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Categorizing and measurement satellite image processing of fire in the forest Greece using remote sensing

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ABSTRACT

This paper has been utilized satellite Sentinel-2A imagery, this satellite is a polar-orbiting, multispectral high-resolution to cover Athens city, greece that located at latitude (37° 58′ 46″) N, (23° 42′ 58″) E., the work aims to measurement and study the wildfires natural resourcesbefore and after fire break out that happenedin forests of athens city in Greece for a year (2007, 2018) and analysis the damage caused by these wildfiresand their impact on environment and soil by categorize the satellite images for the interested region before and after wildfires for a year (2007) and a year (2018) and discuss techniques that compute the area covered of each class and lessen or limit the rapidly spreading wildfires damage. The categorizing utilizing the moments with (K-Means) grouping algorithm in RS (remote sensing). And the categorizing results show five unique classes (water, trees, buildings without tree, buildings with tree, bare lands) where, it can be notice that the region secured by each class before and after wildfires and the changed pixels for all classes. The experimental resulted of categorizing technique shows that the good performance exactness with a good categorizing and result analysisa bout the harms resulted from the fires in the forest Greece for a years (2007 and 2018).

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1. INTRODUCTION

Remote sensing technology has been utilized during the last few decades to study land cover and earth observation to survey the distribution quantity of natural planet resources. Remote Sensing has been developed in spectral, spatial and temporal resolution to utilize satellite images for choosing area, mapping, understanding, evaluation, accuracy computation of image and error modulation [1, 2]. Image categorizing is one of a decent strategy in digital image preparing for land-cover information extraction and utilizing the data contained in remotely sensed images. Where, the classes are recognized into a characterized topical class (water, trees, building without trees, buildings with trees, and bare lands) [3-5]. Satellite image categorizing is broadly utilized for extracting the spectral highlights from satellite images and analyze land-cover map of the area selected [6-8]. Where, the categorizing techniques can be defined as two significant types: unsupervised and supervised categorizing [9, 10]. The study picked for research is front of the zone of Athens town in Greece taken by (Sentinel-2(Optical)) by a resolution 10 meters Shown in the Figure 1.

Figure 1. Positionof study area in athens city (Greece)

Actually, there are a lot of works that have considered the handling of satellite images and know the subtleties and take advantage of the exploit the gigantic data that the images [11-13]. This data is utilized to predict future environmental disasters or changes in climatic conditions and numerous different things in numerous everyday issues. Here are a portion of the works that have been researched and studied in this field. In [14-16], show the size harms and dangers in Turkey especially over Mediterranean and Aegean Regions caused by Forest fires. Several digital image processing methods used to study the fire categorizing and compute the fire influenced on the burned areas. In [17, 18], shown the object of categorization that are based on develop categorization proceedings for the map of burning area and a series damages of fires that happened during the summers of (2007) and (2009) in Greece, by providing pour system " l'Observation de la Terre (SPOT)-4 HRVIR images". In [19-21], present a categorize of satellite image environment utilizing a creative technique called reflection based phenology method (RBPM). Where, the (landsat 8) datasets has been utilized which keep imagery in multispectral. The basis of band reflection values is utilized in the categorizing process. The categorizing accuracy of the PRBM method utilized overall accuracy, confused matrix, and kappa coefficient as a quality measurement. In [22, 23], State a categorizing technique used to discover the classes of land cover in satellite images. In this work, the categorizing techniques that utilized are supervised categorizing, unsupervised categorizing and Object-oriented categorizing. The moment feature clustering technique is utilized in this paper as unsupervised categorizing for the Athens city region in Greece to categorize the fires, serious damages and threats that happen in that area. The rest sections of paper are as follows: in Section 2 illustrates the problem statement. Section 3 illustrates and weproposed system diagram about image categorizing techniques. A Section 4 describes the experimental results and analysis of results. Finally, we have given in Section 5 the conclusions with future suggestions.

2. PROBLEM STATEMENT

One of the most significant factors of utilizing the regionof Athens city in Greece are the wildfires causing immense harms in this region and having (five kinds of land classes) and being utilized as support for understand. These kinds of classes are agricultural region Buildings Without trees, rivers, Agricultural region. Buildings with trees, and bare lands, where, the areas in which fires happen are determined by utilizing techniques to categorize it and discuss the impact of fires on each area covered by each class. Satellite image of that area was taken by (Sentinel-2 Optical) with resolution 10 meters. The categorized images before and after the fire are analyst and studied to calculate the amount of damaged buildings happening and fires, in the forests of Greece between years (2007 and 2018).

