Automatic geotagging using GPS EXIF metadata of smartphone digital photos in tree planting location mapping

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Abstract. Tree planting is one of the programs that are currently being promoted. The location of tree planting is important to be monitored in the future. Tree planting activities carried out on the UNNES campus always carry out online documentation and reporting. However, the problem is the difficulty in obtaining the coordinates of the location of the plants because what is currently done is clicking on maps manually. In this research, we designed automated geotagging tree planting photos. Digital photos from smartphones are read, then extracted EXIF information to get GPS coordinates. Then the coordinates are obtained automatically, then stored in the database. The coordinates can be reversed to display on maps. In our experiment, we study in two cases. Case 1 the original photo near the building, Case 2 the photo near the forest. We can show that the result of mapping represents the actual state of the photo. So, the use of GPS information on photo smartphones can be an alternative solution in terms of documenting planting photos to get an accurate location.

1. Introduction

Tree planting is an effort to reforest and restore climatic conditions [1]. Through tree planting, it is hoped that it can make the air fresh and balance the ecosystem. UNNES, as a conservation campus, also organizes a tree-planting program for every student. In tree planting programs, the location of planting is very important. Students do the planting, then input data through the system and choose an address. However, the current problem is that students click the coordinates manually. As a result, many actual locations with locations documented in the database are inaccurate. So, a solution is needed, how to get coordinates automatically and more accurately.

Along with the development of technology, nowadays, GPS has developed as a technique for determining the location of coordinates. GPS has been widely used, for example, to find friends or family [2], in terms of transportation [3], vehicle tracking [4, 5], vehicle security [6], autonomous [7], and in determining the location of wheels [8]. We can see many uses of GPS, but not many have implemented it in environmental terms. So in our study, we will discuss the automation of GPS coordinate locations in tree planting. Currently, cellphone cameras are equipped with location information stored in EXIF (Exchangeable image file format) metadata [8]. The study regarding the level of GPS accuracy on smartphones is also interesting to study, including [9] as well as the use of smartphone GPS in a campus environment [10] and tourism [11]. Currently, almost every smartphone

is equipped with GPS, so when taking pictures using the camera, location information is stored in EXIF metadata. EXIF can store information such as time, camera settings, make, model, location, and other information. Information in images can be widely used, both in terms of copyright and in terms of security, for example, steganography [12].

There are many activities that can be done with EXIF metadata. Previous studies examining EXIF include image classification with EXIF [13], for copyright [14], and image enhancement [15]. Information in EXIF can be extracted, one of which is through ExifTool [16]. Research on errors in EXIF data has also been reviewed by Orozco [17]. In this paper, we discuss the use of EXIF generated from digital cameras on smartphones. GPS coordinate information is then extracted and stored in a database for documentation at the time of tree planting input.

2. Methods

In this study, we used photo data obtained in the UNNES tree planting database (Siomon). The information inputted by students is as in Table 1.

Table 1. Information that needs to save for planting documentation

Variable	Description
Tree information	Tree information such as Plant height stem diameter,
Address location	User input address location
Coordinate location	The user clicked manually on the maps provides
Time	User input the time of planting
Photo	The photographic of tree planting

We used a random sample of photos contained in the database. Then detect photos that already contain EXIF GPS or not. Next, we extracted the information contained in the EXIF. The extraction results are then stored in the database; then the coordinates are returned in the form of maps as shown in Figure 1. The Exchangeable Image File Format (EXIF) is a specification for image formats like JPEG and TIFF. The information includes the camera setting, the information of the picture itself as well as the copyright information, the shooting environment, and the geographic information. Our proposed method is shown in Figure 1.

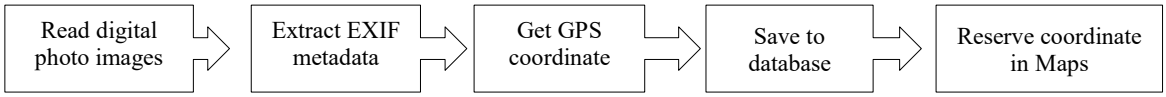

Figure 1. The automatic geotagging method our experiment.

