

Digital Archaeolog y

Course code: ARC-524

Title: Digital Archaeology

Course Title breaking

Digital

Archaeology

A.T the Cambridge Dictionary, "digital" primarily means using electronic systems (like computers) to store and process information as numbers (0s and 1s), creating digital data, recordings, cameras, or displays (like digital clocks). It also broadly refers to anything related to computer technology, the internet, and the modern digital world, impacting communication, media, and daily life

Study of human past based on the objects they used and contextual Eco facts,,,,,,,,,

Antecedents

WHAT IS DIGITAL ARCHAEOLOGY?

Digital archaeology is a field that applies advanced digital technologies to the study of ancient material culture. It enhances traditional archaeological methods by integrating tools such as databases, mobile computing and imaging hardware, artificial intelligence, sophisticated analytics, 3D modeling, geographic information systems (GIS), and remote sensing

SUCH AS

GIS, 3D modeling, AI, Remote sensing
LASER Scanning, Photogrammetry,
Virtual Reality **Using Drone**



Antecedents

OTHER DEFINITION

Digital archaeology applies digital tools and technologies to archaeological research, documentation, analysis, and preservation, enhancing traditional methods for studying past human societies, managing data, and creating virtual reconstructions of sites and artifacts.

SUCH AS

GIS, 3D modeling, AI, remote sensing
LASER Scanning,
Photogrammetry, Virtual Reality,

So what are simply DA`s

- Taking photos
- Excel sheets and measurements
- Videography
- Shooting high resolution videos
- Imaging



So Could you tell me what others??????

It`s actually Future of Archaeology, What is going to happen in the study of Archaeology after few decade!!!!!!

Correlation with other terms

Digital Cultural heritage:

For a field dedicated to preserving the past, heritage stewardship relies heavily on modern innovations. As mentioned above, digital cultural information, use of digital tools to manage and visualize data and the collection of digital data in the field.

(Richter, Ashley (18 July 2014).

So Could you tell me what others correlation you found??????

Take a Slip/ Token/ Paper

Do you know What is **Planogram**?

Write down your

Name:

Plan A:

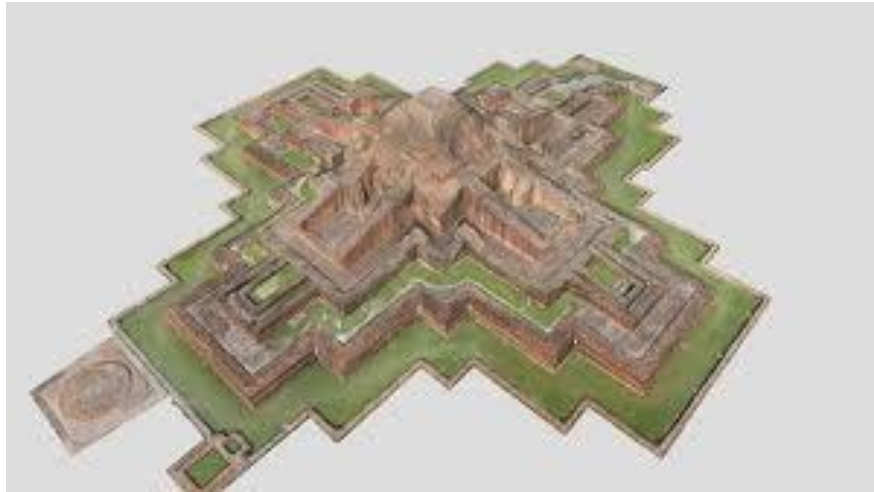
Plan B:

Consent: Yes

Target Year:

Any Comments:

Digital Archaeology Works in Bangladesh



Instances



Instances



Use of Drone in Archaeology

- ✓ Settlement pattern
- ✓ Site Sketch/Mapping
- ✓ Catchment area identification
- ✓ Water source finding
- ✓ Vegetation
- ✓ Topography

Archive

Archive *Archive* is derived from the French *archives* (plural), and in turn from Latin *arch̄ium* or *arch̄ivum*, the romanized form of the Greek ἀρχεῖον (*arkheion*). The Greek term originally referred to the home or dwelling of the Archon, a ruler or chief magistrate, in which important official state documents were filed and interpreted; from there its meaning broadened to encompass such concepts as "town hall" and "public records". The root of the Greek word is ἀρχή (*arkhē*), meaning among other things "magistracy, office, government", and derived from the verb ἄρχω (*arkhō*), meaning "to begin, rule, govern" (also the root of English words such as "anarchy" and "monarchy")

