Classification of the Earth Cover for the Regions around the College of Science / Thi Qar University from Satellite Imagery

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Abstract: In this study, we made a supervised classification of the satellite imagery for the neighboring regions around the Orientation of the College of Science in Thi Qar University to know the features of the earth cover accurately. These features may really effects the contents of the local environment inside the College, where some of biological tests and experiments are made.

The aim of this study is to get accurate information about the percentage of the land cover there from a high resolution image (3 m). Such image is very difficult to be classified by the standard methods of classification with the common software like (ERDAS Imagine). So, we develop our classification by certain manual treatments by using the tools of the (Adobe Photoshop) package to make final map and the accurate percentages.

Key words: Remote Sensing, Supervised Classification, Manual Classification, IKONOS Image, High resolution Classification.

تصنيف الغطاء الأرضي للمناطق المحيطة بموقع كلية العلوم/جامعة ذي قار من خلال الصورة الفضائية

الخلاصة:

في هذه الدراسة قمنا بتصنيف موجه لصورة فضائية للمناطق المحيطة بموقع كلية العلوم، وذلك لمعرفة معالم الغطاء الأرضي للمنطقة بدقة والتي قد تؤثر بشكل واضح على البيئة المحلية وعناصرها الغازية والجوية في أجواء الكلية، حيث تجرى هناك التجارب والاختبارات البايولوجية المتنوعة.

وكان الهدف من هذه الدراسة هو الحصول على معلومات دقيقة عن نسب معالم الغطاء الأرضي للمنطقة القريبة من مبنى كلية العلوم من تصنيف موجه لصورة فضائية عالية الدقة (3 م) ومثل هذه الصور لا يمكن تصنيفها بدقة بالاقتصار على برامج التصنيف الجاهزة مثل برنامج أردس (ERDAS Imagine 8.3.1) وهو البرنامج شائع الاستعمال في ميدان معالجة وتصنيف الصور الفضائية، فلجأنا إلى طرق يدوية لتحسين التصنيف بالاستفادة من تقنيات برنامج (Adobe Photoshop) لإنتاج الخارطة النهائية.

1- **Introduction**

From the Satellite Images, we can easily recognize some ground features like rivers, streets, buildings, and etc. But some times we need to calculate the amounts of these features, which are impossible by naked eye.

The new remote sensing softwares like ERDAS Imagine, provides good digital ability to read the value of every pixel in the image, and so it can classify every range of light values as spatial category. If this work depends only on the light (Electro-megnatic) response from the ground features, it is called unsupervised classification.

If we have enough information about the observed area, we can achieve such intelligent classification, because we know something the apparent things in the satellite image. This last knowledgement make us able to intervene in the digital classification process to distinguish between the similar, or overlapped features, this case is called supervised classification [**R. 1**].

2- Spectral reflectance and spatial characteristics of land features

The physical and chemical of materials define their spectral reflectance and emittance spectra that can be used to identify them. Then the spectral reflectance refers to the ratio of radiant energy reflected to that incident on a body [**R. 2**].

So that, the identification of many earth surface features is primarily the function of the spectral response of these features.

Figure (1) illustrates the spectral characteristics of several features, which may be common and effective.

The detection of electro-magnetic reflectance can be performed electronically by the satellite sensors, but some limited regions of the electro magnetic spectrum may be absorbed by the atmosphere which are called atmospheric windows [**R. 3**]. The sensors can not receive the responsibility of feature in these regions from the satellite, so they are neglected in sensor design. All these windows are laid out of the visible area from the e,ectro-magnetic spectrum.

We will deal with the visible range, which is enough to describe all surface features that we see in our region.

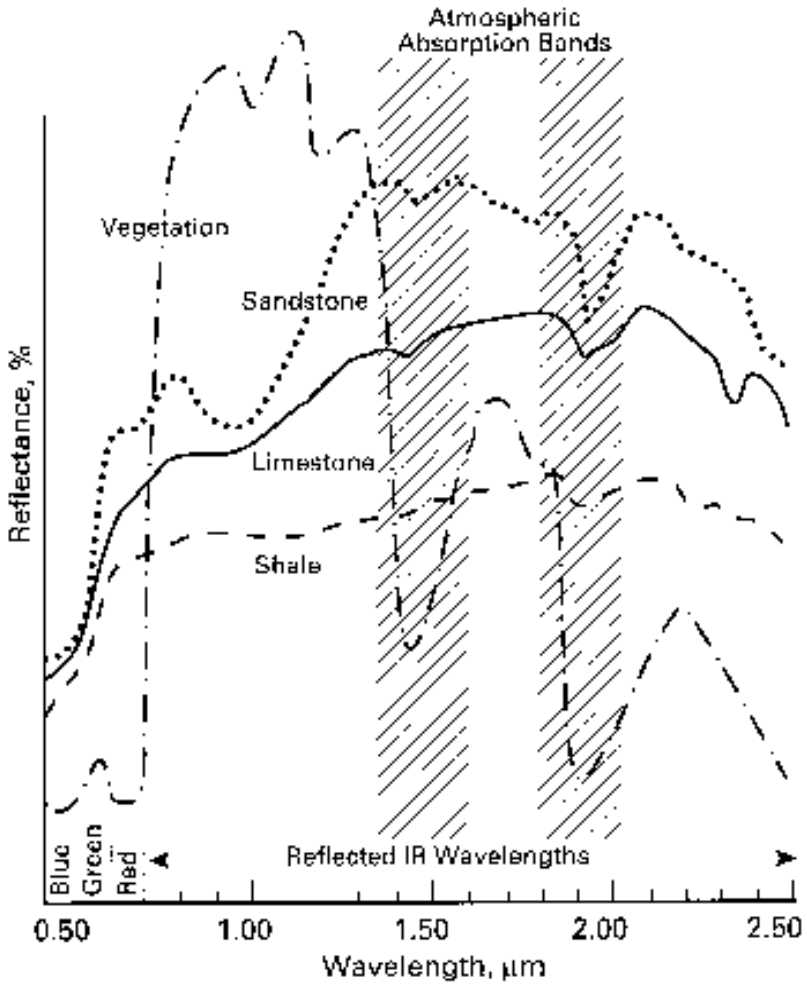


Figure (1): Spectral Reflectance of several land features, and spectral bands of typical remote sensors systems.

