

IMAGE METADATA ON SOCIAL MEDIA: A COMPARATIVE STUDY ON IOS AND ANDROID APPS

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Abstract: *Sharing and uploading photos as social media content is taking over the Internet with the advancement of mobile devices literally. Human desire to uphold and enrich these relations possibly another inspiration of the purpose of projecting onto the world. With the limitation of our hectic lives and time constraint to socialize, social media offer an easy and convenient platform to maintain contact with relatives and friends. In this paper, a comparison on how different social media handle metadata that are embedded on the photos that has been captured using mobile devices camera. When those photos are upload to the social media, all the metadata in the photos will be compare on different mobile operating systems namely Android and iOS. Some social media may remove all the metadata that are embedded in the original photos, and some may leave a little bit metadata. To extract all the metadata, a EXIF metadata extractor system is develop using Python programming language with other libraries. The result shows the image metadata that are available for the respective photos.*

Keywords: *image metadata, social media, uploaded photos metadata, EXIF metadata, mobile operating system*

Introduction

Social media are a platform for people to interacting with each other by sharing their photos, videos, and comments. Social media users are getting more and more every year (Firdaus, 2020). The number of social media users as of 2020 is up to 3.96 billion from multiple platforms such as Facebook, Instagram, Twitter, and others ("How et al., 2022). Facebook have the most active users in social media platform with more than 1 billion monthly active users on first quarter of 2020 ("Topic: et al., 2022).

Most of the action of uploading status, photos, videos, and others are uploaded from the user's device. Any of the information's that are being shared on social media are includes with the details about the device used to share it are called metadata. According to (Gangwar & Pathania, 2018), metadata has the information of file size, time and date, and creation date. Metadata has many purposes to help the user find the relevant information. This metadata information is hidden on the images.

Mobile device is a term for any electronic device that can be easily moved and can fit in the bag or pocket. People can surf Internet anywhere with mobile device such as café, library, and workplace. With the technology advancement of smartphones, it has become more accessible for people to log in to their social media accounts everywhere and anytime. According to Datareportal 88% of Malaysian use smartphone to access the internet (“Digital 2018”, 2022). Each social media such as Facebook, Instagram, and Twitter have its own application that can be installed based on the devices Operating System (OS) such as Android, iOS, and Windows 10 for laptop.

According to (Fletcher, n.d.), most social media user does not aware that their image contains metadata such as device information, GPS location and others details that can be obtained from the images. With the development of technology on mobile devices, many devices have implemented the privacy features on their devices. By limiting the access to the image metadata, mobile devices such as Android and iPhone have limited the metadata of the images (Kollnig et al., 2021) User may only can view information such as filename and GPS location only, other metadata cannot be viewed.

Existing metadata extractor tools have limited features, such as to save all the metadata of the images into excel or csv file format. This makes it difficult to analyse large number of images. Another feature is most of the tools does not output any graph or infographic to show what metadata that are available on the image.

Related Works

With the introduction of mobile devices, accessing to the internet, and capturing image have become easier and convenience as today smartphone able to capture high quality image using mobile devices camera. People mostly will use their mobile devices such as Android device or iOS device to capture the image using the device camera. Nowadays people tend to upload image to social media using their mobile devices, as it much more convenient to upload to social media platform compared to using laptop or tablet that are heavier compared to smartphone. Every image that are taken from mobile device have information about the captured images. This information is called metadata, the metadata that contains in those images are called Extended File Information (EXIF). According to (Tan et al., 2018) image metadata consist of model, GPS location, colour space, and other metadata based on the mobile devices that may have limited metadata in those images. Research done by (Prasetyo et al., 1918) on automatic geotagging using GPS EXIF metadata of smartphone digital photos.

When uploading those images to social media platform, the metadata may be fully removed or partially removed based on the platform that user uploading the image. This research is to compare the metadata from the images that are captured from mobile devices and to compare the metadata of the images that are uploaded to social media platform.

A. Operating system

Android is an OS that are developed by Google and created based on Linux kernel. Android also is an open-source project licensed by Google Mobile Services (GMS) that include core application such as Play Store and Google Play Services. Android is the leading OS in the market (“Operating et al., 2022). Android OS use a software stack that include Linux kernel, native libraries, Android Runtime, Application framework and Applications. Linux kernel is

the bottom layer of the software stack. Android Operating System is built on this layer made by Google.

iOS is a Mobile Operating System that are exclusively to iPhone model that are created by Apple Inc. (Lazareska, 2017). The comparative analysis of Windows, Unix, Linux, Mac, Android and iOS operating systems based on the OS features and their strengths and weaknesses has been done by (Adekotujo et al., 2020) and iOS is the second most used Operating system behind Android. iOS was released on June 2007 with initial name iPhone OS. iOS was the first mobile Operating System to introduce Siri an intelligent personal assistant on iOS. Siri able to give an answer to question that being asked by user.

