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

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ABSTRACT

In this paper, a polar-orbiting satellite has been used called Sentinel-2A imagery, 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 resources before and after fire break out that happened in forests of Athens city in Greece for a year (2007, 2018) and analysis the damage caused by these wildfires and their impact on environment and soil by Categorize the satellite images for the interested region before and after wildfires for a year (2007, 2018 respectively) and the region covered of every class has been calculated and discuss their techniques 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 observed that the area covered by every class before and after wildfires and the changed pixels for all classes. The trial results of categorizing mechanism presents that the perfect performance accuracy with a pretty categorizing and result analysia 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 abstraction and utilizing the data holds in remotely sensed pictures. Wherever, the classes are recognized to 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.
Actually, there are several jobs that have related with satellite images and teach the perspicacity and gather the benefit of the achievement the huge data [11-13]. This data is utilized to predict coming environmental disasters or modifies in climatic situation and numerous different possessions in numerous everyday matters. Now are a portion of the the whole thing that have been researched and considered in this scope. In [14-16], describe the scope harms and dangers in turkey especially through Aegean and Mediterranean areas caused by the fires of Forest. Numerous digital image processing methods utilized to study the wildfire categorizing and compute the wildfire 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 throughout of the summers (2007 and 2009) in Country Greece, by providing pour a system “ l’Observation de la Terre (SPOT)-4 HRVIR images”. In [19-21], state a categorize of satellite image environment utilizing a creative technique called reflection based on phenology method (RBPM). Anywhere, the datasets of the landsat8has was utilized that save imagery in multispectral. The source of the reflection of band 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 we proposed 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
The greatest significant factors of applying the region of Athens downtown in Greece are the wildfires causing immense harms in this area and having (five types of land cover classes) and being applied as funding for recognize. These kinds of classes are agricultural area 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 similar districts in picture can be categorized by using the elements of apparent understanding. The categorizing technique can be unsupervised or supervised classifications to be away into a clear class based on the number of extracted features and acknowledged with that image apparent [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 based moments of K-means algorithm is employed to extricate wholly features and categorize image and the Figure 2 shows impressions of the proposed method for categorizing.

Figure 1. Position of study area in Athens city (Greece)
3.1. Input satellite images

The input image is satellite imagery taken by (Sentinel-2A) satellite covered Athens downtown, Greece that situated at scope 37° 58′ 46″ N, 23° 42′ 58″ E with the multispectral high-resolution. 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 presents the information technical of original image and the original satellite image of Greece before and after the fire between years (2007, 2018) are presented in the Figures 3 and 4 respectively.

| “Product” | “Satellite/Sensor” | “Resolution” | “Acquired Date” | “Band Combination” |
|-----------|-------------------|--------------|-----------------|--------------------|
| 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 |

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

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 is relied upon focus on every pixel without effecting of the correlation contiguous pixels and improve the recognizing between the image highlights applies the following connection on the image [19]:

\[ A_e(q,z) = \text{round} \left( \frac{A_o(q,z) - H}{H-L} * 255 \right) \]  

(1)

Where, \( A_e(q,z) \) refers to the new image upgraded, \( A_o(q,z) \) represents to the (input image), and \( q, z \) is alluding to the files of the pixel in the image. Halludesto the eater (1%) for pixels estimations of (input image) and \( L \) alludes to the bottom (1%) of pixels estimations of (input image) [25-27].

The division of the image can be defined as a process to dividing it into of the block squares of regular size. And we find process isn’t concerned during the spectral scattering of image, it are simply partition geometrical. In this work, the size of every block square is (4×4), where, it relies at the measure of the image spatial resolution. Where; the lower image resolution are isolated to squared number less than higher image resolution. In order to adoptesuitabledata is checked in everythesquare block.

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

\[ M = r \times F_p \]  

(2)

Where in (2), 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 \( F_p \)).

1) determined the (distance \( d \)) that mean (between each the (pixel in specific square) and of the center of square) and depends on the position of pixel by utilized of the following procedure:

a) The 1’s quarter the distance \( d_{1} \) is calculated by utilized the equation:

\[ d_{1} = \sqrt{(|x-x_0| - 1/2)^2 + (|y-y_0| - 1/2)^2} \]  

(3)

b) The 2’s quarter the distance \( d_{2} \) is computed utilized the following equation:

\[ d_{2} = \sqrt{(|x-x_0| - 1/2)^2 + (|y-y_0| + 1/2)^2} \]  

(4)

c) The 3’s quarter the distance \( d_{3} \) is computed by utilized the equation:

\[ d_{3} = \sqrt{(|x-x_0| + 1/2)^2 + (|y-y_0| + 1/2)^2} \]  