3. PROPOSED SYSTEM DIAGRAM

The features of the homogeneous districts in an image can be categorized by utilizing the elements of visual understanding. The categorizing method can be supervised or unsupervised to be relegated into a defineded class dependent on the number of features extraction identified with that image [22]. The satellite image contains many properties for example; casing of remote sens for spectral area, and every one of highlights properties exists in separate class [24]. In supervising categorization; the classes are demonstrated by giving a group sample of analysed information to the administer [17]. The K-means algorithm-based

moments is utilized to extract all features and categorize image. Figure 2 describe the concepts of the proposed method for categorizing.

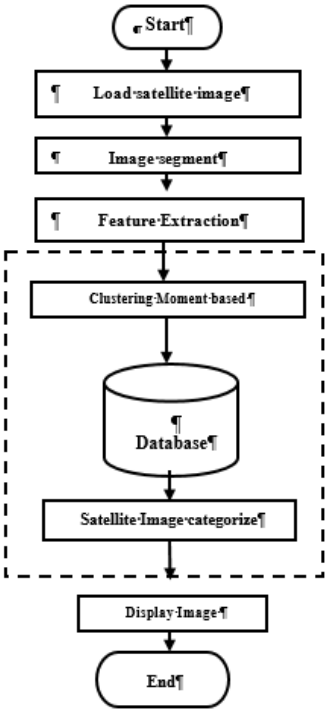


Figure 2. Block diagram of technique satellite categorizing

3.1. Loadsatellite images

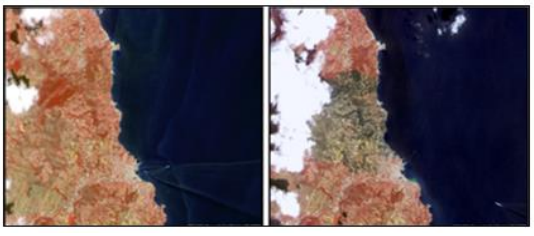
Satellite (Sentinel-2A) imagery is a polar-orbiting, multispectral high-resolution to cover Athens city, Greece that situated at scope 37° 58′ 46″ N, 23° 42′ 58″ E. The Greece image was caught by (Sentinel-2 Optical) with resolution 10 meters. It covers the wildfires (natural resources) before and after fire break out that happened in forests for between years (2007, 2018). Table 1 shows the technical information of original image and the original satellite image of Greece before and after the fire between years (2007, 2018) are shown in Figures 3, 4 respectively.

Table 1. Technical information of original image

Product	Satellite/Sensor	Resolution	Acq. Date:	Band Combination used to create this image:
Geo Tiff format	Sentinel-2 (Optical)	10 meters	20 July 2018 & 30 July 2018	4, 3, 2 (R-G-B) Visible color & 8,4,2 (R-G-B) False color layers

(a). Mati-Greece- before Fires (b). Mati-Greece- after Fires 2018

Figure 3. The images represent Mati-Greece before and after Wildfires for a year 2007



(a). Mati-Greece- before Fires (b). Mati-Greece- after Fires 2018

Figure 4. The images represent Mati-Greece before and after Wildfires for a year 2018

3.2. Image enhancement and segmentation

In this paper is shown upgrade for appearative visual to the image by utilizing preprocessing. This stage isrelied upon focus on every pixelwithout effecting of the correlation contiguous pixels and forimproves the recognizing between the image highlights applies the following connection on the image [19]:

$$A_e(q,z)=\text{round}[(A_o(q,z)-H)/(H-L)*255] \quad (1)$$

Where, Ae (q, z) refers to the new image upgraded, Ao (q, z) represents to the (original image), and q, and z are alludingto the files of the pixel in the image. Halludes to the top (1%) for pixels estimations of (original image) andL alludes to the bottom (1%) of pixels estimations of (original image) [25-27].

The division of image can be defined as a process to dividing it into block squares of regularsize. And we find process isn't concerned through the spectral scattering of image; it is simply partition geometrical. This work, the size of each square is (4×4) where, it relies upon the measure of image spatial resolution. Where; the lower image resolution is isolated to squared number less than higher image resolution. In order to adoptesuitable data is contained in each the square.

