Remote Sensing in Archaeology: A Brief Review

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الاستشعار عن بعد في علم الآثار: ملخص استعراض

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تاريخ تقديم البحث للمجلة: ٢٠٢٠/٧/٢   تاريخ قبول النشر: ٢٠٢٠/٩/٦

Abstract:

In recent years remote sensing has become one of the most frequently used techniques in archaeology. As a modern technology, its history rooted in the 19th century, fundamentally to record the landscape and its structures through remote sensing photography system. With its various techniques in the field of archaeology, remote sensing offers the rapid acquisition of a huge quantity of metric and qualitative data in order to identify or describe archaeological sites. Archaeological remote sensing application help, with the creation of maps and obtaining useful data for the detection of buried archaeological sites that are related to the physical and environmental parameters. Another potential use of the technique by the archaeologists is to identify and interpret land use patterns as well as the monitoring and preservation of cultural resources. The remote sensing system is a multi-disciplinary science which composed of many other technologies from other disciplines and all act as one complete system known as Remote Sensing. Multiple studies have successfully proved the effectiveness of the remote sensing in archaeology to reveal known and unknown archaeological sites. Yet, to our knowledge, the use of such non-destructive technique in the field of archaeology is very limited in our studies, especially by the local researchers. Regarding Iraqi Kurdistan region very few researches relied on remote sensing techniques in their studies and almost all the studies, which used the technique, done by foreign teams. Regarding this point of view, the main reason would be the lack of information by the local researchers or the difficulty of accessing the satellite images. The main purpose of this paper is to present a brief overview of the use of remote sensing with its main principles in archaeological research and site discoveries.

Keywords: Archaeology, Remote sensing, Aerial photography, Satellite images, Interpretation of satellite images.

ملخص البحث:

في السنوات الأخيرة، أمضى الاستشعار عن بعد من أكثر التقنيات الحديثة استعمالاً في علم الآثار. كتقنية حديثة, يعود تأريخها استخدامها إلى القرن التاسع العشر وبشكل أساس لتسجيل المناظر الطبيعية وما يحيط بها من خلال الاستشعار عن بعد والتصوير الفوتوغرافي. بفضل التقنيات الحديثة المستخدمة في مجال علم الآثار, نستطيع الحصول على كميات هائلة من البيانات والمعلومات الدقيقة عن ماهية ونوعية المواقع الأثرية. في مجال الآثار يساعد تقنية الاستشعار عن بعد في إنشاء خرائط دقيقة والحصول على البيانات التي تساعدنا في الكشف عن المواقع الأثرية المدفونة تحت سطح الأرض التي لا نراها واضحة بالعين العادية. يمكن الاستفادة بشكل كبير من هذا الحقل العلمي في مجال تحديد وتفسير أنماط الأراضي الزراعية وكيفية الحفاظ عليها. نظام الاستشعار عن بعد والذي يدخل ضمن عمل العديد من التقنيات والتخصصات العلمية والعملية, إذ يعرف النظام بأكمله باسم الاستشعار عن بعد. أثبتت الدراسات الحديثة مدى فاعلية هذا الجهاز للكشف عن المواقع الأثرية الظاهرة وغير الظاهرة (غير المرئية), على الرغم من محدودية استخدام هذه التقنية غير المدمرة في مجال علم الآثار, وخصوصا في دراساتنا الأثرية من قبل الباحثين المحليين في إقليم كوردستان/ العراق, حيث استخدم هذه التقنية عدد ضئيل من الباحثين واغلبهم من الأجانب, والسبب الرئيس في ذلك هو نقص وقلة في المعومات من قبل الباحثين المحليين وصعوبة الوصول إلى صور الأقمار الصناعية. الغرض من اختيار هذا الموضوع هو تقديم لمحة موجزة عن استخدام الاستشعار عن بعد مع مبادئه الأساسية في البحث الأثري للكشف عن المواقع الأثرية.

<u>كلمات مفتاحية</u>: الآثار، الاستشعار عن بعد، التصوير الجوي، صور الأقمار الصناعية، تفسير الصور الفضائية

1. Introduction

Archeology is characterized as the systematic approach to uncover the human history and its surroundings. Archeology includes not only systematic excavations and surveys, but also field data research. Archeology is an interdisciplinary science, in a broader word (Hadjimitsis et al., 2013). Remains tend to be buried and forgotten, so that archaeology has developed a variety of methods for recovering the human remains. Archaeology has borrowed and adapted many other techniques, theories and methods from other disciplines but have been modified and made them to be very much archaeological (Drewett, 2011).