Note that the vegetation reflectance is very low in the three color components, but the green one is higher than others, so they appear green. While they have a thermal reflectance or emittance [**R. 4**].

Water appears black because it is like mirror, so the ray reflects on it's surface in one angle [**R. 5**].

The building shapes have straight lines, so they are easily recognized. Some modern research include a developed edge detection filters to distinguish the shapes of buildings [**R. 10**].

The rural areas have some differences, because of the multi cases of them. They are some times irrigated, planted, cropped, or have grass.

3- The effect of the land features on the local environment

The College of Science lies in Al-Naseriyah City, in the south-west side, at the latitude 31° 2’46.10"N, longitude 46°13’58.00"E [**R. 6**].

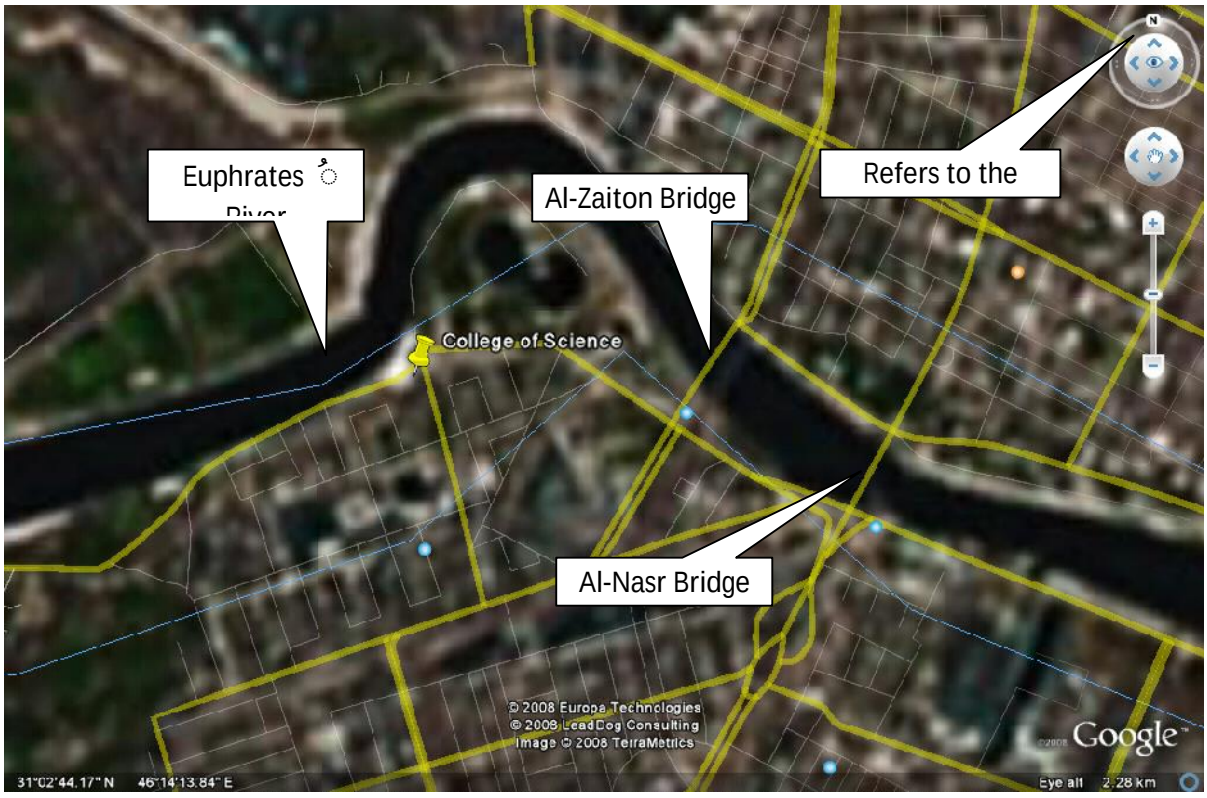


Figure (2): The region of the college of science, by Google Earth data base.

The college location is very good because it lies on the bank of Euphrates river, near a wide park, little residential housing, secondary street with light traffic, and on the other side of the river there is a wide agricultural field.

All these features will highly affect the local environment, which may give the region a special weather in some atmospheric elements.

It is will known that the vegetation and trees affect the percentage of Oxygen, Carbon Oxides, Humidity, temperature, and decrease air dust.

In the other hand, the traffic, buildings, and residential house consume Oxygen, and produce Carbon Oxide, as will as produce a noise.

The river helps to decrease temperature, and increase humidity. The wide fields on the other side of the river may help to reduce the percent of the air dust which is may irritates from the near areas.

The temperature, air dust, humidity, Oxygen and Carbon Oxides are greatly effected by the distribution of some features in the region of the College.

So our study today calculates the accurate percentages of all features that may affect on the local environments, by providing the accurate statistics about the regions neighboring the college to pave into other studies.

4- The satellite imagery of our work

The image in Figure (2) above was obtained by Google Earth, an it is a good software to scan all the Earth, but it's data base, specially about Al- Naseriyah, is old or sometimes not enough spatial resolution [**R. 6**].

We get an enhanced imagery of the region from Space Imaging –Midle East Company, IKONOS Satellite, of spatial resolution equal three meters. Figure (3) display the image [**R. 7**].

Figure (3): Our imagery. The upper box displays the building nearby.

It is more resolution, real color, recent (November /2006) than the Google image [**R. 8**].

