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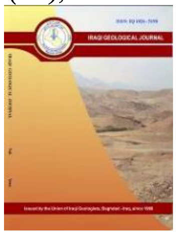

Dem Imagery for Investigation and Verification Najaf-Karbala Hill Formation by Using Remote Sensing Techniques

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Abstract

The development of the techniques of remote sensing and the software used to deal with data packets or digital technologies, to control vast areas in describing and diagnosing the formologies of the earth, which have become necessary in studying natural phenomena on the earth, knowing the origin of the earth and the interaction of factors that affect it and predicting future changes through Monitor, analyze and compare. The purpose of the presented study was to investigate and verify on Hill of Najaf-Karbala location, by applying remote sensing techniques and GIS template. To fulfill this goal in search, applied Digital Elevation Models (DEM) images were used in the study. The generation of DEM images applied for a geographic database is important in many applications. ArcGIS V10.5 is used to achieve this study and analysis of the study area to verify the goal. It is one of the major processing including in elevation assignment systems, and the traditional approach is manually identify elevation of contours from existing topographic map. It is the physical make-up of the land, including natural and manufactured physical features. Moreover, the DEM Image aid thought to verify and identify all features (series of hills, or small hills, knoll, Gullies, Spurs, and a gully is a small valley). Additionally, a spur is a sloping ridge jutting out from the side of a hill, and in some time in terrain, hillsides have been eroding to form a series of gullies separated by spurs. In this study, every bend in a contour either indicates gullies or spurs. In addition, it is crucial to be able to tell which gully or spur. Finally, The study verified that most regions of Najaf and Karbala lie on terrain formed big hills.

Keywords: STER Imagery; Digital Elevation Models (DEM) image; Remote Sensing Techniques; GIS programs; Najaf-Karbala Hill.

1. Introduction

The GIS feature is an effective tool and good management for the wide and widespread use of DEM images (Al-Badri, 2010; Yurtseven, 2019; Zhu et al., 2019; Forkuo, 2008 and Kettunen et al., 2017). DEM (Digital Elevation Models) data is made up of three sources 1. ground surveys, 2. photogrammetry and 3. digitization of cartographic documents.

The measurements of the survey must be very accurate and identical to reality and not have any errors, by collecting data from the surveyors and also must be very accurate in accordance with the

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geometry of the terrain and height to be accurate DEM accuracy is very high to be used on all small and large areas and all available applications (Ghazal et al., 2012).

The primary and secondary nodal data, which represent the general average of the highest elevations and heights, are then used to interpret the model of the aerial images of the scene or region representing the satellite images (ASTER), depending on the sampling of samples and their compatibility with good photographic images or Which have been processed (Al-Ramahi, 2020). Through manual digitization, semiautomatic application, or automatic dot scanning with contour lines, the numbering of mapping documents is performed and worked, and accuracy is based on the high quality of mapping resources and analog/ digital conversion processes (A/D) (Jasim and Hassan, 2020).

After these precise procedures, we get a coordinate from a regular network of elevations called DEM. Ideally, values are recorded from a topographic survey. The paper of topographic maps data are topographic and complementary data for the topographic survey (Aziz et al., 2020). In order to achieve the desired benefit and to exploit the possibility of GIS programs, accurate and up-to-date data should be provided to the study area to become a substitute for many efforts and provide facilities and quick and good help for many basic and engineering applications (Al-Ahmady and Al-Jarjees, 2020). Thus, the challenge has become realistic and tangible in transforming huge quantities and years and High and according to scientific methods, known to a digital representation can be worked on in the Geographic Information Systems (Al-Sulttani and Beg, 2020), which depend on digital number (DN) for digital elevation modeling (DEM) models, there is no actual and real comparison between (GIS) and other applications or software in the investment of this data and the real benefit in many ways and most important expenses and the number of employees and the speed of delivery with storage And the management of this data for other projects and side, as well as the possibility of maintenance and analysis and provide visual output much better than other applications, which are characterized by easy and flexible and beautiful display, which has become a competition for designers and architects (Rasheed and Al-Ramahi, 2021; Khanjer et al., 2020).

In this study, GIS is a good tool for the design, analysis, and display of topographic features of earthworks, based on (DEM) data. This is also a good source of data and other projects without repeating work on (DEM) models To the production of types of secondary photographers, which are used as maps later such as catchments and water basins and identify the tributaries that feed the lakes and types of photographers that determine the topographical nature of any forms of land hills and mountains (Ali et al., 2018; Al Fahdawi et al., 2021).