(5)

d) Finally, this equation is the 4’s quarter the distance \( d_{4} \), can be computed by the following equation:

\[ d_{4} = \sqrt{(|x-x_0| + 1/2)^2 + (|y-y_0| - 1/2)^2} \]  

(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 moment feature of pixel \( F_{M_p}(i,j) \) in a definite square in the image by applying the following of relation:

\[ F_{M_p}(i,j) = F_p(i,j) \times d_{i} \]  

(7)

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

\[ MB(x,y) = \frac{1}{B_x \times B_y} \sum_{x=0}^{B_x} \sum_{y=0}^{B_y} M_p(x,y) \]  

(8)
Where, \( B_w \) refers to the width of square, and \( B_h \) refers to the height of square, and \( F_p(i, j) \) refers to the value pixel of selected square. \((I, j)\) is the (pixel indices) in selected square of image.

### 3.4. Clustering satellite image

In this step, the implementation of K-Means procedure is utilized by two input parameters, the first is moment feature values of wholly quadrangles of image and the second is the number of clusters. The moment feature is extracted for each image square and put away in the two dimensional array, and the K-Means procedure is useful 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 analysis

The Greece categorizing step is done after the gathering of highlights and kept in database. The categorizing method is based upon the checkup for spectering amount to all pixels in the (built-up database), based to the nearness for all (pixels) into the classes available in a database. Categorizing method are accomplished by determining the similarity evaluation \( (S_q) \) between each image (pixel) \( F_{xy} \), the average \( \mu \) by put on the (9), the maximum value \( S_q \) for pixel in image valuation for every class [25].

\[
S_q = (1 - |\mu - F_{xy}|)
\]  

(9)

### 4. EXPERIMENTAL RESULTS AND ANALYSIS

The greatest significant factors of utilized the Athens city area in Greece images having the five types of the classes and being applied as assistance for clarification. It completed to discourse the variances between a classes and learning the area of safe by every (class). An images occupied by the (Sentinel-2A) satellite covered in 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 stratify the categorize method, the database contains feature of moment element valuations for squares of image identical for the latter best centroids achieved from applying the k-means on the squares of image, where the number of repetition probable to grow gathering and best centroids before and after (Wildfires) the image of Greece shown in Figure 3 (a, b) are 6, 2 respectively a year (2007). The Five classes with best Centroids characterise feature for definite squares of categorized image. The Figures 5 and 6 show a classes with the best Centroids characterise feature for definite squares of categorized image. The Figures 5 and 6 show a classes with the best Centroids characterise feature for definite squares of categorized image. The Figures 5 and 6 show a classes with the best Centroids characterise feature for definite squares of categorized image. The Figures 5 and 6 show a classes with the best Centroids characterise feature for definite squares of categorized image. 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\[
\text{Area Covered (m}^2\text{)} = (\text{No. of Pixels})\times10^2
\]  

(10)

![Figure 5. Five classes with the best centroids before fires in 2007](image1)

![Figure 6. Five classes with the best centroids after fires in 2007](image2)

The categorizing results of images of Greece before and after (Wildfires) for years (2007) are presented in Figure 7. The trial results as presented in Figure 8 illuminated the region covered by every class before and after Wildfires in Greece for a year (2007) was changed and detects the damage caused by these fires and their effect on environment and soil.
In the other side, the number of cycles needed to get convergence and best centroids before and after (Wildfires) in the image of Greece as shown in Figure 4 (a, b) are 5, 6 respectively for a year (2018). Figures 9 and 10 describe the best centroids for the categorized image before and after (Wildfires) for a year (2018). The results of test appeared in Table 2 and 3 illuminated the region secured by every class before and after (Wildfires) in Greece for a year (2018) was changed and identify the damage caused by these fires and their effect on environment soil and soil. The categorizing results of images of Greece before and after (Wildfires) for a year (2018) is shown in Figure 11, its notice there are five unique classes.

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

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

Figure 9. Best centroids for five classes after fires in (2018).
Figure 10. Best centroids for five classes before fires in (2018)
The experimental from resulted about of the proposed categorizing approach presents that good of the performance accurateness of the image categorized taken by Sentinel-2A satellite and give the great analysis results about a damages about because 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)imageryis a polar-orbiting, multispectral high-resolution satellite that cover Athens downtown, 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 of resulted presents that good of the performance correctness in categorizing with five various classes (trees, water, bare lands, buildings with tree, buildings without tree ) and good result and analysis about 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