সাধারণত আর্কাইভ হচ্ছে সংরক্ষণাগার। অর্থাৎ ঐতিহাসিক গুরুত্বসম্পন্ন সরকারি ও বেসকারি নথিপত্র, দলিলাদি, পুরানো বিরল পুস্তকাদি, পাণ্ডুলিপি প্রভৃতির সংগ্রহশালাকে আর্কাইভ বলে। এটিকে মহাফেজখানাও বলা হয়।

According to the Oxford English Dictionary, Archive is-

1. a collection of historical documents or records of a government, a family, a place or an organization; the place where these records are stored.
2. (computing) an electronic record of the data on a computer system, stored on a separate device for safety and security.

History of Archive

Most probably ancient Greek Archive was the first archive type institute what was continue to the middle age. Later it was more developed in the Spain, Germany, France, England and America.

In Indian sub continent-Sultani & Mughal- Mohafej khana

East Indian company was a written and record base governance

Record law In 1854; Record Manual in 1888; Imperial Record Department was established in 1891.

After independence of India it got a new name from '*Imperial Record Department*' to '*National Archive of India*' on the other side Pakistan named it as '*National Archives of Pakistan*'. Our's is '**National Archives of Bangladesh**'

Archive

Archaeological Archive-

All the Museums, Regional offices of Govt. DOA, University Departments and personal collections are the Archaeological Archives but.....

Two main elements for archaeological archive are:

- 1. Documentary archive:** Digital files, written documents, drawn records, Films, audios and videos, photographs etc.
- 2. Material Archive:** Other materials, pottery, stone or meta objects, wooden artifacts, Inscriptions, floral and faunal remains etc. Conserving all those objects in a place for a long time is the Archaeological archive.

Archive: ADAPt

At first historical archaeologist of England used Archaeological Archive in their archaeological research to conserve data. Europe introduce an standard guideline for practicing archaeological archive named *Archaeological Data Archive Protocol (ADAPt)*

ADAPt is the template, checklist and tool kit of pro-forma what specially designed for strengthen the archive to produce the data.

Recording Manual

ADAPt Policy

Procedures

Tools:

Project management
checklist

Data Transfer agrrement

Data management plan

Flowline

Data acceptance guidance

File format list

File naming convention

Suggested folder structure

Image capture guidelines

Metadata forms

Deposition guidelines


Creating PDF for archiving

Database and spreadsheet

Selection criteria for files

Metadata for recording
images

Archive: ADAPt

 Historic England	Archive Management Checklist	Project Stage: Project Initiation
Project number:	Project Name:	Event:

Complete	Task	Person Responsible	Target date	Notes
<input type="checkbox"/>	RASMIS Project number allocated and passed on to Archives team Or informal project number created	PM Archives		
<input type="checkbox"/>	Project Management file created	PM		
<input type="checkbox"/>	Project folder created and location recorded	Archives		
<input type="checkbox"/>	Data Management Plan (DMP) created	PM		
<input type="checkbox"/>	Archive repository identified and has agreed in writing to receive archive	PM		
<input type="checkbox"/>	Written landowner agreement to allow HE to remove finds from site	PM		
<input type="checkbox"/>	Written landowner in principle agreement to transfer of title to finds	PM		
<input type="checkbox"/>	Record project in AA systems	Archives		
<input type="checkbox"/>	Site archive task list and timetable created	PM Archives		
<input type="checkbox"/>	Project Management File updated with PD and all other relevant documents	PM		
<input type="checkbox"/>	Ensure project files are named in accordance with file naming convention	PM/All		
<input type="checkbox"/>	Ensure project data are saved to the correct project folder	PM/All		
<input type="checkbox"/>	Alert AAC and PM to complete files And copied to secure store	All Archives		
<input type="checkbox"/>	Stage Complete	PM Archives		SIGNATURE

Importance of archaeological archive:

Excavation destroys, but the archive preserves

- 1. Preservation of Irreplaceable Evidence**
- 2. Foundation for Re-analysis and New Research: GIS, DNA, AI**
- 3. Scientific Transparency and Accountability**
- 4. Cultural Heritage Protection: Cultural memory, Urbanization, Looting, war, Vandalism, Climate change, war**
- 5. Educational Resource**
- 6. Legal and Ethical Responsibility**
- 7. Digital Archaeology and Long-Term Access: GIS, 3D Models, Databases**
- 8. Public Engagement and Knowledge Dissemination: AR, VR**
- 9. Informed Cultural Resource Management**
- 10. Safeguarding Archaeological Ethics**