The region limited among Al Najaf and Karbala is a large complex of terrain in Iraq, generally, sand is covert land type, all present though attributed region to the desert. It is in the middle west of Iraq, the study area lies at 43.4760152E- 44.5415707E latitude and 32.7894972N-31.8600527N longitude, showon Fig. 1. Applied ASTER Borne Sensor system GDEM image (Global Digital Elevation Model) in 2009 produce, it has survey 60x60 kilometers, spatial resolution 15 meters), see Table 1. To achieve mosaic for many survey cover area of Iraq by GIS application and clipping boundary of Iraq (Ali and Mashee, 2014, Mashee and Zina, 2020).

Using the projection coordinate system WGS_1984_UTM_Zone_38N, measure unite are meters. Use background map to indicate and point correct work, one of these, satellite images of landsate TM sensor for bands 1, 2, 4 in 2002 survey producing, spatial resolution IS 28.5 meters. Second, maps papers were produced in 1998 for Ministry of Defense-military survey, pieces are form number I-38-U/NW, I-38-T/NE, I-38-U/NE, I-38-T/SE, H-38-C/NW, H-38-B/NE, SCALE IS 1:100000 (Mashee and Hadi, 2017; Abd et al., 2018).

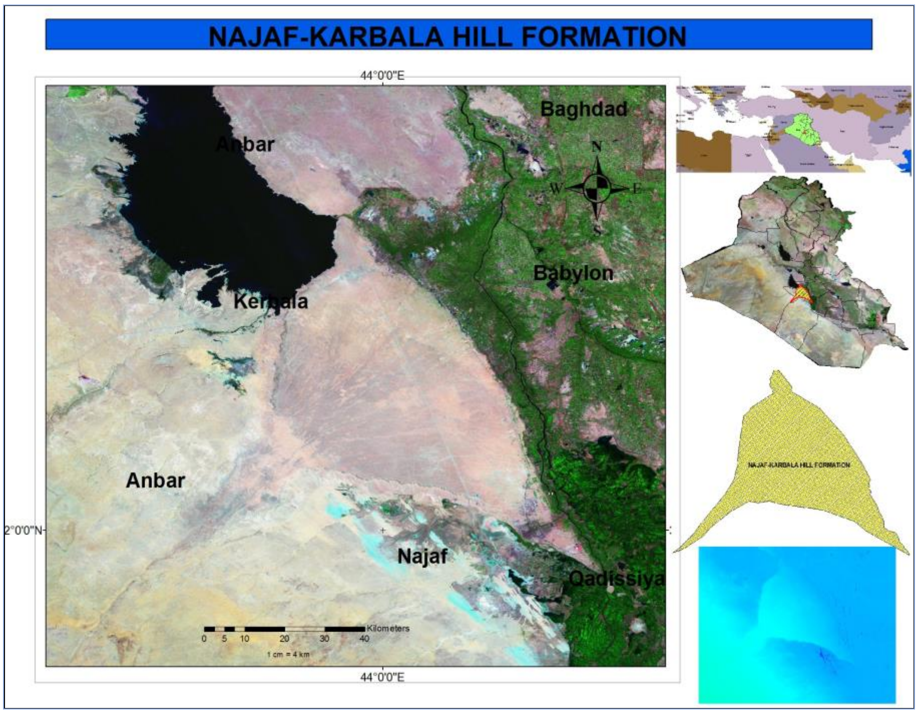

Fig. 1. The study area, the large map of Iraq represent back-grounds reference

Map of satellite image landsat TM and (a) DEM image clipping, (b) satellite image clipping from landsat TM image, (c) map paper mosaic of aerial photographs taken in 1998 representing the study area.

Table 1. Representation, the Specifications of Satellite ASTER Sensors Imagery

Sub-System	Band No.	Spectral Range(µm)	Spatial Resolution	Quantization Levels
VNIR	1	0.52-0.60	15 meter	8 Bit
	2	0.63-0.69		
	3N	0.78-0.86		
	3B	0.78-0.86		
SWIR	4	1.60-1.70	30 meter	8 Bit
	5	2.145-2.185		
	6	2.185-2.225		
	7	2.235-2.285		
	8	2.295-2.365		
	9	2.360-2.430		
TIR	10	8.125-8.475	90 meter	12 Bit
	11	8.475-8.825		
	12	8.925-9.275		
	13	10.25-10.95		
	14	10.95-11.65		

2. Materials and Methods

The main objectives of the present work consist of three stages:

Define the work area from the source DEM image for landscape (region limited between Najaf and Karbala), and geometry matching will be done by correcting with the coordinate system WGS_1984_UTM_Zone_38N.