5- The application work

We aim to classify the imagery as the most important feature categories, and then to draw a suitable map for the region. This will be achieved by some steps:-

5-1 Rough delineation and Visual interpretation (by eye)

The (3 m) resolution image enabled identification of features in the image such as single houses, farm land, trees, and roads. First an initial rough classification of areas and features in the image was performed in order to identify the essential features in the region. So, a visual tour by the ERDAS Imagine viewer is very important. We explore all the region, maximize, and minimize ground features to make a proper delineation. Reading pixels values in the feature pictures is very useful to know the variance between their colors, when we make a classification.

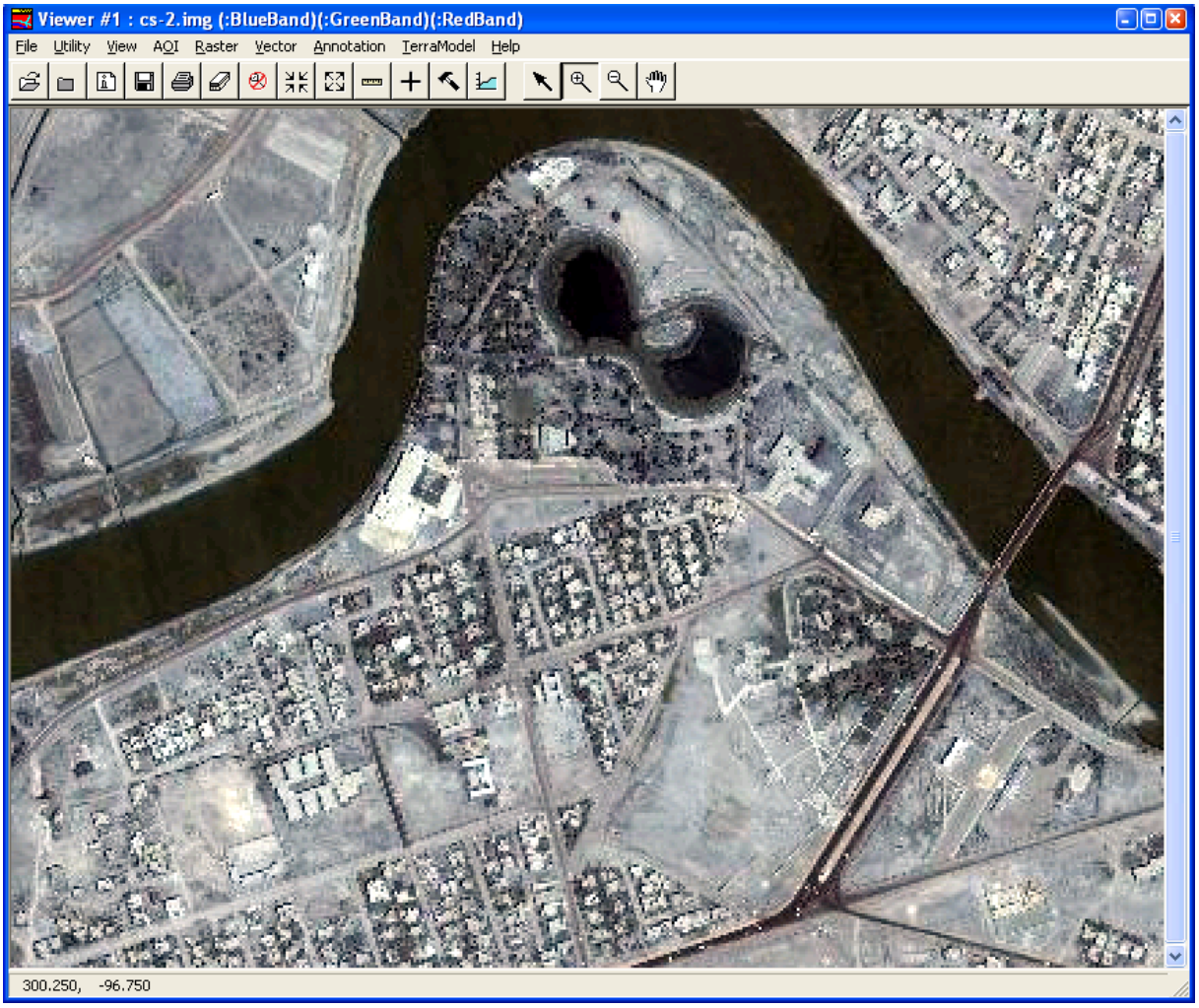


Figure (4): Our imagery in the Viewer of ERDAS Imagine 8.3.1.

By experience, we know that some enhancements may be essential, to make the image more contrast. This will make the adjacent different features clear.

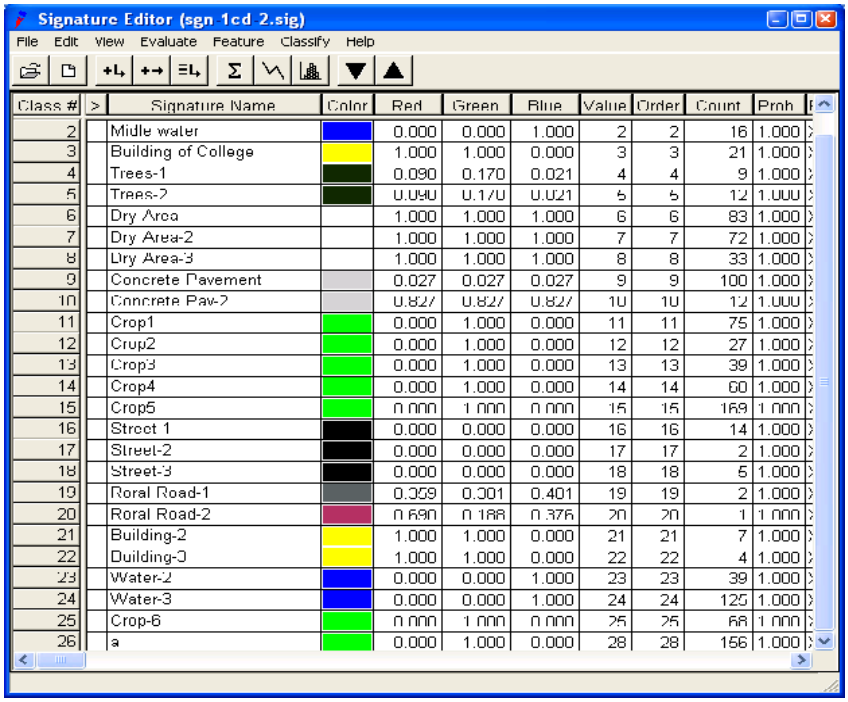
Then we make a supervised classification from the signature editor as in Figure (5) below, which displays a (26) categories.