3.3. Feature extract

The moments can be utilized to differentiate images as estimation that dependent on their highlights of color [23]. The Moment features can be described as a particular of quantitative measure that used to extract data set in each the image square. Where, the mass alludes to a set distribution of pixels, the (first-ordered moment) given in (2) is utilized to extract the moment features.

$$M = r \times F_P \quad (2)$$

Where, the applied force (F_P) can be represent as the pixel of block and the distance can be refer to r from the center of block to the applied force.

1) determined the distance (d_s)that mean (between each the pixel in specific square and the center of square) anddepends on the location of pixel by utilized the following process:

   a) Inthis equation, the 1's quarter the distance (d_{s1}) is determined by utilized the equation:

   $$d_{s1} = \sqrt{(|x - x_o| - 0.5)^2 + (|y - y_o| - 0.5)^2} \quad (3)$$

   b) Inthis equation, the2 ' s quarter the distance (d_{s2}) is determined utilized the following equation:

   $$d_{s2} = \sqrt{(|x - x_o| - 0.5)^2 + (|y - y_o| + 0.5)^2} \quad (4)$$

   c) Inthis equation, the 3 ' s quarter the distance (ds3) is determined by utilized the equation:

   $$d_{s3} = \sqrt{(|x - x_o| + 0.5)^2 + (|y - y_o| + 0.5)^2} \quad (5)$$

   d) Finally, this equation isthe 4 's quarter the distance (d_{s4}) can be computed by the following equation:

   $$d_{s4} = \sqrt{(|x - x_o| + 0.5)^2 + (|y - y_o| + 0.5)^2} \quad (6)$$

Where, x, y are indices of pixel in a square and x_0, y_0 refers to the indices of the center square.

2) We can calculate the feature moment of pixel $FM_p(I,,j)$ in a specific squarein the image by applying the following relation:

   $$FM_p(i,j) = F_P(i,j) \times d_s \quad (7)$$

3) The moment features of a specific square(*MB*) in the image can be determined by utilized the following relation:

   $$MB(x,y) = \frac{1}{B_h \times B_w} \sum_{x=0}^{B_h} \sum_{y=0}^{B_w} M_p(x,y) \quad (8)$$

Where, $B_w$refers to the width of square, and $B_h$refers tothe height of square, and $F_P(i, j)$ refers the value pixel of the selected square. (i, and j) are the pixel indices in selected squareof the image.

3.4. Clustering satellite image

In this step, the implementation of K-Means algorithm is utilized by two input parameters, the first is moment feature values of all squares of image and the second is the number of clusters (or classes). The moment feature is extracted for each image square and put away in the two dimentional array, and the K-Means algorithm is applied and gathering of all these highlights to get the best of the features (centroids). Where, pixels esteem in the image belongs to each centroid are put away as a vector in database that utilized in the image categorizing.

3.5. Satellite image categorizing and analsisy

The Greece categorizing stage is done after the clustering of highlights and stored in database. The categorizing technique relies upon the examination for spectring amount to every pixel in the built-up database, depending the nearness for every pixel into the classes accessible in a database. Categorizing technique is executed by deciding the likeness estimation (S_q) between every theimage pixel Fxy and the mean μ by apply the (9), the highestvalue $S_q$represents to pixel in image estimation for any class [25].

$$S_q = 1 - \left| \mu - F_{xy} \right| \quad (9)$$

4. EXPERIMENTAL RESULTSAND ANALSISY

One of the most important factors of used the Athens city region in Greece images having five kinds of classes and being utilized as help for the interpretation. It made to discuss the differences between classes and study the region of that secured by each class. The images taken by (Sentinel-2A) satellite, this satellite is a polar-orbiting, multispectral high-resolution to cover Athens city, Greece that situated at scope (37° 58′ 46″) N, (23° 42′ 58″) E. In this work, the input images categorized before and after the Wildfires for a years (2007 and 2018). Where, the variations of the spectral highlights in these images give five classes: (water, trees area, buildings without trees, buildings with trees, and bare lands). After apply the categorizemethod, the database includesmoment feature element estimations for image squares identicalfor the the lastbest centroidsperformedfrom applying the (K-Means) on the image squares, where the quantity of iterations expected to get assembly and best centroids before and after (Wildfiresin) the image of Greece shown in Figures 3(a) and 3(b) are 6, 2 respectively for a year (2007). The best five centroids represent a feature for specific squares in categorized image. Figures 5 and 6 represent the best centroids for the categorized image before and after the (Wildfiresfor) a year (2007). While, the area covered by each class in categorized images can be compute for a years (2007 and 2018) by using the (10).