Apply DEM images by using some techniques operating in GIS template, and distinguish detection investigation of this region representation hills.

Detection of changes a various types of hills by obtaining results analysis.

Compare results of Najaf-Karbala hills with other simple's hills.

In addition, apply classification techniques in order to illustrate and find the

3. Results

3.1. Image Classification

3.1.1. Elevation data

The elevation data is usually composed of test points that are separate from each other and have the smallest distances, such as spot elevations or contour lines. Through the interpolation technique, the DEM is created for these regions without relying on the rest of the other elevation data. This technique is implemented by a set of algorithms called surface interpolation for the conversion of continuous elevation and contours (DEM). The algorithm techniques include both such as weighted moving averages, bi-cubic splines, kriging, and finite elements (Ouma, 2016).

More commonly, DEM has been generated using Triangular Irregular Networks (TIN) from contour data within GIS (ARC/INFO software) designed specifically for becoming available elevation, as shown in Fig. 2.

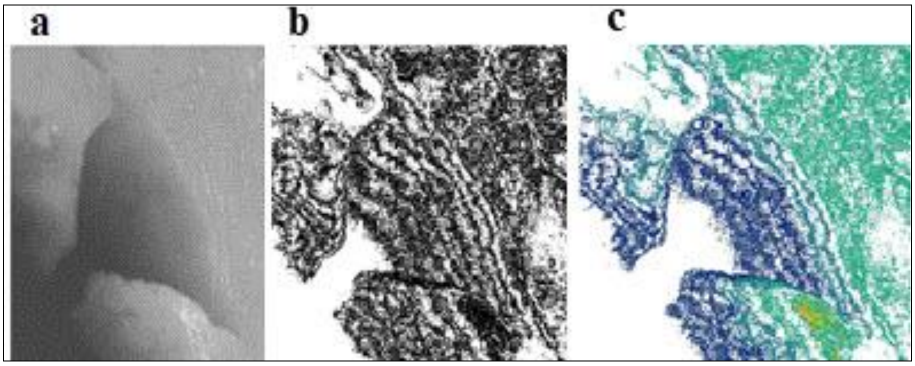

Fig. 2. (a) Representation Band 2 of DEM Image source; (b) apply contour operating on DEM Image source, with contour interval equal 10 meter and the symbolic is feature single color, contour operating had been bordered the elevation region; (c) symbolic contour are quantities graduate color for 5 classify represent various elevation and perform bordered clearly.

3.1.2. DEM modeling

A DEM is descripted by three components, the DEM resolution (grid cell or pixel), DEM accuracy, and DEM spatial extent.

To create a three-dimensional plan containing vertices and any irregular forms and compare them with realistic heights and known real accuracy, and because work on the technology DEM is essentially a process of technical creation, many of the secondary details and the most important is neglected at most and determined by the algorithm procedures applied in this model, Always be smooth, tuneful, soft and precise (Forkuo, 2008; Carrara et al., 2013; Amante, 2018).

Interesting is the focus on areas that are dangerous and difficult to control and that supports the reasons under which the task of creating DEM technology, which also depends on data input and accuracy, shown Fig. 3, to facilitate the management of natural hazards and difficult to reach successfully, Outputs of elevation data, and their applications Determining the modeling of inundation, flood areas, tidal phenomena, watersheds (dam construction) and assessment of damage from earthquakes, volcanoes and tsunamis phenomena.

Local elevation data were obtained from the United States Geological Survey (USGS) and GIS applications, using 1:25,000 and 1: 50,000.

After checking the height data, it matches the available local data such as the military area department data and the accuracy data for some research and related departments, such as the agriculture engineering, reforestation and archeology departments, which always have accurate data of 1: 25000. This measure gives correct data up to 90% Meters. As for the scale of 1:50,000, it gives true data up to 90% of the height of a 10 meters survey area (half of the perimeter boundary). The remaining percentages of the truth represent the average deviation from the real Earth's rise. Precision researchers can look for this mean deviation to declare 100% accuracy. Data was collected between these two groups and the smaller scale (1:50,000) was treated as the lowest scale for the entire region. Therefore, DEM partners have taken their data from the introduction of available data abundant in these two measurements as a basis for contour lines.