Modern archaeological studies include a variety of other disciplines, such as geology, Geography, chemistry, biology, anthropology, statistics, etc. Remote sensing has gained significant attention in recent years because it can assist archaeological studies, along with other sciences, to collect useful knowledge based solely on non-destructive and non-contact techniques to researchers. The Remote Sensing is essentially a multi-disciplinary science that involves a variety of different disciplines such as optics, spectroscopy, imaging, computers, electronics and telecommunications, satellite launching etc. all these technologies, used in the Remote Sensing Science, and are combined to operate as one full device in itself (Aggarwal, 2004).

The significance of using satellite images as a safe method to discover traces of ancient human occupation and past archeological sites has been stressed by national and international space agencies such as NASA and ESA, supported by UNESCO and now acknowledged by archeologists and the scientific community of remote sensing.

Remote sensing has offered new horizons and new archaeological study possibilities. For instance, different techniques of aerial photography, oblique or vertical, can detect anomalies on the surface associated with subsurface remnants, whereas the use of infrared and thermal electromagnetic radiation can be used to identify archaeological underground remains. The technique allows us to obtain data about surface materials from a distance. Remote sensing techniques enable’s scientists to understand the earth more than any other time before through these sophisticated techniques (Ashraf et al., 2011).

Satellite remote sensing has applied to archaeology effectively since the second halve of the last century. Satellite images largely employed in archaeology to study or identify completely unknown archaeological sites or partially known sites. The identification and observation of archaeological traces are very hard; this is due to many factors such as natural and manmade obstacles (trees, buildings. etc.).The high resolution of remote sensing images in the last decade opens new perspective in archaeology. Satellite data sets are effective in detecting archaeological spatial features; this is due to the traces left by the human’s activity on the surface. The traces normally appear as damp, crop and soil marks and this is mainly because of any hard buried structure under the vegetation or due to differences in moisture content.

In addition archaeologists can rely on remote sensing techniques during their investigation of an archaeological site before, during and after the excavation proses. In terms of subsurface remains, geophysical surveys can provide valuable information at the micro-level scale. On the other hand, traces of human past can be identified by aerial photographs and satellite remote sensing techniques at the macro-scale. These techniques have the ability of monitoring the surrounding area of a cultural heritage site simultaneously and record any changes due to urban expansion and/or land use changes (Lasponara and Masini, 2012).

The process of archaeological site identification through satellite images is a complex task and related to many other facts such as solar radiation, vegetation and the variation of archaeological site structure. Hence, remote sensing data in archaeology is an important means of gaining information about physical properties on the earth's surface from different types of land surface. Currently, remote sensing in archaeology provides new opportunities to evaluate characteristics of archaeological sites, which can facilitate the understanding and interpreting the total site structure with its surrounding (Abdullah et al., 2020). There are several satellite platforms with different specifications capable to provide archaeological land surface data from ground-based techniques, airborn and spaceborn platforms such as, multispectral and hyperspectral imaging, synthetic aperture radar (SAR), light detection and ranging (LiDAR) (Fig. 1). Archaeology is one of the first fields used elevated remote sensing platforms starting from kites followed by hot air balloons, aircraft to space stations and finally satellites (Luo et al., 2019).

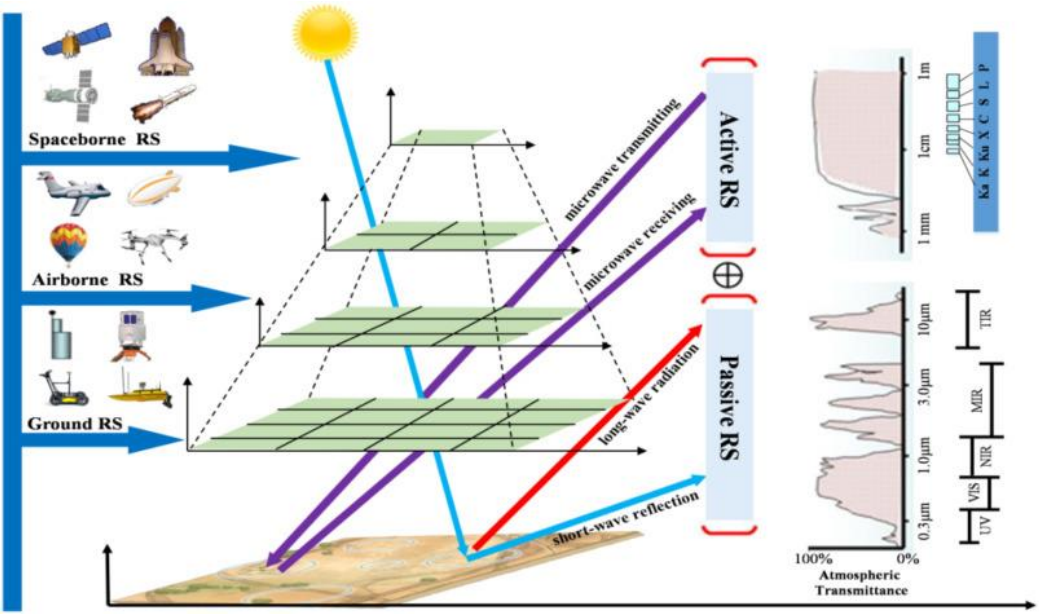

Fig. 1. The schematic illustration of remote sensing platforms (created by Lei Luo)