We take up a number of categories for every type of surface features, because it is really more than one type in every feature.

For example, water has near black (24 Red, 44 green, 53 Blue) in the deep water, and dark blue color in the shallow water (68 Red, 82 Green, 167 Blue).

The Vegetation, has different color for palms, or other types. The crop, in the rural fields, is also different in color.

The colors of houses, streets, are also different.



Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob
2		Midle water		0.000	0.000	1.000	2	2	16	1.000
3		Building of College		1.000	1.000	0.000	3	3	21	1.000
4		Trees-1		0.090	0.170	0.021	4	4	9	1.000
5		Trees-2		0.090	0.170	0.021	5	5	12	1.000
6		Dry Area		1.000	1.000	1.000	6	6	83	1.000
7		Dry Area-2		1.000	1.000	1.000	7	7	72	1.000
8		Dry Area-3		1.000	1.000	1.000	8	8	33	1.000
9		Concrete Pavement		0.027	0.027	0.027	9	9	100	1.000
10		Concrete Pav-2		0.827	0.827	0.827	10	10	12	1.000
11		Crop1		0.000	1.000	0.000	11	11	75	1.000
12		Crop2		0.000	1.000	0.000	12	12	27	1.000
13		Crop3		0.000	1.000	0.000	13	13	39	1.000
14		Crop4		0.000	1.000	0.000	14	14	60	1.000
15		Crop5		0.000	1.000	0.000	15	15	169	1.000
16		Street 1		0.000	0.000	0.000	16	16	14	1.000
17		Street-2		0.000	0.000	0.000	17	17	2	1.000
18		Street-3		0.000	0.000	0.000	18	18	5	1.000
19		Roral Road-1		0.359	0.301	0.401	19	19	2	1.000
20		Roral Road-2		0.690	0.188	0.376	20	20	1	1.000
21		Building-2		1.000	1.000	0.000	21	21	7	1.000
22		Building-3		1.000	1.000	0.000	22	22	4	1.000
23		Water-2		0.000	0.000	1.000	23	23	39	1.000
24		Water-3		0.000	0.000	1.000	24	24	125	1.000
25		Crop-6		0.000	1.000	0.000	25	25	68	1.000
26		a		0.000	1.000	0.000	28	28	156	1.000

Figure (5): The multiple categories which we adopted in our classification.

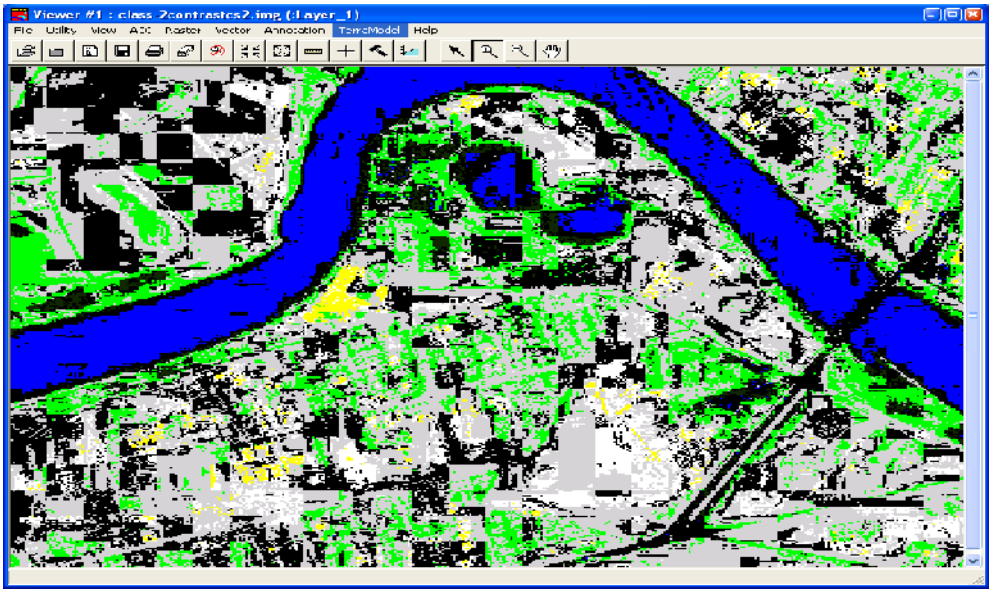


Figure (6): A pseudo color image represents the classification according to the categories in figure (5).

5-2 The Problems and weakness points in the classification

The resulted image is very good comparing with the classification image for the small area like our region, but there is an overlapping between some different features because of the approach in color between them and because of the shadow of trees and buildings. So that, some small roads are disappeared, some buildings are shown as rural areas, and some water lakes appear black like a street color.