$$\text{Area (m2)} = \text{No. Pixels} \times 10^2 \quad (10)$$

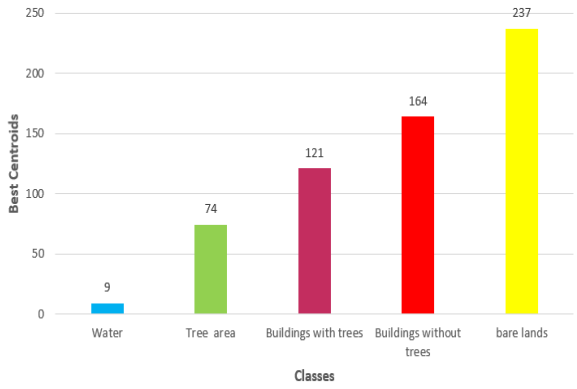


Figure 5. Five classes with the best centroids before fires in 2007

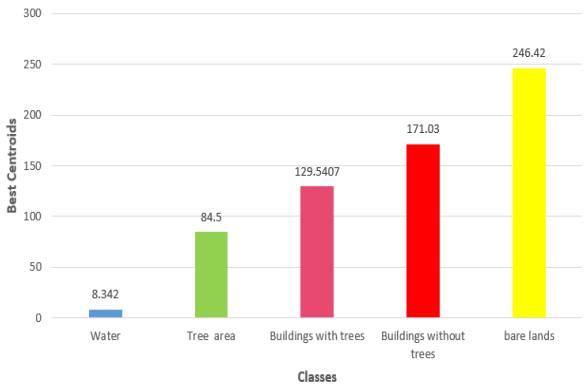
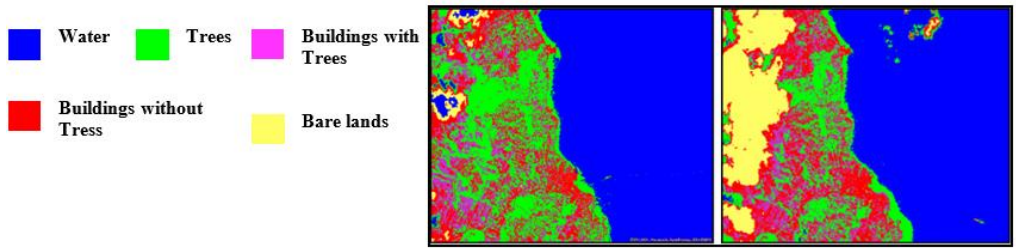


Figure 6. Five classes with the best centroids after fires in 2007

The categorizing results of images of Greecebefore and after (Wildfires) for years (2007) are shown in Figure 7 its notice there are five unique classes. The experimental results as shown in Figure 8 clarified the area covered by each class before and after Wildfires in Greece for a year (2007) was changed and detect the damage caused by these fires and their effect on environment and soil.



(a). Before Wildfires (b). After Wildfires

Figure 7. The categorized images of Greece before and after Wildfires for a year (2007)

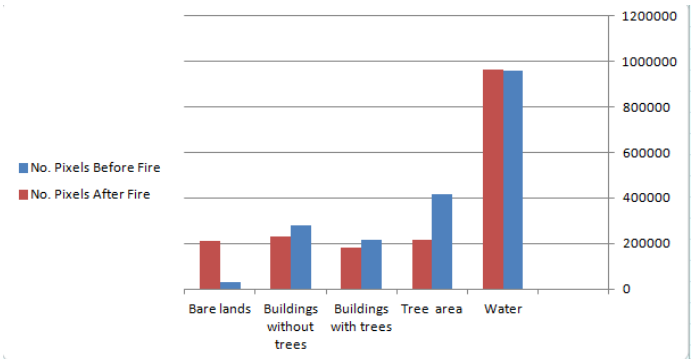


Figure 8. The effect on No. of pixel for each class in categorized image before and after fire in (2007)

In the other side, the number of cycles needed to get convergence and best centroids before and after (Wildfiresin) the image of Greece as shown inFigures 4(a) and 4(b) are Figures 5 and 6 respectively for a year (2018). Figures 9 and 10 represent the best centroids for the categorized image before and after the (Wildfires) for a year (2018). The test results appeared in Tables 2 and 3 clarified the zone secured by each class before and after (Wildfiresin) in Greece for a year (2018) was changed and identify the damage caused by these fires and their effect on environmentsoil and soil. The categorizing results of images of Greecebefore and after (Wildfires)for a year (2018) is shown in Figure 11 its notice there are five unique classes.