2. Principles of remote sensing

Remote sensing is defined as a technic of obtaining information about an object or phenomenon through the analysis of collected data from sensors without making any physical contact with the object (Levin, 1999; Parcak, 2009) or can be defined as the science of identifying, observing, interpreting information, and measuring objects or surface without coming into direct contact with them (Campana, 2016). This can be done through mounted devices on aircrafts or any other platforms from the space. Remote sensing includes any techniques or methods that allow the use of electromagnetic radiation in order to identify and detect various phenomena from the earth (Sabins, 1997). According to these definitions, many techniques such as satellite remote sensing, aerial photography, geophysical surveys, ground spectroscopy or even terrestrial laser scanners, are considered as remote sensing techniques (Johnson, 2006). The main concept of remote sensing, therefor, is the acquisition of data on the earth's surface without making any physical contact with the object or phenomena. The most used remote sensors are human eyes. Our eyes work as a remote sensor by collecting information through eyes, without having any physical contact, and then transmitted by (Optic nerves) finally; the obtained data would be collected inside our brain. Comparatively, it's the same for remote sensing techniques. The remote sensors collect information within their resolution cells without making any direct contact with objects on ground. The basic principle of remote sensing is the reflected electromagnetic energy and then storing the reflected energy detected by the sensor which is far from the sensed object.

The process of remote sensing data acquisition and analyzing the achieved information in principal consists of three fundamental components (signal, sensor and the sensing). It all starts from a reflected energy that comes from an object or phenomena from the earth and part of the reflected energy would be captured as data by the sensor. The achieved data is send to a receiving station which is called sensing. In the receiving station, automatically some pre-processing takes place and then the data is handed to the users to be analyzed for their application (Panda, 2012).

Basically, remote sensors are composed of two main parts, the sensor and detector in which they detect and record the reflected energy from the surface objects. Each type of sensor detects different part of the electromagnetic spectrum, which means each material in nature sends back different signals to the detector. The sensor obtains information through the atmosphere in the form of radiation. The function of the recording system is to convert the recorded data from the recording system in to a readable form. This is accomplished by filtering the recorded energy through inner system and dividing it by beam splitters into different wavelength bands in order to produce electrical signals by converting the detected energy. Consequently, a digital format of radiometric data is achieved in the electrical signal process. Nevertheless, detection and separation of objects or surface highlights implies recognizing and recording of brilliant vitality reflected or radiated by objects or surface material. Different objects in different bands of the electromagnetic spectrum return different amounts of energy, incidental to it. This depends on the material properties (structural, chemical, and physical), surface ruggedness, angle of incidence, strength, and radiant energy wavelength (Aggarwal. 2004).

Digital processing of remote sensing data with the advancement of modern technology has provided a revolution in the field which was at the starting point providing data in digital format and then processing the data digitally. Indeed for doing this an effective computer program with a dedicated image processing application and software is required. Meanwhile, "the computer cannot replace the knowledge, experience and understanding of the image interpreter (archaeologist) but can allow quantitative analysis of huge data sets and make the information extraction and interpretation easier also for large areas under investigation" (Lasponara and Masini, 2012, P.8).

2.1 Natural and artificial remote sensing

As it has been highlight by Weng (2013), remote sensing is the art and science of recording, measuring, and analyzing information about a phenomenon from a distance. As human being we sense our world through our senses some of our senses need direct contact with the subjects while others can be sensed from a distance. This is the same for remote sensing techniques. Geophysical techniques, which are used to reveal subsurface objects, such as (Ground penetrating radar (GPR), electromagnetic methods and electrical Resistivity Survey) need to have a direct contact with the ground to sense the buried features. We, as humans, perceive the surrounding world through our five senses; eyes, noses, ears, tongue and skin. Some of our senses such as touching and testing for collecting information need direct contact with the object while others such as seeing, and hearing doesn't require direct connection with the objects. In this sense, we are performing remote sensing all the time (Panda, 2012). These make humans to be natural remote sensors. On the other hand, to study large area on earth's surface archaeologists and other related subjects use variety of devices such as remote sensing. These sensors are mounted on platforms such as helicopters, planes, and satellites that make it possible for the sensors to observe the Earth from above. The transmitted energy from the earth's surface are vary therefore the transmission of energy from the ground are also different. Because of this differentiation most sensors record information in different portions of the electromagnetic spectrum. Consequently, energy variation helps to create images of the earth's surface. Sensors see this variation of energy in both visible and nonvisible areas of spectrum, while human eyes detect this variation of energy in visible portion of spectrum (Baumann, 2009).