Archive Law and Regulations

The Monumental Legacy of the Antiquities Act of 1906

Antiquity act 1968, Antiquities Ordinance 1976

Draft antiquity act 2015

National Tourism Guideline 2010 and

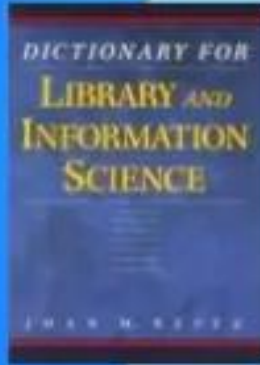
Other charters





What is Cataloging?

2



- *cataloging*

- *The process of creating entries for a catalog. In libraries, this usually includes bibliographic description, subject analysis, assignment of classification notation, and activities involved in physically preparing the item for the shelf, tasks usually performed under the supervision of a librarian trained as a cataloger. British spelling is cataloguing. See also: cataloging agency, cataloging-in-publication, centralized cataloging, cooperative cataloging, copy cataloging, descriptive cataloging, encoding level, and recataloging.*



Cataloging

Cataloging is the systematic process of **recording, describing, organizing, and classifying objects or information** so they can be easily identified, retrieved, and used in the future

Cataloging means documenting **artifacts, samples, photographs, drawings, and digital files** with clear, standardized information. A proper catalog usually includes:

- Unique identification or accession number
- Object name and type
- Material and technology
- Measurements and condition
- Provenience (site, context, layer)
- Date of discovery and excavator
- Storage location and digital references



Cataloging

Why cataloging matters

- Prevents loss or misidentification of objects
- Preserves contextual information
- Supports research, comparison, and re-analysis
- Ensures legal, ethical, and professional standards
- Enables digitization, databases, and online archives