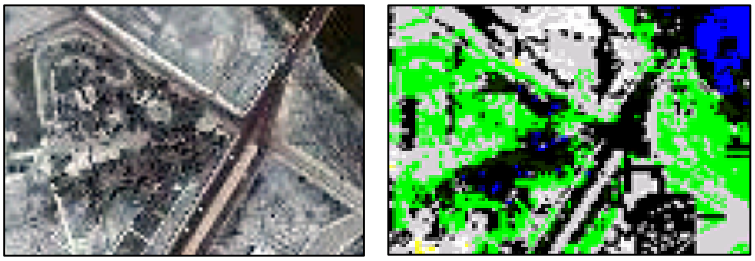


Figure (7): the overlapping between the trees and street.

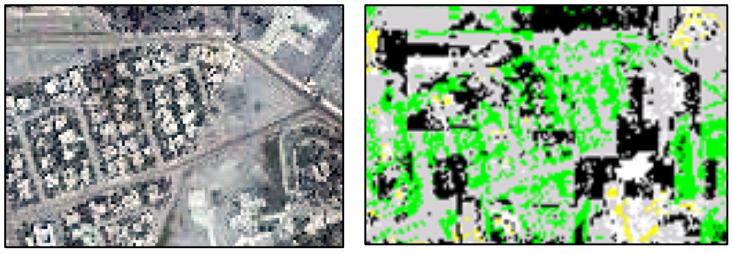


Figure (8): The approach in color among

feature make some streets to be disappeared.

Because of the high color resolution, there are a wide grading in color for the same feature (See Fig.(5)), this makes the classification very difficult and less useful.

It is well known that the high resolution imagery can not be easily classified [**R. 1**]. So, we make several changes in categories and enhancement for the image but it is still not good map.

We want to produce a map more accurate and clear than what the standard classification in ERDAS done.

So we will complete the work by following special ways and another software.

5-3 Development our work

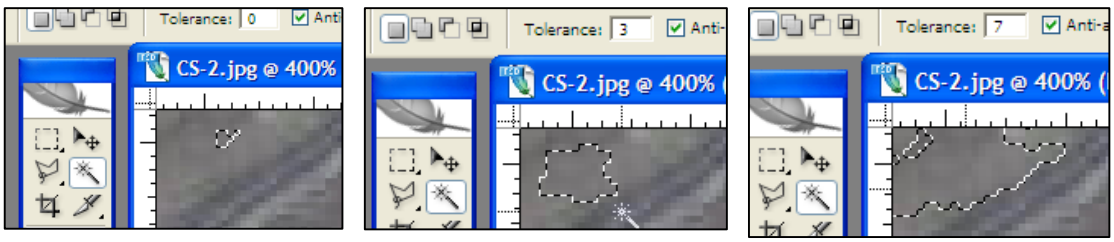
Now we should use another way to get proper results. We will use the Adobe Photo Shop CS-3 to complete the work.

This software has an excellent abilities to deal with layers, select a range of color with an accurate threshold and other techniques to edit the images [**R.9**].

In Adobe Photoshop we will make a manual classification for every feature alone to separate it accurately.

The magic bar in Photoshop has tolerance of color ranges, enables us to select the feature by it's color with wide grading. Figure (9) below, shows the benefit of the grading color selection of magic bar, when we select a point in the upper left side of the image which is a farm, only a small area was enclosed. Then when the tolerance was increased the enclosed area was

increased in the region of the same farm, this way enable us to select any feature in the high resolution image in spit of it's grading, which can not be done well by the common classification software.



(a) (b) (c)

Figure (9): By the magic bar tolerance we can select any grading feature.

(a) with tolerance = 0 (b) tolerance = 3 (c) tolerance = 7

The Photoshop then enable to select every pixels in the image which have the same color, so we will select all features in the

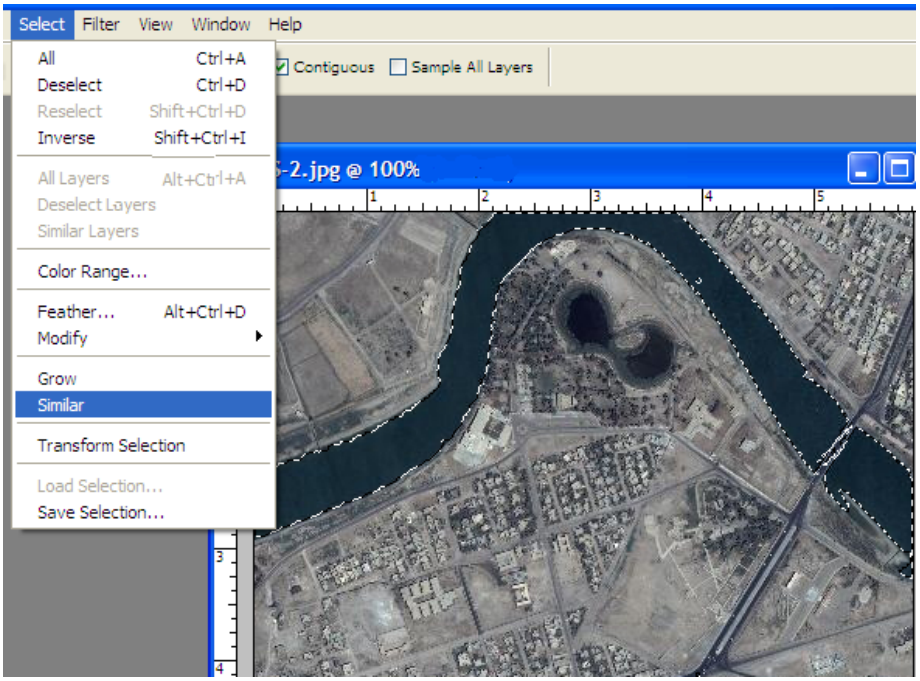


image according to it's color.

Figure (10): Photoshop enables to select the same feature in the image by the similar color gradient.

After that, we will inverse the selection to delete other areas. So, we will get an image for one feature only and consider it a single layer of our work. Then, it is easy in Photoshop to give the selected feature a single color to prepare for the resulted pseudo color which represents the final classification.