2.2 Passive and active remote sensors

Sensors can be partitioned into two groups Passive and Active remote sensing (Fig. 2). Passive sensors rely upon an outer source of energy in which it measures the reflected daylight emitted from the sun. The most well-known passive sensor is the photographic camera. Active sensors have their own source of energy, it actively sends out sound waves and measures the reflected waves coming back to the sensor; a model would be a radar gun. These sensors send out a signal and measure the amount reflected back. Active sensors are more controlled because they do not rely on shifting brightening conditions (Ashraf et al., 2011).

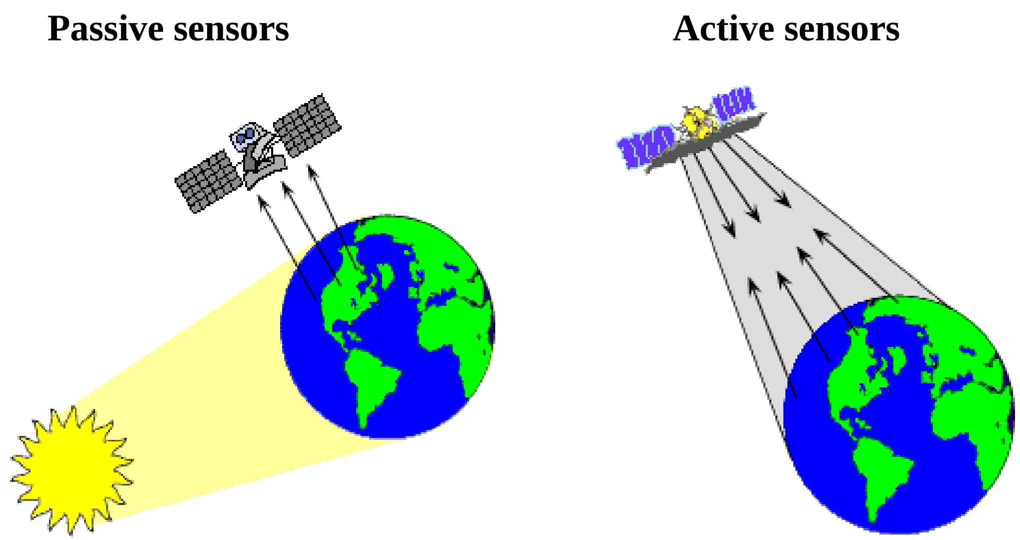

Fig. 2. Showing the two different types of remote sensing sensors (Passive & Active) sensors (Google Image)

Cameras can be both active sensors and passive sensors. With the flash turned on the camera sends its own source of energy. After it illuminates the target, the reflected energy would be captured by the camera when it comes back to the lens. It means that cameras are active sensors when the flash is on (Fig. 3).

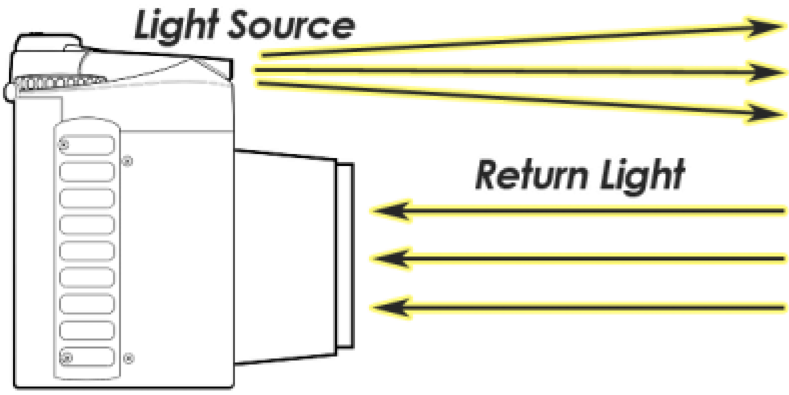

Fig. 3. Explaining the way how active sensors work by sending its own energy (Source: https://gisgeography.com/passive-active-sensors-remote-sensing/)

On the other hand, cameras can become passive sensors when the photographer doesn't use flash, but instead it relies on naturally emitted light from the sun. Without the sun, there wouldn't be passive remote sensors (Fig. 4).