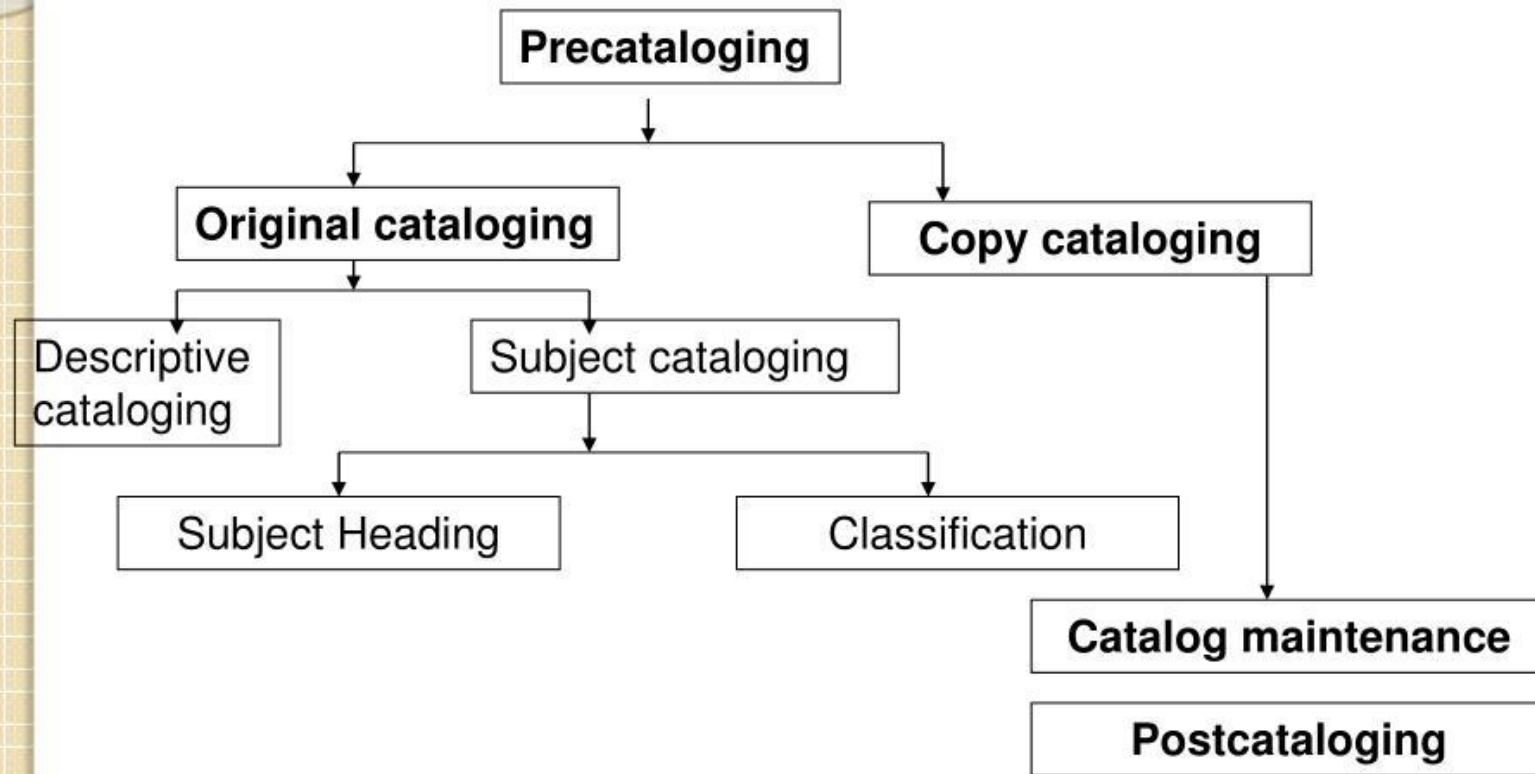
Cataloging

According to '*International Standard Archival*' there are four steps for cataloging-

1. Fonds: it is an institution or full specific archive such as Bangladesh national Archive
2. Series: How many types of material elements, data stored in an archive those each and every type is called a series such as Daily paper, Journal, Artifacts etc.
3. File: each and every recording is called single recording or documentation file. For example- Icon, statue etc
4. Item: . How many kinds of icons are there is to be documented such as Buddha icon, Hindu Icons, Jain Icons etc. and this is called Item.



CATALOGING WORKFLOW



Digital Documentation

How Microsoft Office program helps us?

Digital documentation has wide range of meaning but here it is converting file into digital format from hard copy to soft copy.

Different kinds of digital documentation are:

1. Word documents (doc. or docx)
2. Portable Documents of File (PDF)
3. Spreadsheet (Xls or xlsx)
4. PowerPoint (ppt or pptx)
5. Audio and video documents. (Mp3, Mp4, 144p, 240p)



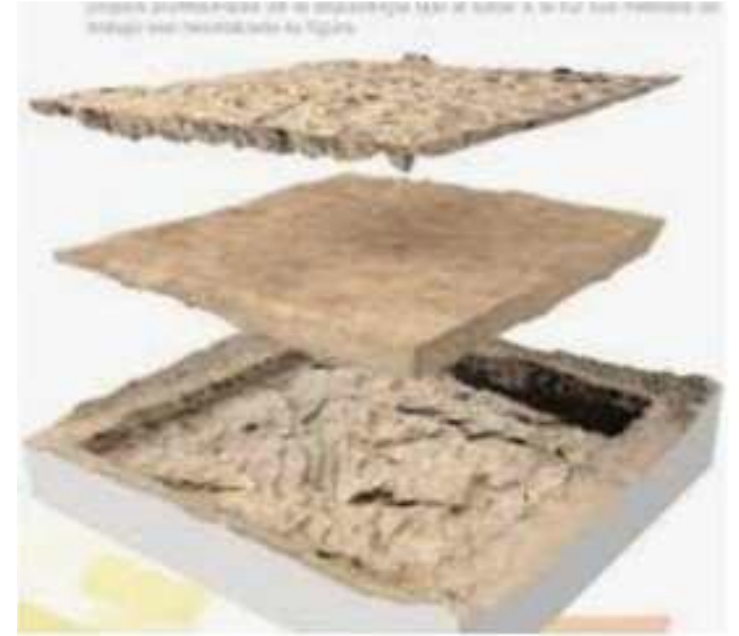
Photogrammetry

Photogrammetry is the science or study of measuring through photographs specially the accurate position of the surface point. It is also called as image based modeling.