Same with Android, iOS will automatically create caches when the application is run. iOS will be stored temporary information when writing or reading on cache memory which is RAM. (Mullan et al., 2019) conducted an analysis to shows that identification of the concrete hardware is much harder for smartphones than it is for traditional cameras.

B. Social Media Platform

The platform provides the ability to create social media websites and services with complete social media network functionality. User can access to social media platform using any devices that are connected to the internet via web-based applications on desktops and laptops or downloading application services social media functionality on their mobile devices such as smartphone or tablet. Some of the most popular social media are Facebook, Instagram, Twitter, and WhatsApp.

C. Image metadata

Image metadata consist of set of data that are describing about the images, such as make for maker of the mobile devices, model for either Android or iOS device, GPS location that contains the latitude and longitude for the location of the captured images, and other set of data that providing the image information (Jeziorowski et al., 2020).

All these set of data are called Exchangeable Image File Format (EXIF), that was developed by Japanese organization Japan Electronic Industry Development Association (JEIDA) that released in 1995. Metadata is stored in internal and external.

For internal, metadata such as EXIF are embedded to the image with filetype such as JPEG, PNG, and TIFF. In external metadata called International Press Telecommunications Council (IPTC) that are describing about the photographer who are capturing the images. Analysis of results (Ghazali et al., 2020) has revealed different combinations of metadata features that contribute variedly in predicting scenery-object image classification when using different classifiers.

D. Digital image

Image is a composed of pixels that are arranged in certain to output in two-dimensional line. Image resolution is depending on the number of pixels, the more the pixels number, the clearer the image. There are four types of images (Khalaf & Varol, 2019):

- i. Binary image – Is an array of two-dimension bits. It only has two colours which is black and white. 1 represent black colour, 0 represent white colour.

- ii. Grey scale image – Grey scale images are images that each pixel has two bits of data. 11 represent black colour, 00 represent white colour.
- iii. Coloured image – Also known as RGB images. Red, green blue colour are combined to create various type of colour.
- iv. Multispectral image – Images that consist of multi layers of colours. Each layer viewing specific colours.

Some of images file format types are:

- i. JPEG – Image that are being compressed to make the size smaller. The compression creates a loss quality resulting in bad quality image.
- ii. BMP – Format that developed by Microsoft. No compression is made to make sure the image is in high quality
- iii. PNG – Format that features lossless quality. PNG file can handle up to 16 million colours.
- iv. RAW – File format of image that are unprocessed that have been created by a camera.

Most mobile devices have location tracking system, it can be used to find the devices if the devices are being stolen or missing. User can get an accurate location of their devices. This GPS location are also embedded to the image when user capturing image using their mobile devices. Moreover, social media platform also uses GPS to embed in the media such as videos and photos when uploaded it. For example, in Instagram user can tag the location of the photos that are being taken, and all their followers can click on the tag to view the locations.

E. EXIF Extractor Tool

EXIF metadata cannot be viewed using the default gallery application. All the mobile devices including Android and iOS are restricting to view the EXIF metadata. Only filename, and GPS location that can be viewed using default gallery application. There are some application and website that provide EXIF metadata extractor.

EXIF extractor by Jeffrey can extract the metadata from the image. This website can extract the GPS location and colour space, but it cannot retrieve metadata such as make, model and lens specification. This website can only view the extract metadata and cannot export all the metadata to the excel or csv file. This tool does not output the GPS location on a map. Study by (Latif et al., 2019) discussed the feature extraction approaches.

Research method

Extracting Images from Mobile Devices

In this part, external tools that is MOBILedit Forensic Express will be used to extract the images from the Android device and iOS device. Mobile devices such as iOS have limited access to the device storage. This makes it difficult to extract the images, as iOS only allow user to view the image that captured using camera when plugged in to computer. All the images file for WhatsApp are hidden from user view and cannot be accessed. iOS does not specify the image based on the social media platform. All the images all stored in one folder.

Android device is easier to extract the images from the storage devices. Android does not limit the user access to the device storage. All the images are in specific folder according to social media platform. Images for Facebook are located on Facebook folder, images for Twitter are

located on Twitter Folder, and so on. This makes it easier to access to the Android device storage just by plugged in to the computer as Android does not restrict the user access.

MOBILedit Forensic Express will be used to extract images from iOS device and Android device to makes sure all the images can be retrieved safely without corrupt. Basically, the same image used to be uploaded on the different social media used in this research which are: i) Facebook ii) Instagram iii) Twitter iv) Telegram and v) WhatsApp.