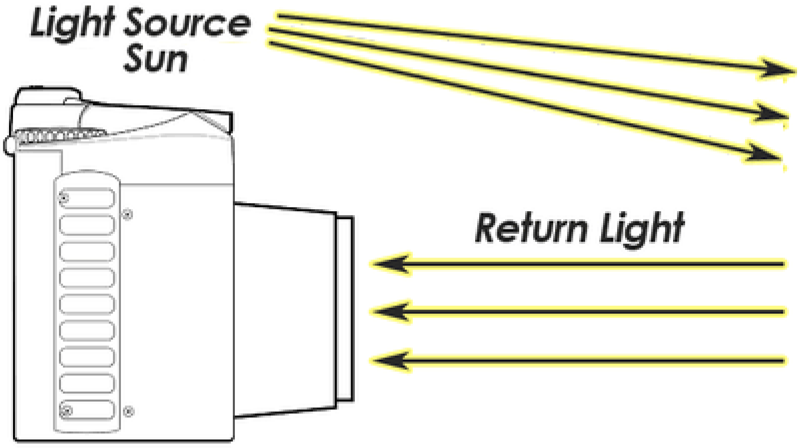

Fig. 4. Remote sensors could be passive when they rely on sun or other energy sources (Source: https://gisgeography.com/passive-active-sensors-remote-sensing/)

3. Principles of Archaeological Photo Interpretation

Virtually all of the techniques of remote sensing depicted here are initially produced for purposes other than archaeology and were then adjusted and altered into a structure appropriate for archaeology. Remote sensing techniques rely on hard science, which is the systematic study of the physical world through observation and experiment, to provide information, in which archaeology also has the same discipline. Remote sensing instrument can be one of the most potential methods to produce reliable and detailed information on horizontal and vertical archaeological site features distribution on the ground (Parrington, 1983). From this point of view, remote sensing as a multidisciplinary science is not solely dedicated to archaeology; therefore, archaeologists need to have their own way of reading and understanding the raw data from the remote sensing system.

With respect to archaeological investigations, remote sensing in archaeology has a great ability to indicate and identify archaeological sites directly where they still exist, even if they are (albeit perhaps heavily eroded) in the form of topographical variation. Alternatively, when they are no longer exist on the ground and can't be seen simply by our vision, they can be revealed indirectly in the form of variation of coloring and growth of vegetation. Sometimes erosion and continually using the ground for agriculture through plowing helps to expose the different color in the soil or the differences in the height of vegetation makes the differences to be visible from space. The reason of the coloring differences refers to those features which may have been buried under the ground (Sanderson, 2010).

When archaeological sites are disappeared, remote sensors play a great role to identify them, especially in documenting their general form or the main parts of the site from a high distance which allows mapping the site through a specific computer application which is designed for such a purpose. Many sites, of course, can be seen and mapped from the ground, but the use of remote sensing data can be more valuable for archaeologists to map and indicate those features, for any reasons which might not be visible from the ground survey (Wiseman and El. Baz, 2007).

Remote sensing in archaeology is a joint subject with other geoscientific methods "ranging from geophysical survey methods to Geographical Information System (GIS), not to forget traditional methodologies of ground-truth and historical data collection" (Tapete, 2018, P.41). For maximum data acquisition, it's necessary that the archeologist try to use the same number of elective assortments of remote-detecting devices under the same number of variable occasional and climatic conditions as his/her assets and skills will permit. At exactly that point he/she can choose the principal productive framework for the point in his/her general vicinity of study. The spectral properties of sites distinguishable by different kinds of remote sensors may perhaps be one of their most characteristic features, and yet the meaning of the differential discrimination of features has not been determined for the most part, since such spectral properties are inadequately comprehended at this date (Gumerman and Lyons, 1971).

In terms of archaeology satellite images dose not solely indicate past human activities but also the modern. Therefore an aerial photograph and Satellite images are an element of contrast which helps to bring out the residual components of the ancient landscape. Remotely detected pictures contain a point by point record of highlights on the ground at the time of exposure, relating both the present day scene and that of the past. The aim of interpreting satellite images is to read and understand both the ancient and modern features and phenomena that appear on the landscape and distinguish between them. In the process of interpretation, the archaeologist must understand the oddness of the modern landscape in the concerned area (Campana, 2016).

To recognize objects, and determine their significances, the recognition of different targets can be accomplished by comparing the visual elements that characterize them, such as shape, size, pattern, shadow, tone, texture and spatial association, which are generally highly dependent on the observation scale (Hadjimitsis, 2013). The first two factors, shape and size generally refer to the general shape of the objects. Meanwhile, complete and relative size can help in the interpretation of the object/target, for instance a buried wall structure. (Lasponara and Masini, 2012).