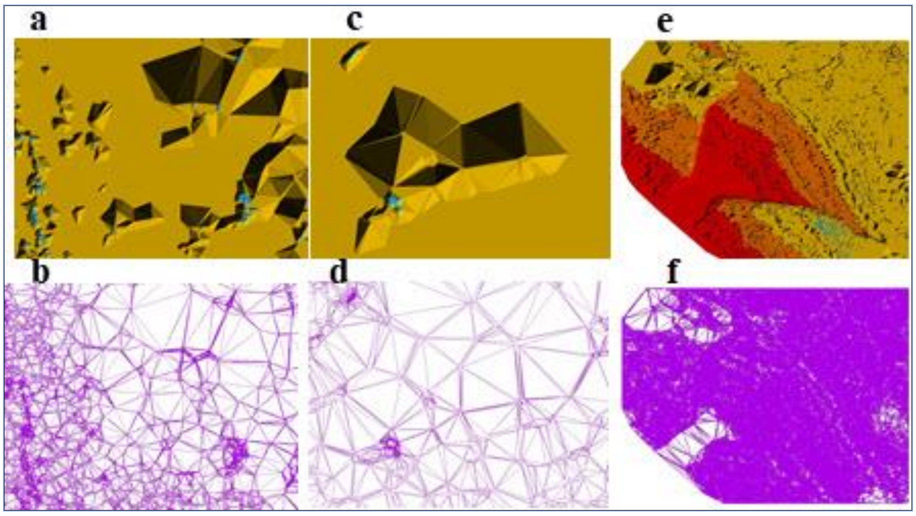

Fig. 3. Illustration, using Triangular Irregular Networks (TINs) operating, (a) represent middle landscape Regular Edge of elevation, (b) represent (TINs) of real elevation symbols classify 9 color, (c, d) represent large landscape regular edge elevation, and (e, f) represent regular edge study area elevation.

3.1.3. Topography features (formology)

The topography of a landscape represents the shape of the surface features. The word terrain refers to the physical structures of the land and includes natural and manufactured properties (human activities from the cultivation and construction of dams and water streams for watering, windbreaks and barriers that prevent the erosion of flood water), any human can study these terrains in human activity areas or deserts, and natural hazards such as earthquakes, volcanoes, and floods (Mashi, 2018).

Society is interested in topographic mapping to understand the topographical structure and understand all aspects, such as the study of the distribution of biological diversity of animals and plants and the rest of the microorganism and tiny microorganism, the knowledge of the soil types and distribution and their poor and rich areas, rain and distribution of communication networks and drainage of rainwater, geologists map science is essential for the work of topographic maps and is almost one of the most important works of geologists for the many tasks assigned to them and increase the wider dependence of the rest of science on these maps, because they show the structures rocky terrain, earthy cracks, the limits of earthquakes and volcanoes, fossil activities to extract wealth in the ground, dams, rainwater collection sites, floods and countless other tasks, as well as topographical structures for the benefits of many have opened up many prospects for other sciences to interest the compositions of surface and underground components. The seabed and the ocean to find and extract minerals and natural resources, as well as forming cells of scientists to assess and quantify natural hazards and predict such as landslides, volcanoes, earthquakes and the emission of vapors from off the ground, topographical maps are a natural extension of cartography, that use the same map elements and their determinants and contributed to increase the models, symbols, lines and complexity, which has become a familiarity with the knowledge of maps, topographical not easily learned and understood.

3.1.4. Contours and contour lines

Contour lines are zigzag lines placed on maps at one level that help us to interpret topographical shapes and landscapes such as hills, valleys and various slopes.

So, what are the contour lines? The contour lines describe the topographic height of any area of these lines. It is at one level, like an manuscript and connects the points that represent elevations to a level, which is a assumption symbol language in cartography of topographic (Mashee, 2017), and together with the sum of the symbols the topography map features and meta-guides on the ground for help and The subterranean manuscripts of the different terrain, such as mountain tops, hills, small and large, defined by periods, steep, flat slopes, steep edges and hill shapes, Scientific areas and exploratory teams easily help us to interpret and translate these lines clearly infinite, and also help us to form logical descriptions and understanding of environmental problems and natural phenomena, as well as identifying tracks and lines safe for any vital projects, show Fig. 4.

