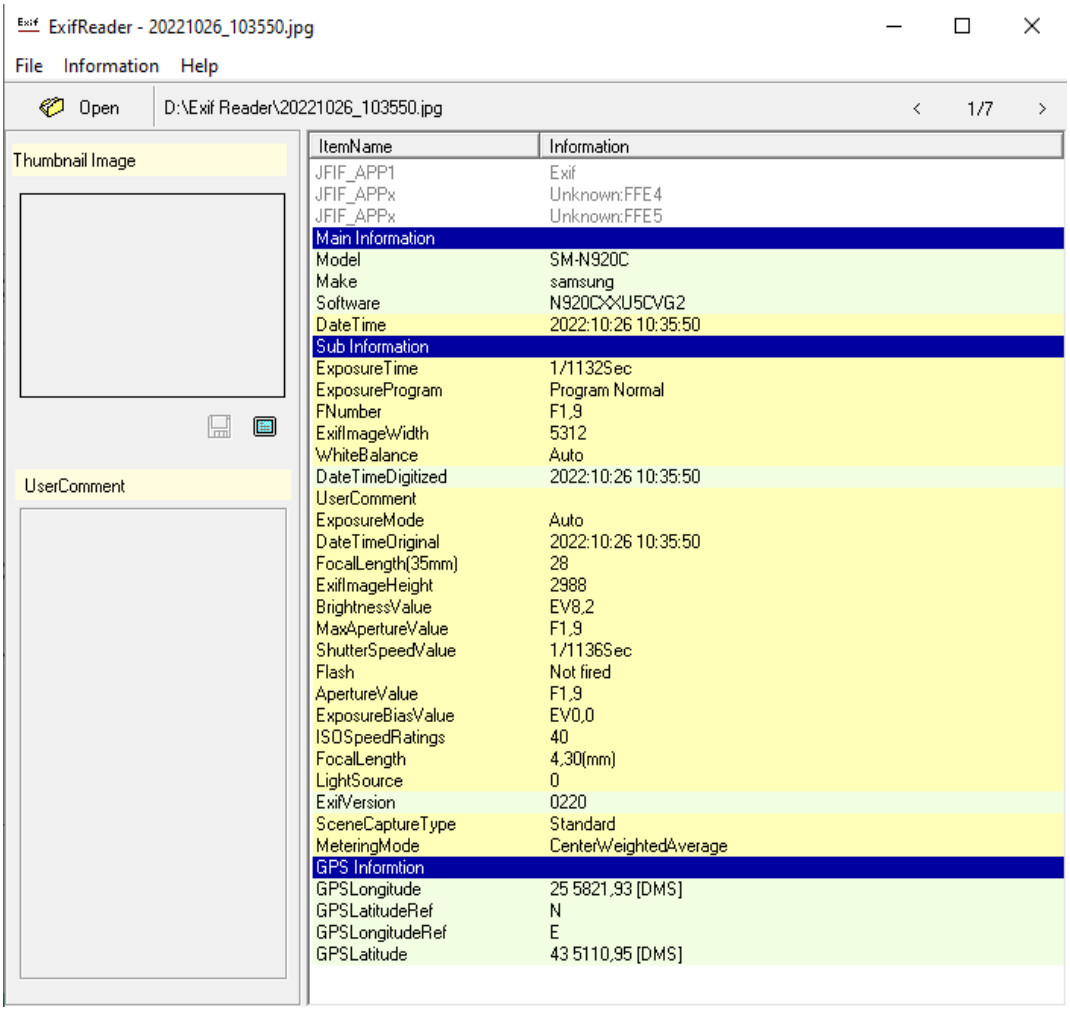

Fig. 9. Extracted information from 20221026_103550. jpg

Extracted information from the image:

Main information:
- Manufacture → Samsung
- Model → SM-N920C
- Date and time → 26. 10. 2022 10:35

Sub information:
- Resolution
- Shutter Speed
- Exposure
- Flash (active or not)
- ISO Speed

GPS (Location) information:
- GPS Latitude: 43 5110,95 [DMS]
- GPS LatitudeRef: N
- GPS Longitude: 25 5821,93 [DMS]
- GPS LongitudeRef: E

CONCLUSION

In conclusion, EXIF data is information that is stored in the photo files, that includes data about the image itself, the camera and equipment used to create it and copyright information.

To include or not EXIF data depends on what the image is used for. If it is a photo of personal event in private area, it is recommended to exclude the information. If the photo is from a public location and will be shared on the social media, it is recommended to keep the EXIF data.

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REFERENCES

Wang, J., Liu, G., Zhang, Z., Dainad, Y., & Wang, Z. (2009). *Fast and robust forensics for image region- duplication forgery*, Acta Automatica Sinica, Vol.35, no.12, pp 1488-95, Dec 2009.

EXIF Data Viewer (2021). https://www.exifdata.com/exif.php

Safonov, I., Kurilin, I., Rychagov, M., & Tolstaya, E. (2018). *Adaptive Image Processing Algorithms for Printing*, Springer Singapore, pp. 304, ISBN 978-981-10-6930-7.

Zhao, Q., Zuo, C., Pellegrino, G., & Zhiqiang, I. (2019). *Geo-locating Drivers: A Study of Sensitive Data Leakage in Ride-Hailing Services*, NDSS Network and Distributed System Security Symposium (NDSS 2019), February 2019.

Vailaya, A., Figueiredo, M., Jain, A., & Zhang, H. (2001). *Image classification for content-based indexing*, IEEE Transactions on Image Processing, vol. 10, no. 1, pp. 117-130, Jan. 2001, doi: 10.1109/83.892448.

Boutell, M., & Luo, J. (2004). *Photo classification by integrating Image content and camera metadata*, 17th International Conference on Pattern Recognition, Volume 4, 23-26 Aug. 2004, pp. 901 – 904.

Ali, S., Ganapathi, I., Vu, N., Ali, S., Saxena, N., & Werghi, N. (2022). *Image Forgery Detection Using Deep Learning by Recompressing Images*, Electronics 11(3), 403, 2022, DOI:10.3390/electronics11030403.