On the other hand, factors like pattern and shadow need further consideration. In some cases, some objects are hardly understandable in the photos but their shadow is much larger than the object itself and this makes the object to be more comprehensible (like poles which carry electrical cables) (Ceraudo, 2013). Concerning tone, this depends on the relative brightness or color of objects in an image, the variations of which allow photo interpreters to differentiate well with form, texture and patterns.

Texture denotes the tonal variation arrangement and frequency, which is highly dependent on the scale of observation. Rough textures, for example, are related to irregular surfaces (such as a forest canopy), whereas smooth textures are connected to more uniform surfaces such as fields, asphalt, ancient divisions of land (Lasponara and Masini, 2012). Finally, the related characteristics are the result of the way in which the component in address is embedded in and related with the context (Ceraudo. 2013). Despite the discussed facts which are already been mentioned above there are some other factors in which influence image quality and consequently affects the object's identification:

• Sensor characteristics (film types, digital systems)
• Atmospheric effects

- Acquisition time (season of the year and time of day)
- Resolution of the imaging system and scale
- Image motion
- Stereoscopic parallax. (Lasponara and Masini. 2012).

4. Aerial Photography

The indirect identification of archaeological site evidence through remote sensing techniques is particularly appreciated in the discovering of previously unrecognized sites and features. The main principles of this context are the capability of these techniques to indicate and identify buried evidences from the human past in the area of their activity. For this purpose several techniques and methodological approaches have been developed to identify relative environmental variations (Ebert, 1984). Satellite images and aerial photography (Vertical & Oblique, Historic and Recent) are complementary documentation. The first applied technique to remote sensing, as a technique to reveal lost landscape, is aerial photography, which is employed since the thirties of the last century. The first aerial photography taken for archaeological purposes, at the begging of 20th century, were taken from military hot air balloon above Stonehenge. The technique can provide a better view of the site above which is invisible to the viewer on the ground. Meanwhile, air born images have a great role to support landscape archaeologist to understand the site and its surroundings within its total context. Humans create subtle features through the time and these are called surface anomalies in which they are only visible when observed from above. The visible characteristics of these features on the photos highly depend on geographical and environmental conditions such as, soil types, vegetation cover, pedology and topography. According to (Luo et al., 2019, P.4) "Crawford was the first specialist to systematically propose and use three interpretation proxies - crop, soil and shadow marks for prospecting and mapping archaeological sites using aerial photographs". To recognize archaeological features indirectly through the use of remotely sensed techniques such as aerial photography, there are a number of interlinked phenomena including:

A- Crop-marks: By crop marks is meant the visual difference in the growth of vegetation (grass, weeds, planted crops, and so on) on a site as contrasted with its normal surrounding. Naturally there are some specific times in the year in which the vegetation differences can be noticed clearly. Thus crop marks are restricted to the growing seasons of the year, in Iraqi Kurdistan the best growing seasons are from April to August. In order to get a better photography, the best season for fully flourishing growth is the end of spring and starting of summer. Meanwhile, better watered features on the plain are most visible when the surrounding grass is wilting. On the other hand, enriched sites with buried organic debris crops grow best in spring, with its quickened growth of cover (Parcak, 2007).

Changing crops color and the speed with their height can be affected by buried features to which they grow. Crop marks can be either classified as positive or negative (Fig. 5). A positive crop marks means that growth and lushness of vegetation traces is the evidence of that, soil nourishment is higher than its normal surrounding environment. Positive marks are more noticeable when the ditch is large and deep. Negative crop marks, a rare occurrence, are shown by an abnormally stunted or even killed vegetation. This indicates that something in the surface geology, such as a layer of stones inhabiting the growth of vegetation (Bewley, 2004).