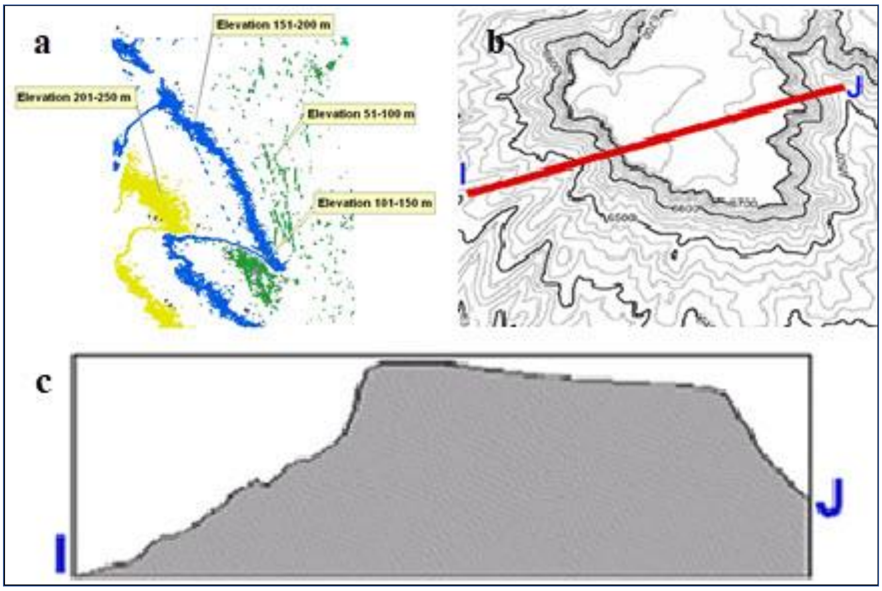

Fig. 4. Illustration (a) contour operating in GIS template with interval 10 m and the region Area elevation limited from 51m to 250 m, (b) representation widespread topographic map demonstration the uphill elongated with a rounded contour line represent cliff and spur and gully, (C) represent profile of cliff between points J and I.

- Hills types

Some important hill types separated in study area:

- **Knolls**

Fig. 5 illustrated hilltop and followed by a number of loop contours or several concentric loop contours depending on high the hill and the interval contour lines (distance) depending on the project or research type. Therefore, many types find of knoll, it is small, middle and large hills, some examples are shown below in Fig. 5.

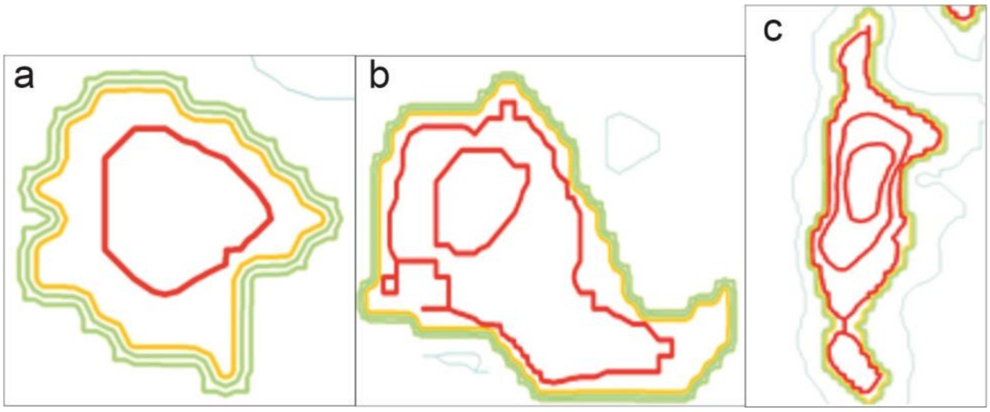

Fig. 5. Represent Knolls, (a) represent Roughly circular individual hilltop and hill line one; (b) represent Roughly circular hill top one and hill line two scattered; (c) represent hill top one and many contour interval and Concentric loop contours depending on how high the hill is. In addition, contour interval is using 10 meters in study area.

- **Elongate**

Generally, all elevations in the study area representation that have hills top type elongates small or large, in the state of find in type edges cliff of spurs and gullies series or separate. Sometimes, find in the study area too found two elongated flattish knolls along a long, shown in Fig. 6.