Figure (11) below, shows the step of our work, the color in the middle displays the water areas in the image only, and all other

features were erased. The right part in the Figure refers to the water layer which was taken blue color.

In Adobe Photoshop we can also to calculate the number on pixels which have the same color, and we can get the total area by multiplying by the resolution of image (3 m), i.e. every pixels equals (3 m * 3m), so it is very easy to calculate the percentage of features in Table (1).

The same steps were made for every features to produce the final results. We select the feature which really effect the environment contents in the region and help to give a proper delineation about the Oxygen, Carbon, Oxides, humidity, air dust, an temperature.

5-3-1 The layer of water

The water of the river and the small lake takes approximately black color in the image, so we easily selected the water region and delete all other ground features in this layer.

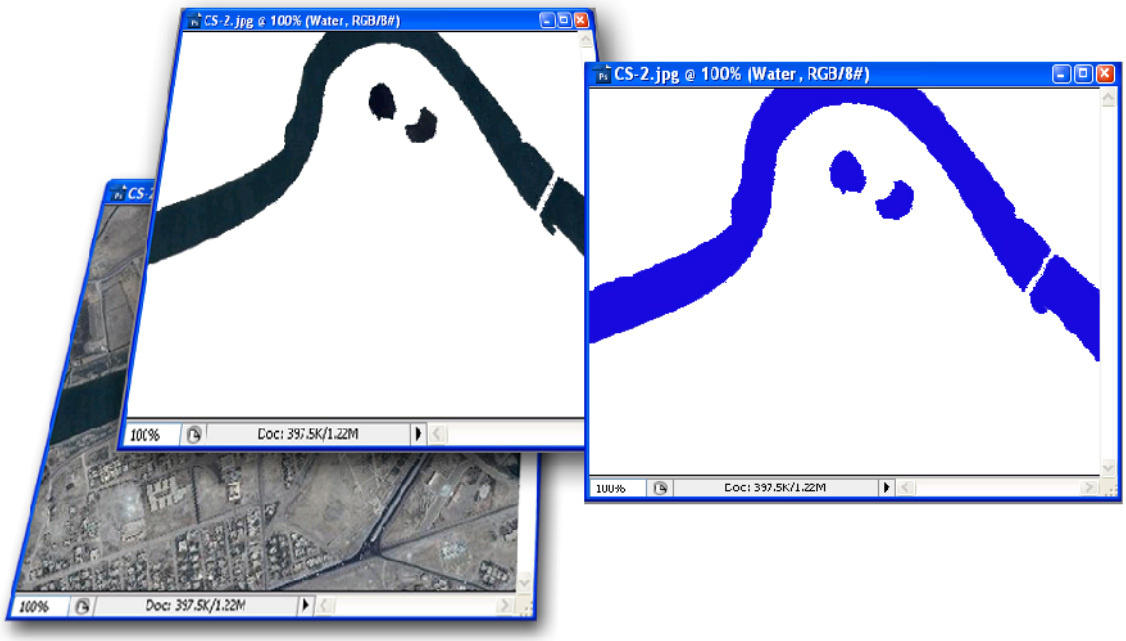


Figure (11): Layer 1 contains all water.

In the figure above we give a pseudo blue color to the water.

By calculating the number of blue pixels in the last map, we can find the whole area of water in the image, which is equal to (22206 pixels).

Every pixel equal to (3 by 3) meters or (9 squared meters), so the area of water in the region shown equal (9 * 22206= 199854 m^2).

So we can say, that there are approximately 200 squared meters covered by water near the building of the college in the boundaries of the imagery.

5-3-2 The layer of Trees cover

We can work on the second band of the imagery, because it is enough to describe the vegetation cover.

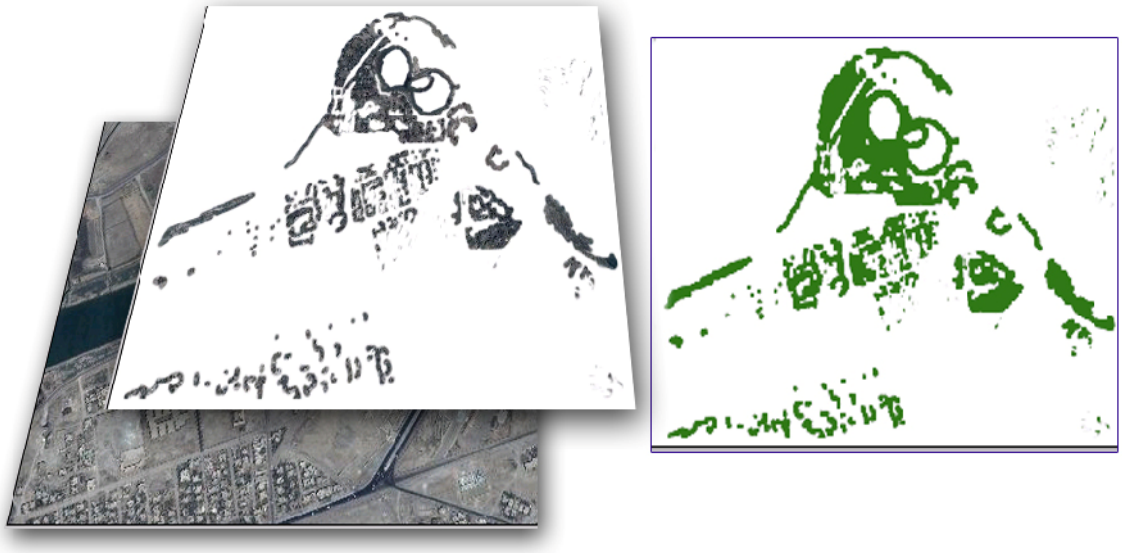


Figure (12): Second layer of the trees.