Figure 9. Five classes with the best Centroids after fires in (2018)

Figure 10. Five classes with the best Centroids before fires in (2018)

Table 2. The cover area and No. of pixel for each class in categorized image before fire in (2018)

Classes	No. Pixels	Area Covers (m^2) (No. Pixels *10)
Water	976500	9765000
Tree area	164780	1647800
Buildings with trees	258928	2589280
Buildings without trees	427780	4277800
Bare lands	21612	216120

Table 3. The cover area and No. of pixel for each class in categorized image after fire in (2018)

Classes	No. Pixels	Area Covers (m^2) (No. Pixels *10)
Water	961896	9618960
Tree area	132647	1326470
Buildings with trees	184336	1843360
Buildings without trees	278648	2786480
Bare lands	242516	2425160

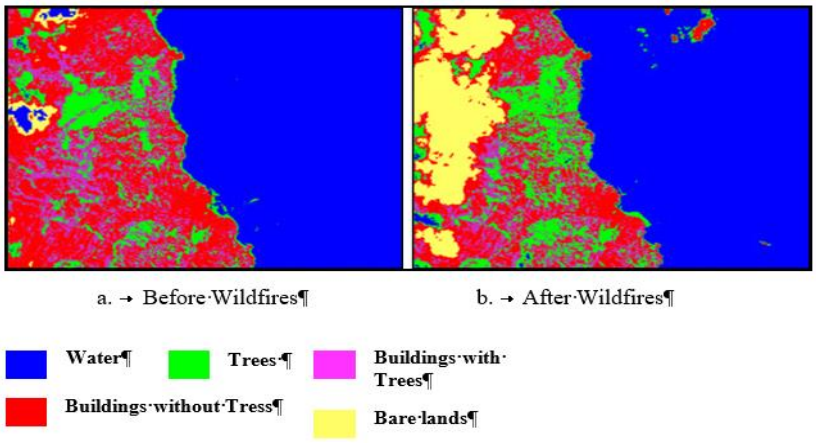


Figure 11. The categorized images of Greece before and after Wildfires for a year (2018)

The experimental resulted about of the proposed categorizing strategy shows that good performance the accuracy of image categorized taken by Sentinel-2A satellite and give the good analysis results about the damages about because of the fires in the forest Greece for a years (2007 and 2018). In a year (2007 A.D.) the tree class is covered the zone (4168920 m2 before Wildfires), while (after the Wildfires it's covered the zone 2137120 m2). Otherwise, the building with trees class is covered the zone (2138040 m2 before Wildfires), while (after Wildfires it's covered 1825720 m2). Also, the (bare lands class is covered the zone 291440 m2 before Wildfires), but (after the Wildfires it's covered 2124000 m2). And the natural images of Greece after Wildfires that alludes to the gigantic harmed in the Athena city. After the Wildfires that occurred in the Greece in (2007) and during the eleven years back turned into the zone covered by the class of trees in (2018) is (1647800 m2), the region covered by the class of bare lands is (216120 m2), and the zone covered by the class of building with trees is (2859280 m2). The observed from the result analysis about the harms resulted because of the fires in the forest Greece for a years (2007 and 2018) where, the number of pixel for class (tree and trees with building) are increasing after (wildfires) in (2007) that refers the size of the development in culturing and reconstruction of buildings during 11 years ago to (2018) which implies that the exactness of proposed categorizing technique for this study.

5. CONCLUSION AND FUTURE WORK

Satellite (Sentinel-2A) imagery, this satellite is a polar-orbiting, multispectral high-resolution to cover Athens city, Greece that located at latitude (37° 58′ 46″) N, (23° 42′ 58″) E. In this work, noticed the influenced zone, the burned zones. It observed the impact on each class before and after the fires that happened in forests of Athens city in Greece for a years (2007 and 2018). The experimental resulted shows a good performance accuracy in categorizing with five different classes (water, trees, buildings without tree, buildings with tree, bare lands) and a good result analysis about the damages resulted from the fires in the forest Greece for a years (2007 and 2018) where, the number of pixel for class (building with tree and trees) are increasing after (wildfires) in (2007) that refers the size of the development in culturing and reconstruction of buildings during 11 years ago to (2018) which means that the accuracy of proposed categorizing technique is best for this study. For future paper, utilized another landsat satellite image for the same zone with SVM or genetic algorithm categorizing

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