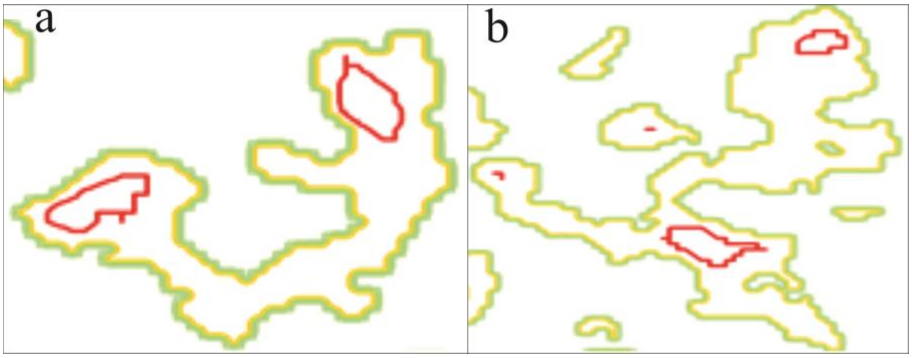

Fig. 6. Elongate hill, (a, b) represent Two elongated, flattish knolls scatter along a long, generally flat ridge a rounded by elevation out or in contour interval, which is representation here 10 meters.

- **Flattish**

Unlike the knolls and elongate, numerous parts of regions are finding hills top type flattish elongations, because of many factorizations, erosion is active with the physical make-up of the land, including natural and manufactured physical features. Too included some external appearance features, such as cliffs, spurs gullies (Fig. 7).

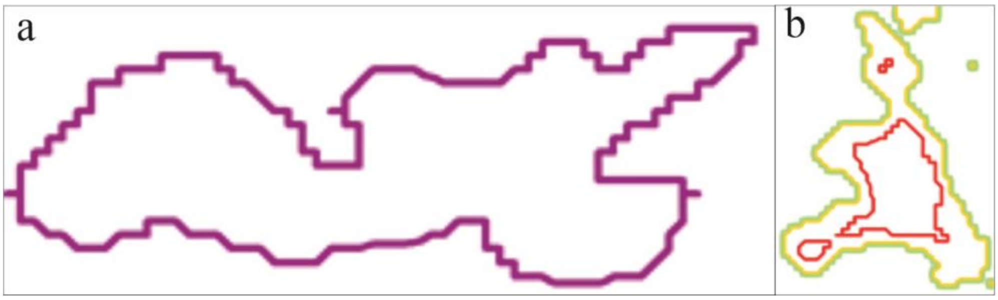

Fig. 7. Represent flattish hills, (a): represent hilltop flattish with 200-250 meters high of elevation and without contour interval included huge region in same elevation, (b): represent hilltop flattish with 50-75 meters high of elevation and too without contour interval included huge region in the elevation. As for the line around the red line represent various elevation unless from contour interval of red line.

- **Saddles**

It looks up to higher ground on two sides, and looks down to lower ground on the other two sides. Alternatively, a saddle, between higher ground to the east and west and lower ground to the north and south (Fig. 8).

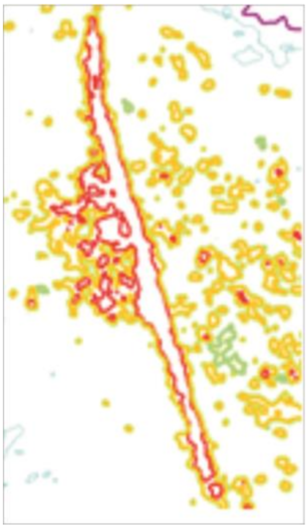

Fig. 8. Represent hill saddles (none organizes) shape, because natural and manufactured physical features by effect many factors. Non-organization, flattish and elongate, includes many of spurs and gullies, and represents always long ridge and many low or high of elevations

3.1.5. Contour characteristics

In the study area, find the shapes of hills to share many of the attributes.

None organizations, previously, can see that.

Most of region hills included less of many for hilltops, therefore, find only some low elevations represent hilltops.

Most various elevations above 50 meters find the hilltop types flattish or elongated and saddle.

Most elevations find divergence and disharmonious at wide intervals.

Sand fills the vacuum between elevation to be past time.

Most of region hills included spurs and gullies (Figs. 9, and 10).

"V" shape contours indicate streambeds and narrow valleys with the point of the "V" pointing uphill and "U" shape contours indicate ridges with the bottom of the "U" pointing down the ridge. A saddle is a ridge between two hills or summits, as shown in Fig. 10.

"M" or "W" shape contours indicate upstream from stream junctions.