The number of the green pixel is (23251), so the whole trees area is (11251 * 9 = 101259 m^2).

There are several types of trees like palm or Eucalyptus trees, but we consider them as one layer.

The layer of trees is saved separately.

5-3-3 The layer of crop area

In the west side of the river, there are rural fields, some of them are covered by a light crop and some by grass. Wide areas are depressed. We take a covered area only.

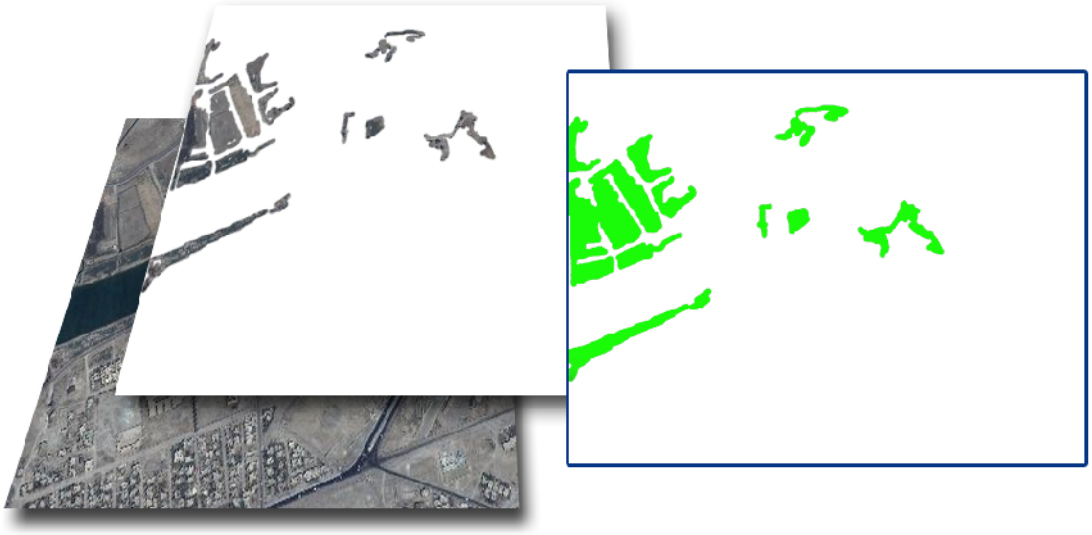


Figure (13): The third layer of the crop areas.

The number of green pixel is (10844), and the whole area of crop is (10844 * 9) = (97596 m^2).

5-3-4 Layer of streets and roads

We take the main streets and the rural streets together in one layer. Some rural streets need rather enhancement by the pen tool in Photo Shop.

The total area of the streets is approximately (3952 pixels*9) =(35568 m^2).

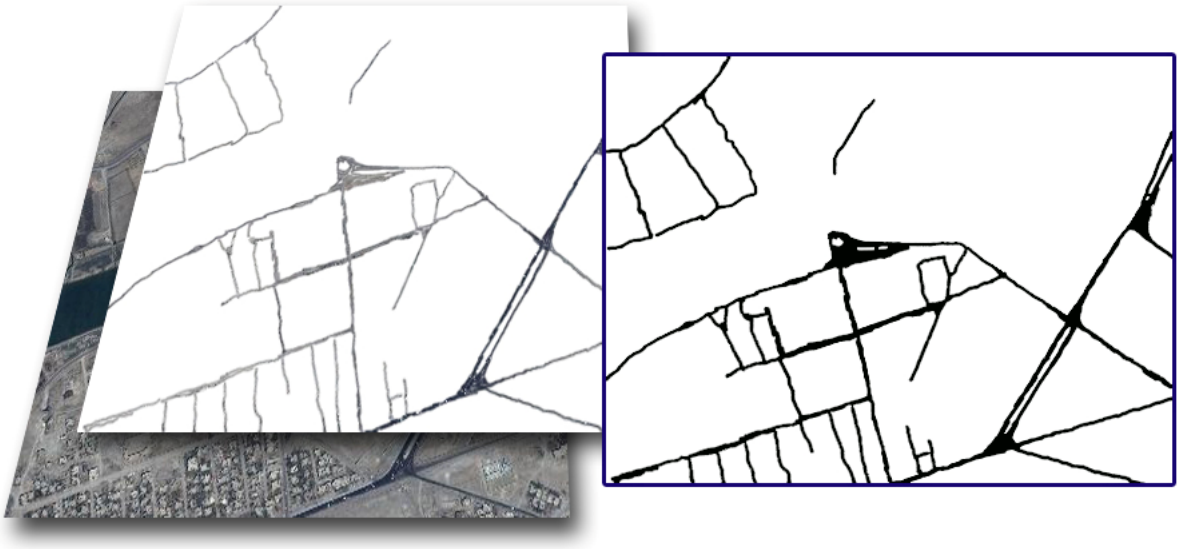


Figure (14): The fourth layer of the streets.

5-3-5 The layer of buildings

The shapes of houses always take straight lines, so they are easy to be limited. We make boundaries for the buildings to separate them as clear areas.

The total buildings area =(31911 pixels *9)=(287199 m^2).