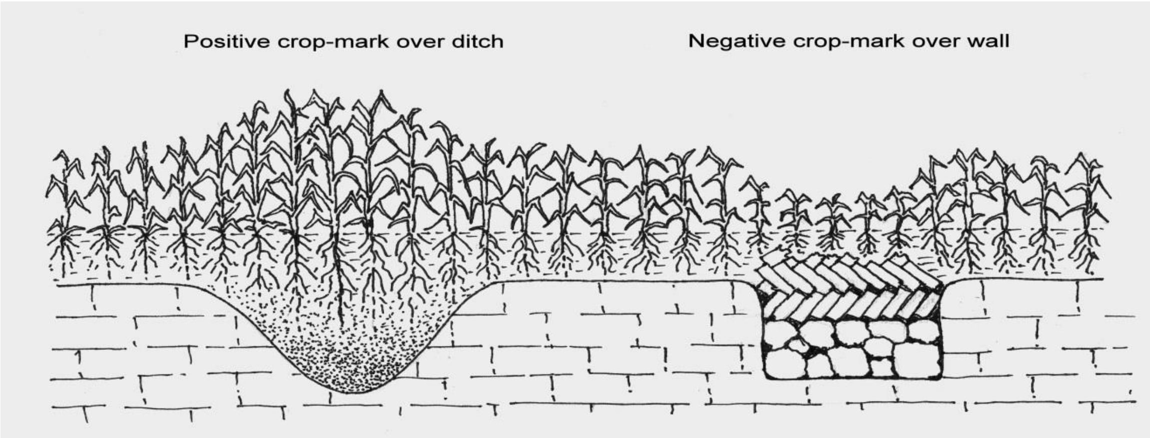

Fig. 5. An illustration of Positive and Negative crop marks. Source (Kent Aerial Photography)

Most of the areas of study in this field are farmlands so types of crops can be easily recognized and potential target sites can be distinguished. In this case, differences in texture on the land cover may suggest there has been a prior disturbance and that a feature may be buried.

B- Soil-Marks: is the indication of color differences in the soil which may appear from past human interventions such as excavations, earth fills or structures. Buried features can cause variation in soil color and these variations of the soil in color, texture and moisture are called soil marks. The contrast between soil and subsoil on bare ground or between filling ditch or normal soil causes the color differences. Soil marks are, also can be observed on the ground when remains of a building buried and covered by soil. The signs of color differences in the soil can be best observed during plowing season, when there is no indication of surface relief (Fig. 6). The best result would be achieved when the soil is damp and fresh from plow or harrow (Prasanna, 2013).

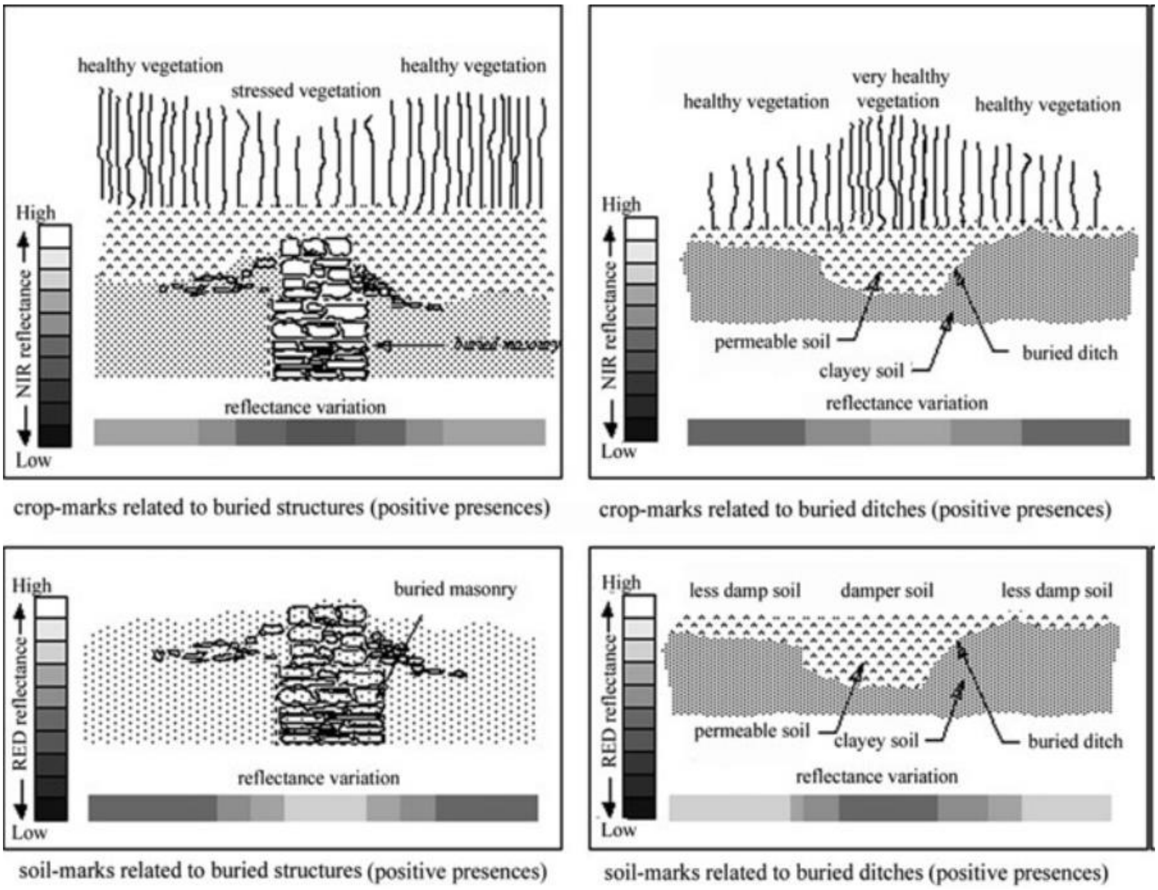

Fig. 6. The influences of buried features on the variation of crop mark growth (Google Image)