Android device extracted images

Fig. 1 to Fig. 4 are the images used for this research. All the images that have been extracted will be created on file name backup_files\phone \raw3. Picture and Android folder that save images created from using social media application. The folder “Camera” that contains images captured using camera, and “Facebook” that contains images that are uploaded to Facebook app. Back to the directory raw3, Pictures folder that save images from social media applications such as Instagram, Twitter, and Messenger. Uploading picture using this application will save the images at this folder. .thumbnails saved the thumbnails that are used by Gallery application which is used to view all images on this Android device. all the media that are being shared on WhatsApp application will be saved on folder Android\media\com.whatsapp\ WhatsApp. Including encrypted chat backup that are saved on local device. “Media” folder, which saved all images, video, and other media file. Image that are being shared using WhatsApp will be saved on folder Images, Documents, and Statuses. All image that are being sent or received will be saved on those folders.

iOS device Extracted images

All the images that have been extracted will be created on file name backup_files\phone\raw3. All the images on the iOS internal storage will be extracted to that file. iOS device put all the image in one folder which is “DCIM” folder. DCIM contains all images that have been captured using this device. iOS does not specify the images based on the social media platform such as Facebook, Instagram, and Twitter, all those images are stored in same folder and makes it difficult to identify which images are from which social media platform.

For WhatsApp images, the files are stored in another folder. But it is difficult to access to those folders as iOS hidden and restrict the access to those folders without using external tools.

Image Metadata Extractor System

Image metadata extractor has been developed which have additional features compared to the existing metadata extractor. The additional features are to be able to save the metadata in excel file. The existing metadata extractor does not have this feature and all the metadata need to be manually inserted to excel file. Another feature is to output the GPS location based on the image’s latitude and longitude to the map.

The interface is the system feature that are develop using streamlit framework. Streamlit framework is easier to develop the web interface as it is lightweight and no front-end experienced required. There is 5 pages which is Extract Metadata page, Graph page, Android Metadata page, iOS metadata page, and search page. To extract the image metadata, user need to browse or drag and drop the images to start extracting the metadata.

Some metadata are not available in some mobile device it will output and error in red box showing what metadata is not available. When image has metadata it will output a message in

bottom in green box, if the image does not have metadata, it will output and error in red box “This image has no EXIF Metadata”. If the image contains metadata about latitude and longitude, it will be output on the map. The location will be output on open street map called Mapbox.

To use the Mapbox feature, authentication token is need and can be create by sign up on Mapbox website. In this research free token was used to output the GPS location on map. The token needs to be created in file name config.toml.

The input file latitude and longitude which are gained from the image metadata will be process by Mapbox API. The Mapbox authentication token will be verify from the file config.toml that include the token that has been created on Mapbox website. When Mapbox authentication token is being verify, it will be output on the Streamlit framework. The GPS location of the images will be output on the Mapbox map.

This paper present eight properties of image metadata namely:

- i. Make (manufacturer)
- ii. Model
- iii. Date and time
- iv. Colour space
- v. Latitude
- vi. Longitude
- vii. Lens specification
- viii. Software

Results and analysis

All the results from the analysis are discussed and documented. There are two comparison and analysis for this research which is to compare on how social media handle metadata when user uploading the images and to analyse images on different types of mobile operating system. For the first result which comparing on how social media handle the metadata. Each social media handles the metadata differently based on the mobile operating system. The following tables shows the comparison result of social media on Android device and iOS device.

Table 1: Metadata properties on Android on different media social

Metadata	Android Facebook	Android Instagram	Android Twitter	Android Telegram	Android WhatsApp	Android Camera
File Name	FB Android.jpg	Instagram Android.jpg	Twitter Android.jpg	Telegram Android.jpg	WA Android.jpg	Image Android.jpg (1)
Make	Not Available	Not Available	Not Available	Not Available	Not Available	Xiaomi
Model	Not Available	Not Available	Not Available	Not Available	Not Available	Mi 9T
Date time	Not Available	Not Available	Not Available	Not Available	Not Available	2021:11:19 15:00:15
Colour Space	Not Available	Not Available	Not Available	Not Available	Not Available	1
Latitude	Not Available	3.09611111111111	Not Available	Not Available	Not Available	3.09636097222222

Longitude	Not Available	101.603055555556	Not Available	Not Available	Not Available	101.603204
Lens Specification	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Software	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