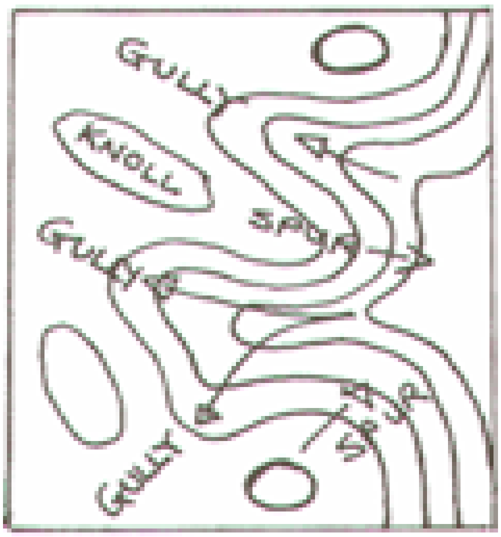

Fig. 9. Represent spur and gully type in contour map, generally, any zigzag lines represent spurs and gullies, the nearest lines bend of hilltop represent gully, unlike these are represent spur

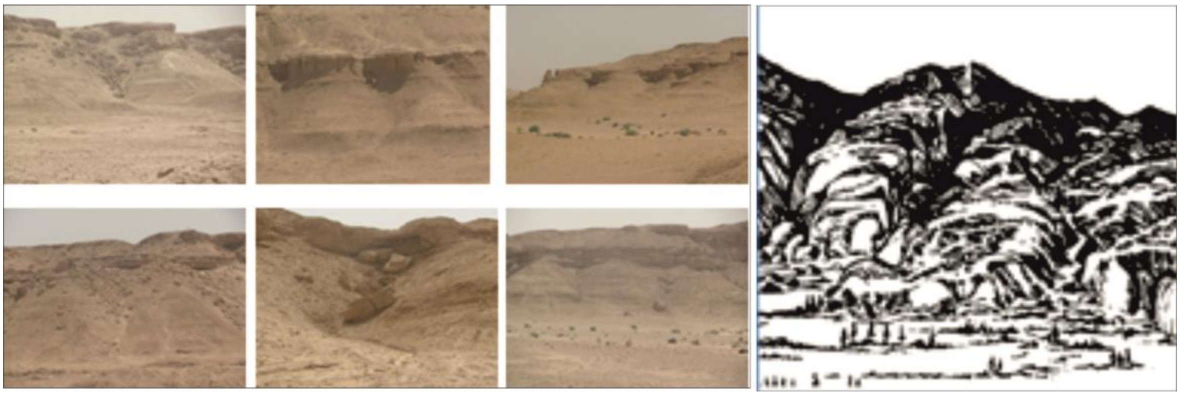

Fig. 10. Represent spur and gully actually, photographic took from end of ridge hills nearest south west Najaf city, notice, always the gullies are near hilltop and spurs are in the down hills, and notice, the shapes U, V, W, and M had been morphology in ridge of hills.

4. Conclusions

In this search, the study area is limited between Najaf and Karbala, by applying remote sensing techniques, and using GIS template which easyly controlled on region by using many layers in the study, and which is representing a huge of data set in work.

Few of the fact that it is impossible controlled on all regions, because of difficulties of rough region motion and no similar features shape. In GIS template use DEM map, the best manner with elevations traditional. DEM shows the various types of elevations.

Moreover, elevation verification is represented by hills type, and edge detection. After then, classification hills by using choice samples from work with GIS template, in order to background reference to other studies and knowledge understood the nature of region. Benefit optimization used this region from all sides. This result obtained comparison with other foreign results, especially, the feature shape of elevations, such as, downhill, hilltop, hillside, knoll, spurs, and gullies. In end of result obtained in this work effort, demonstration attempted offer the nature region, and verify this region topography has many features of hills, generally, shapes indicate this region included big hill elongated between Najaf and Karbala, clearly, from the above work when applying DEM imagery.

The study recommends to use field measurements of joints and seismic sections to indicate the effect of tectonic and structural activities on the origin of morphological features in the study area.

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References

Abd, M.M., Al Ramahi, F.K.M., Al-Mohammed, F.M., 2018. Assessment of irrigation water quality for Dabdaba for Mation by using GIS Techniques in Kar-bala Province. Indian Journal of Natural Sciences, 9(50), 14677-14684.

Al Fahdawi, Y.M.N., Al Ramahi, F.K.M., Alfalahi, A.S.H., 2021. Measurement Albedo Coefficient for Land Cover (LC) and Land Use (LU), using remote sensing techniques, a study case: Fallujah City. Journal of Physics, 1829 012003.

Al-Ahmady, K.K., Al-Jarjees, S.D., 2020. The usage of GIS for the DEVAS-TATED urban centers management and preservation of monuments/ study case: Nabi-Jarjis District in Mosul City in Iraq. Iraqi Geological Journal, 53(1B), 57-69.