3. Results and Discussion

We have developed automatic geotagging using GPS EXIF data for Seed location mapping using PHP programming language. We use function in PHP "exif_read_data ()" [18] to read the image then extract the metadata information. In this study, we compare in two cases. We select a sample image that taken a photo in a forest area and in a near building area. Case 1 an image in a forest area, case 2 an image near a building area, so we can visually see the results on the photos and the results on maps. Metadata extraction can be carried out using ExifTool [16]. While in this study, extracted EXIF data on the https://www.exifdata.com/exif.php [19] site as a comparison to the program we developed. The image used is shown in Figure 2. We sensor the face due to the privation of the photo.

(a) (b)

Figure 2. Photo example of planting. (a) Photo of planting around the building; (b) Photograph of planting in forest areas

Table 2. EXIF data information of sample images

Figure 2 (a)		Figure 2(b)	
Information	Value	Information	Value
Camera	Xiaomi Redmi 4X	Camera	OPPO A1601
GPS Position	7.051230 degrees S, 110.402835 degrees E	GPS Position	7.060587 degrees S, 110.343811 degrees E
Date of Creation	2019:11:15 08:12:03	Artist	260710176021102
Resolution	2340x4160	Resolution	1717x3052
Make	Xiaomi	Make	OPPO
Model	Redmi 4X	Model	A1601
Aperture	2	Aperture	2.2
Exposure Time	1/224 (0.0044642857142857 sec)	Exposure Time	1/101 (0.0099009900990099 sec)
Focal Length	4.1 mm	Focal Length	3.5 mm
Flash	Off, Did not fire	Flash	No Flash
File Size	1128 kB	File Size	1511 kB
File Type	JPEG	File Type	JPEG
MIME Type	image/jpeg	MIME Type	image/jpeg
Image Width	2340	Image Width	1717
Image Height	4160	Image Height	3052
Encoding Process	Baseline DCT, Huffman coding	Encoding Process	Baseline DCT, Huffman coding
Bits Per Sample	8	Bits Per Sample	8
Color Components	3	Color Components	3
X Resolution	72	X Resolution	72
Y Resolution	72	Y Resolution	72
YCbCr Sub Sampling	YCbCr4:2:0 (2 2)	Software	PicsArt Photo Studio
YCbCr Positioning	Centered	YCbCr Sub Sampling	YCbCr4:2:0 (2 2)
Exposure Program	Not Defined	Date and Time (Original)	2019:11:25 08:48:42
Date and Time (Original)	2019:11:15 08:12:03	Light Source	Unknown
Metering Mode	Center-weighted average	White Balance	Auto
Color Space	sRGB	F Number	2.2
Sensing Method	One-chip color area	ISO	80
Exposure Mode	Auto	Orientation	Horizontal (normal)
White Balance	Auto		
Focal Length In 35 mm Format	0 mm		
Scene Capture Type	Standard		
F Number	2		
ISO	100		
Compression	JPEG (old-style)		

Table 2 provides the metadata according to Figure 2. We can see that the metadata contains model, GPS, and other information. In this study, we focused on GPS Position information. This information contains latitude and longitude information. For example, the GPS information in Figure 2 (a) is 7.051230 S, 110.402835 E, and in Figure 2 (b) is 7.060587 S, 110.343811 E, see dashed red line square. With this coordinated information, we can automatically save it to the database. This information automatically captures from the photo, so this coordinates more accurately than clicked manual by the user. On the other hand, this information can be extracted further, such as time and other information. Furthermore, the coordinates that can be extracted are displayed on the map, using the help of Google Maps as shown in Figure 3.