Table 2: Metadata properties on iOS on different media social

Metadata	iOS Facebook	iOS Instagram	iOS Twitter	iOS Telegram	iOS WhatsApp	iOS Camera
File Name	FB iOS (2).jpg	IG iOS (2).jpg	Twitter iOS (2).jpg	Tele iOS (2).jpg	WA iOS (2).jpg	Image (2) iOS.jpg
Make	Not Available	Not Available	Not Available	Not Available	Not Available	Apple
Model	Not Available	Not Available	Not Available	Not Available	Not Available	iPhone SE (1st generation)
Date time	Not Available	Not Available	Not Available	Not Available	Not Available	2022:01:17 10:19:00
Colour Space	1	1	1	1	Not Available	1
Latitude	Not Available	Not Available	Not Available	Not Available	Not Available	3.0486555555555555
Longitude	Not Available	Not Available	Not Available	Not Available	Not Available	101.75294444444444
Lens Specification	Not Available	Not Available	Not Available	Not Available	Not Available	(4.15, 4.15, 2.2, 2.2)
Software	Not Available	Not Available	Not Available	Not Available	Not Available	14.6

Table 3. Metadata properties on Android and iOS camera photos (original photos)

Metadata	Android Camera		iOS Camera	
File Name	Image (1) Android.jpg	Image (2) Android.jpg	Image (1) iOS.jpg	Image (2) iOS.jpg
Make	Xiaomi	Xiaomi	Apple	Apple
Model	Mi 9T	Mi 9T	iPhone SE (1st generation)	iPhone SE (1st generation)
Date time	2021:11:19 15:00:15	2021:11:19 16:58:38	2022:01:17 10:19:00	2022:01:17 10:19:00
Colour Space	1	1	1	1
Latitude	3.09636097222222	4.17752197222222	3.0469805555555555	3.0486555555555555
Longitude	101.603204	101.290471972222	101.74945833333333	101.75294444444444
Lens Specification	Not Available	Not Available	(4.15, 4.15, 2.2, 2.2)	(4.15, 4.15, 2.2, 2.2)
Software	Not Available	Not Available	14.6	14.6



Figure 1: Image (1) Android.jpg



Figure 2: Image (2) Android.jpg



Figure 3: Image (1) iOS.jpg



Figure 4: Image (2) iOS.jpg

Table 1 shows that most social media platform on Android device have remove all the metadata from the original images. Only Instagram application that still save the metadata about the GPS location which is latitude and longitude.

Table 2 shows iOS devices all the metadata that can still be view when user upload those images to social media is colour space. Colour space is just a number model that describe the colour of the images. There are three primary colour that can combine to create another colour which is red, green, and blue also known as RGB. On iOS device all social media platform handles the metadata by leaving metadata about colour space, while for WhatsApp all the metadata has been remove completely.

Table 3 shows the metadata found from this analysis. Image (1) Android.jpg and Image (2) Android.jpg have metadata about make, model, date time, color space, latitude, and longitude. But does not have metadata about lens specification and software. This shows that Android device have limitation about lens specification and software metadata in the images.

Image (1) iOS.jpg and Image (2) iOS.jpg shows that iOS image that has been captured using device camera have more metadata compared to the Android device. The extra metadata which is lens specification which is for focal length, iris, and focus setting. The software metadata show that the image was taken using iOS device with iOS version 14.6. iOS device has more EXIF information on the images compared to the Android device.

Conclusion

For overall this research has been complete on analysis and comparing the social media on how the metadata are handle when user upload the images to those social media platforms. In this research the first objective which is to develop a system to extract the image metadata has been achieved. The system was programmed using Python programming language with Streamlit framework and others Python libraries such as pandas, map box, and plotly.

All social media platform handles the metadata differently based on the mobile devices. Same social media platform such as Facebook handle the metadata differently based on the different types of mobile devices, including other social media such as Instagram, Twitter, WhatsApp, and Telegram.

The analysed image on different mobile operating system shows that each mobile operating system has their own metadata information embedded in the images. Some mobile operating system has more EXIF metadata embedded on the images compared to the other mobile operating system that does not fully embedded EXIF metadata on the images.

The main limitation in this research is this metadata extractor system only can extract certain EXIF metadata such as make, model, date time, colour space, latitude, longitude, lens specification and software. Other's metadata cannot be extracted using this system. Moreover, this system can only extract file in JPG, JPEG and PNG format only. This system cannot extract metadata from other file format such as WEBP, RAW, and others. This is because mobile devices such as Android and iOS mainly use file in JPG format. Social media may change how they handle the metadata in the future due to privacy and security concern. All the images are from my own mobile devices, and all the results may output differently when using others device. All the images are also from my own devices, result may vary if using this system on others image or devices.

In conclusion this research is mainly focus on mobile operating system specifically android and iOS that are the main smartphone in the market. People tends to use their smartphone to capture the images and upload those images to the social media platform; Facebook, Instagram, Twitter, Telegram and WhatsApp. There are some metadata can be found from those platforms and operating system.

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