Al-Badri S., 2010. Najaf Anchorage Noah's Ark. Najaf Heritage Magazine, 1(1), 7-91.

Al-Ramahi F.K.M., 2020. Spatial analysis of radon gas concentration distributed at Baghdad City Using Remote Sensing (RS) and Geographic Information System (GIS) Techniques. Iraqi Journal of Agricultural Sciences, 51(Special Issue), 21-32.

Al-Sulttani, A.H., Beg, A.A.F., 2020. Hypsometric Analysis of Al-Adhaim Basin Using a New GIS- Technique. Iraqi Geological Journal. 53(2B), 154-170.

Ali S.M., Mashee, F.K., 2014. Analyzing the terrorist operations in Baghdad using the RS and GIS Techniques. International Journal of Science and Research (IJSR), 3(11), 346-351.

Ali, A.B., Mashee, F.K., Kadim, S.N., 2018. Study spectral indices of land cover around al-shari lake and produce mapping by using remote sensing technique. Indian Jour-nal of Natural Sciences, 8(49), 14215-14224.

Amante, C.J., 2018. Estimating Coastal Digital Elevation Model Uncertainty. Coastal Research, 34(6), 1382–1397.

Aziz, N.A., Abdulrazzaq, Z., Mansur, M.N., 2020. GIS-based watershed morphometric analysis using DEM Data in Diyala River, Iraq. Iraqi Geological Journal; 53(1C): 36-49.

Carrara A., Bitelli, G., Carla, R., 2013. Comparison of techniques for generating digital terrain-models from contour lines. International Journal of Geographical Information Science, 11(5), 451-473.

Forkuo, E.K., 2008. Digital Terrain Modeling in a GIS Environment. The International Archives of the Photogrammetry. Remote Sensing and Spatial Information Sciences, 37(B2), 1023-1030.

Ghazal, N.K., Shaban, A.H., Mashi, F.K., Raihan, A.M., 2012. Change detection study of Al Razaza Lake region utilizing remote sensing and GIS Technique., Iraqi Journal of Science, 53 (4), 950-957.

Jasim, A.A., Hassan, M.A., 2020. SENTINEL-1 Processing and analysis to estimate ground displacement and identify activation faults, case study of the 2017 Mw 7.3 Earthquake, near the Iraq-Iran Border. Iraqi Geological Journal, 53(1D), 93-113.

Kettunen, P., Koski, C., Oksanen, J., 2017. A design of contour generation for topographic maps with adaptive DEM smoothing. International Journal of Cartography, 3(1), 19-30.

Khanjer, E.F., Hassan, W.A., Ismael, B.S., Gazal, N.K., 2020. Radon distribution in Baghdad Governorate by using remote sensing techniques. Journal of Physics: Conference Se-ries; 1530, 012152.

Mashee, F.K., 2017. Estimation the blast wave pressure effecters by apply Remote Sensing (RS) and Geographic In formation System (GIS) techniques. Iraqi Journal of Physics, 15(34), 87-98.

Mashee, F.K., Hadi, G.S., 2017. Study the wet region in Anbar Province by using Remote Sensing (RS) and Geographic Information System (GIS) Techniques, Iraqi Journal of Science, 58(3A), 1333-1344.

Mashi, K.F., 2018. Monitoring Al-Hammar Marsh topography and climatic applied satellied MODIS Imagery. Indian Journal of Natural Sciences, 8(47), 13705-13714.

Ouma, Y.O., 2016. Evaluation of multiresolution Digital Elevation Model (DEM) from Real-Time Kinematic GPS and ancillary data for reservoir storage capacity estimation. Hydrology, 3(16), 1-27.

Rasheed, M.J., Al-Ramahi, F.K.M., 2021. Detection of the impact of climate change on desertification and sand dunes formation east of the Tigris River in Salah Al-Din Governorate using remote sensing techniques. Iraqi Geological Journal, 54(1A), 13-23.

Yurtseven, H., 2019. Comparison of ASTER, contour lines and LiDAR based DEMs in terms of topo-graphic differences in forested area. Eurasian Journal of Forest Science, 7(2), 166-186.

Zhu, Y., Liu, X., Zhao, J., Cao, J., Wang, X. Li, D., 2019. Effect of DEM interpolation neighbourhood on terrain factors. International Journal Geo-Information, 8(1), 30-48.