C- Shadow sites: The effect of light and shade, which is sometimes been described as (Shadow marks). "shadow and highlight are used to emphasize physical features which still exist but may be almost invisible on the ground, such as the barely detectable earthworks of prehistoric field banks or heavily eroded burial mounds" (Stefano. C. 2015. P, 3). The main difficulty in detecting them lies in recording them at the right moment, some earthworks, which are obvious in a low sun, will not show at midday. In this case, the sun should be in an "angle between 45 and 90 to the line of the sight, as in vertical or near vertical view" (Riley, 1946, P. 12). The position should be most considered when oblique photos are taken. In taking oblique photos the shadows should be facing to the the photographer, which means that the site should be located between the sun and the photographer. That's why most archaeological aerial photographers use the low sunshine of winter, early morning sunrise or late evening at other times of the year (Rowlands and Sarris, 2007).

5. Aims of archaeological remote sensing

The main aims of remote sensing in archaeology can be identified as follows:

1. The documentation of archaeological contexts in great and objective detail.
2. The acquisition of information on buried deposits sometimes completely invisible at ground level, describing in some detail the metrical, geometrical, and physical-chemical properties of the subsurface features.
3. The well-balanced and representative recording of both positive and negative kinds of archaeological evidence.
4. The monitoring, from very large scale to small scale, of landscape transformations, allowing the development of conservation and planning policies.
5. The mapping of archaeological data, interpretations, and reconstructions through the use of GIS technology that can cope with the inherent complexity of past landscapes and archaeological sites (Campana, 2016).

5.1 Remote sensing can assist the archaeologist in the following ways:

a) In the discovery of previously unknown sites. This has been the most spectacular use made of aerial techniques. There are many cases where low level oblique photography, using mainly straightforward black and white panchromatic film, has resulted in the discovery of a variety of archaeological sites.
b) Mapping known and unknown archaeological sites. Both vertical and oblique aerial photographs can be used as base maps on which one can see the related information to the archaeological site. On one hand both techniques enables archaeologists to study large areas in which some of the patterns cannot be understandable from the ground level. On the other hand, taking small scale photographs can produce detailed photo of the site, it allows identifying all of the environmental parameters which may have caused the creation of the site in a specific location (Genderen, 1976).
c) Detecting, identifying and interpreting surface/subsurface properties without direct contact with the object of study (i.e., non-invasiveness)
d) Making remote observations of the archaeological sites, in order to prevent risks for the operator and reducing costs of in situ investigations;

e) The possibility to revisit in time and carry out iterative workflows of data analysis for the purposes of monitoring and condition assessment for example, multi-temporal change detection (Tapete, 2018)

Conclusion

Consequently, these results confirm the importance of using satellite images to identify and monitor spatial variation of archaeological site characteristics over the earth's surface. Archaeological surveying is a complex set of techniques with aims of understanding the spatial dimensions of material remains of human past. With these aims in perspective, remote sensing technologies have been applied in archaeological surveying from the later part of the 19th Century. As it's been mentioned, the achieved results are varying in their applicability to archaeological features according to the various spectral surveying techniques, but their capability is more than what has been shown. The ultimate dream of an archaeologist is to use a technique or an instrument to rely on to provide and reveal all evidences of human occupations, but with no doubt, it can be stated that, there is not such devise that can provide such reliable and detailed information for archaeologists as they wish. Traditional ground based site survey as a unique technique can't be replaced by remotely sensed data, but at the same time, data gathered from remote sensing images can identify many archaeological features which are not expected from the ground. However, there are some factors which may limit the use of the remote sensing techniques and satellite images in our studies such as logistical and technological aspects. Furthermore, another factor would be the lack of information related to the techniques of remote sensing science. The main cause for the second factor would be having no published or written papers related to the subject with our language. Therefore the lack of non-English papers, especially in the local language, makes the role and impact of the science to be hidden from non-English archaeologists. To overcome these limitations, further studies need to be done in this field with clarifying the importance of the subject and encourage local archaeologists to study in the field in order to raise interest and create local experts in such valuable science.

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