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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.

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		

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

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

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File Informatio	n Help					
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		GPS Information GPSLatitudeRef GPSLatitude GPSLongitudeRef GPSAltitudeRef GPSAltitudeRef	N 44 716,6538 [DMS] E 27 1534,4133 [DMS] Unknown (1) 28643/1000 meters			
						~

Data extracted with ExifReader:

Fig. 5. Extracted information from DJI_0761.jpg

Extracted information from the image:

Main information:

- Manufacture \rightarrow DJI
- Model \rightarrow 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:

Exif ExifReader - IMG_20221026_103810.jpg

File Information Help

		ItemName	Information		
iumbhail Image		JFIF APP1	Exif		_
-		Main Information			
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	the second	ExposureProgram	Unknown (0)		
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		ExposureTime	1/717.4Sec		
		FocalLength	4.74(mm)		
		Flash	Not fired(Compulsory)		
D 10		LightSource	Other		
mageDescription		MeteringMode	CenterWeightedAverage		
		SceneCaptureType	Standard		
		FocalLength(35mm)	O(mm)		
		MaxApertureValue	F1.0		
		DateTimeDigitized	2022:10:26 10:38:10		
		ExposureBiasValue	EV0.0		
		DigitaZoomRatio	10000/100		
		ExifImageHeight	2016		
		WhiteBalance	Auto		
		DateTimeOriginal	2022:10:26 10:38:10		
		BrightnessValue	EV12.8		
		ExifImageWidth	4480		
		ExposureMode	Auto		
		ShutterSpeedValue	1/71Sec		
		ExifVersion	0220		
		GPS Informtion			
		GPSLatitudeRef	N		
		GPSLatitude	43 5110,89 [DMS]		
		GPSLongitudeRef	E		
		GPSLongitude	25 5821,93 [DMS]		
		GPSAltitudeRef	Sea level		
		GPSAltitude	82/1 meters		
		GPSTimeStamp	07:38:10		

Fig. 7. Extracted information from IMG_20221026_103810.jpg

Extracted information from the image:

Main information:

- Manufacture \rightarrow 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:

Exif ExifReader -	20221026_103550.j	pg		_		×
File Informatio	n Help					
🌮 Open	D:\Exif Reader\20)221026_103550.jpg		<	1/7	>
Thumbhailleaga		ItemName	Information			
		JFIF_APP1 JFIF_APPx	Exif Unknown:FFE4			
		JEIF_APPx Main Information	Unknown:FFE5			
		Model	SM-N920C			
		Make	samsung			
		Software	N920CXXU5CVG2			
		DateTime	2022:10:26 10:35:50			
		Sub Information	1/11228-00		j	
		ExposureProgram	Program Normal			
		FNumber	F1,9			
		ExifImageWidth	5312			
		WhiteBalance	Auto			
UserComment		DateTimeDigitized	2022:10:26 10:35:50			
		ExposureMode DateTimeOriginal FocalLength(35mm) ExifImageHeight BrightnessValue MaxApertureValue ShutterSpeedValue Flash ApertureValue ExposureBiasValue ISOSpeedRatings FocalLength LightSource ExifVersion SceneCaptureType MeteringMode	Auto 2022:10:26 10:35:50 28 2988 EV8,2 F1,9 1/1136Sec Not fired F1,9 EV0,0 40 4,30(mm) 0 0220 Standard CenterWeightedAverage			
		GPSLongitude GPSLatitudeRef GPSLongitudeRef GPSLatitude	25 5821,93 [DMS] N E 43 5110,95 [DMS]			

Fig. 9. Extracted information from 20221026_103550. jpg

Extracted information from the image:

Main information:

- Manufacture \rightarrow Samsung
- Model \rightarrow SM-N920C
- Date and time \rightarrow 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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