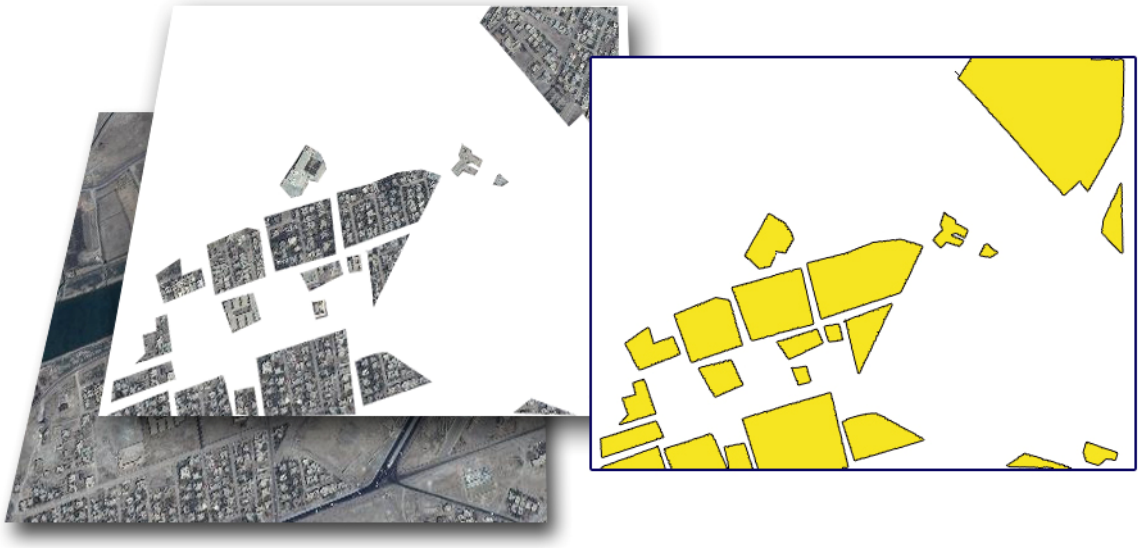


Figure (15): The fourth layer of the buildings.

5-3-6 Resulted map

Now, we merge all layers in one map represents all the important features with clear legend, as in the figure below.

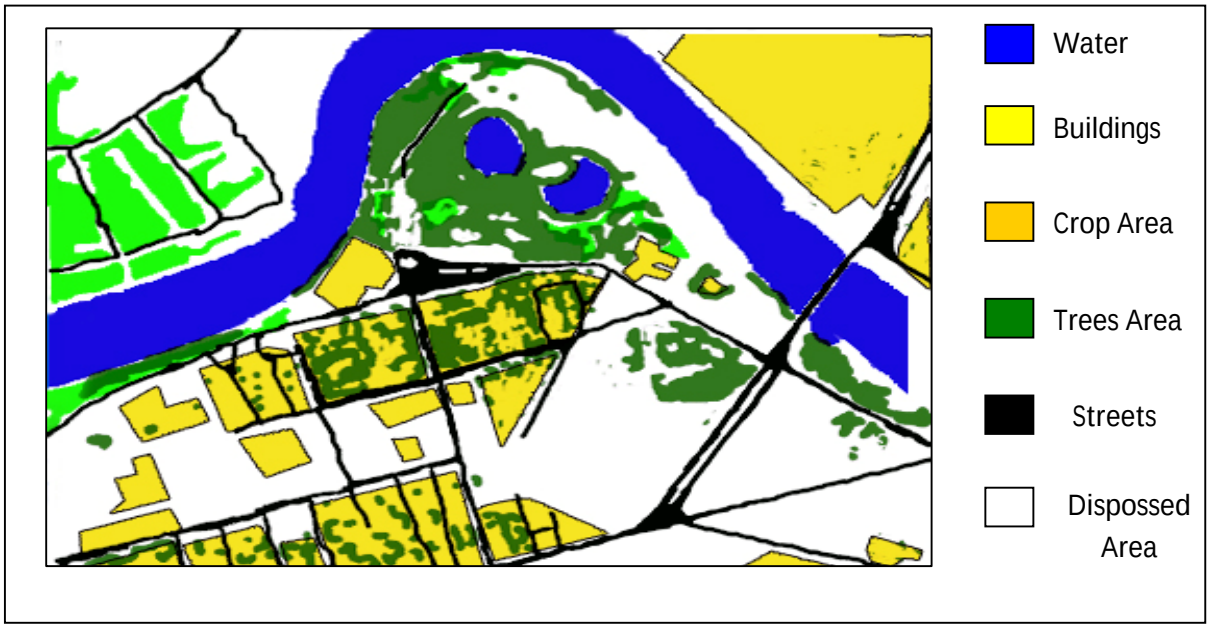


Figure (16): The last map.

The table below shows the percentage of the selected features. Note that there are wide areas neglected.

Table 1: The percentage of the land features in the image boundaries.

Features	Color	Areas (m^2)	Percent.	Description
Water		199854	16.4 %	The river and the small lakes in the park.
Trees		101259	8.3 %	Palm and Eucalyptus trees.
Crop		97596	8.0 %	Light grass and crop areas in the other side of the river.
Streets		35568	2.9 %	Street and paved road.
Buildings		297199	24.3 %	Building of the college and small houses.
Neglected		489644	40.0 %	
Total		1221120		

6 – Results

The high water percentage (16.4%) may rise effect the humidity in the region and decrease the temperature [**R. 11**].

The percent of the trees (8.3 %) may effect the gas air contents, humidity, and temperature. And their distribution may effect the winds speed and dust [**R.12**].

The percentage of crop area (8.0 %) may effect the temperature, humidity and prevent some dust causes [**R.12**].

The type and percentage of buildings (24.3 %), and the small narrow streets refer to the little pollution in the region or less oxides percentage [**R.13**].

7- The conclusion

1- This study is an introduction to pave the way to other studies aim to know the relation of the environment elements with the ground cover.
2- The classification of high resolution imagery is not beneficial, because of the overlapping of adjacent features and the shadows of trees and buildings, so we need sometimes to several methods to enhance the work.
3- The Adobe Photoshop is a very useful tool to make a part of the essential processing on the satellite imagery, specially when we need to separate layers or select the features by color.
4- In our work we made a manual treatments to complete our work by Photoshop, and these treatments can not be done by ERDAS Imagine or any other software which is specialized in Digital Image Processing of remote sensing.
5- Table (1) and Figure (16) display the percentages and distribution of the land cover feature in the region of the college.

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