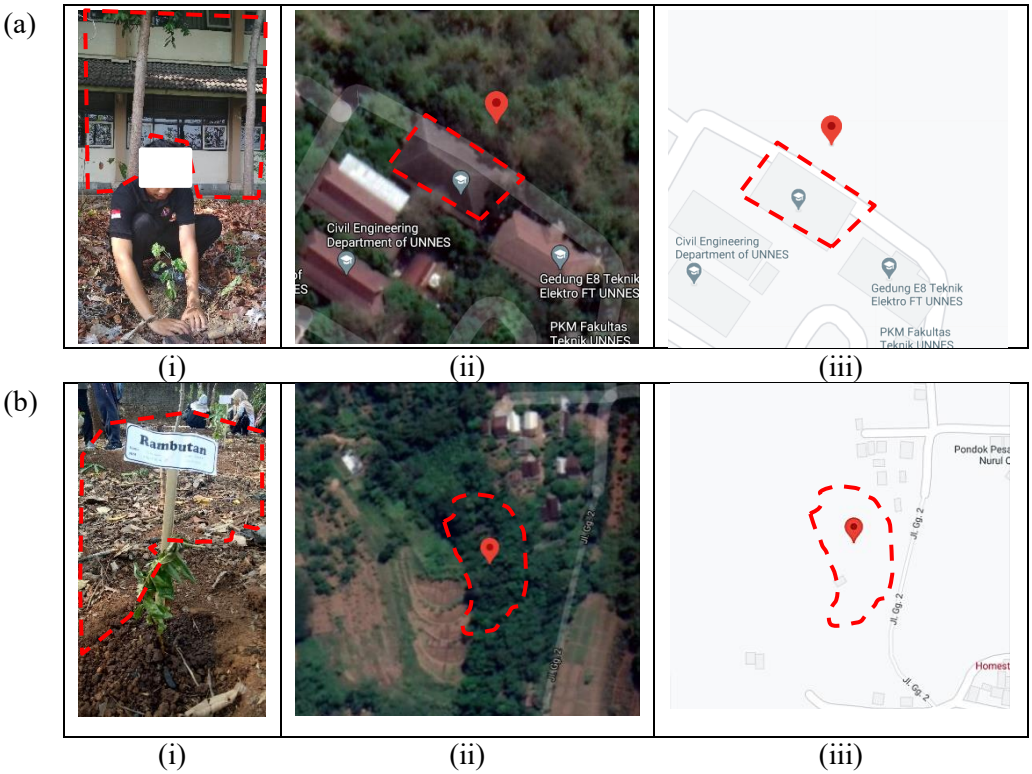

Figure 3. The result of mapping the original photo coordinate in the maps. (a) The photo was taken from near the building area, (b) the Photo was taken near the forest area.

Lets we can see in Figure 3, the Figure 3 (a) (i) is the original photo images after we extract GPS coordinates then locate in MAP by google maps on satellite view - Figure 3 (a) (ii) and street view- Figure 3 (a) (iii). The first image indicates the photo was taken near the building (see dashed red line), so the result of the map, we can see the building near the thick red maps. While in Case 2, see Figure 3 (b) that the original photos place in the forest area, then we can see that the result of the map is shown in the map area too (Figure 3 (b) (ii) and Figure34 (b) (iii). Based on our experiment, we can use the EXIF of GPS information to automatically save the coordinate of the planting location. So we can monitor the plant in the future by this location.

4. Conclusion

Our study is to solve how to automatically detect the geolocation of tree planting programs. In our proposed method, we have done by extracting the EXIF data of image photographic. We get information of GPS coordinate, then save it to the database. The coordinate can is displayed on maps Kembali, one of which is using the google maps service. The results of our experiment, with two case examples, show the results of the coordinate mapping in accordance with the environmental condition data. We conclude that the use of GPS data in photos can be used as a technique for the automatic extraction of coordinates so that the planting location can be tracked accurately.

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