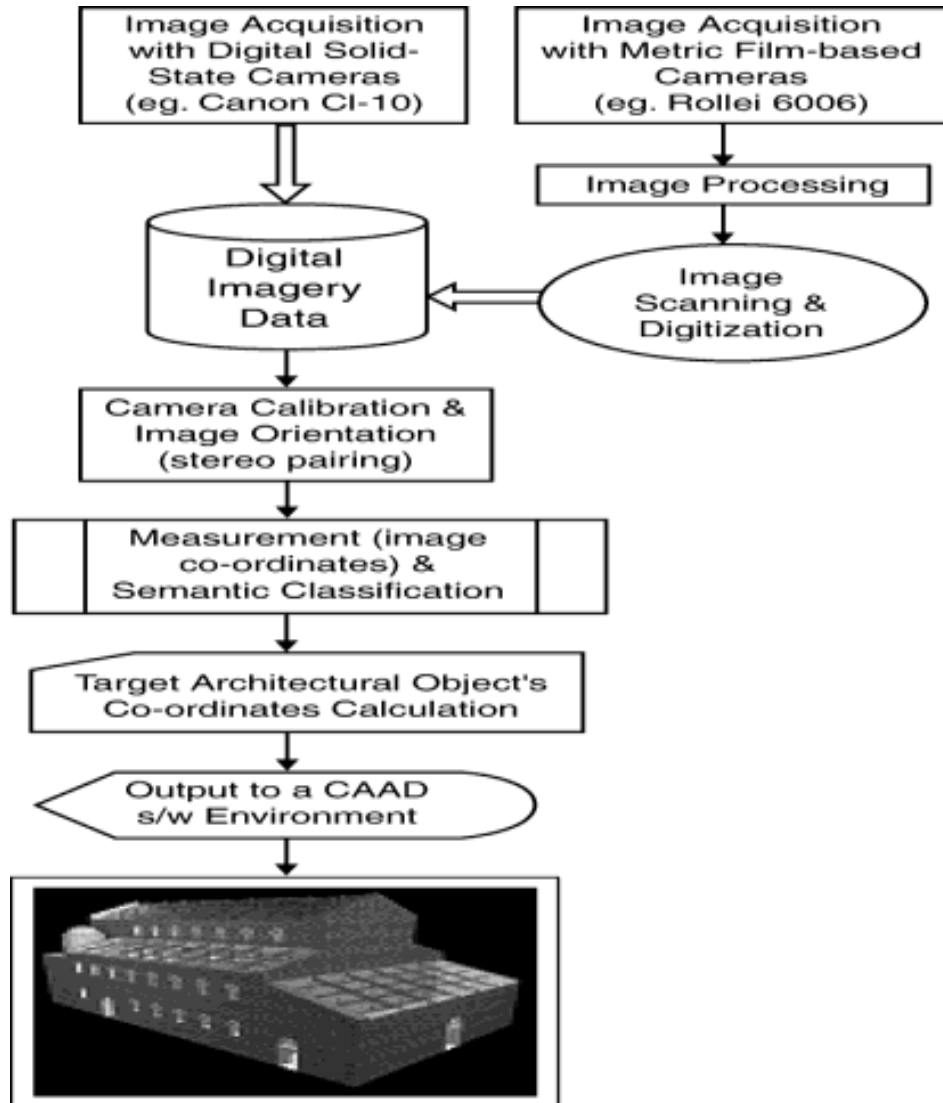
Input of a it is a photograph and output is a map or sketch or 2D/3D Model.

It can be classified into different ways but it is divided into two parts on the basis of camera position.

- Aerial photogrammetry
- Terrestrial photogrammetry



Photogrammetry



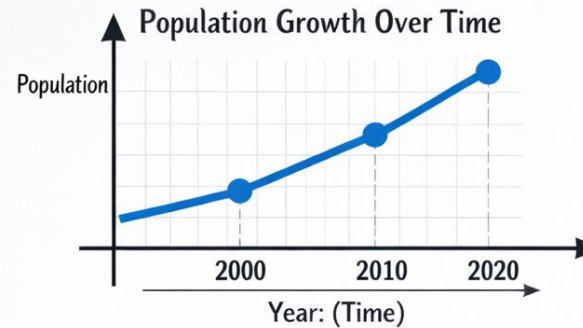
3D works in Archaeology

3D modeling is the process of creating a three-dimensional digital representation of an object or surface using specialized computer software.

- 3D Maps
- 3D Image
- 3D Modeling
- 3D Model Printing

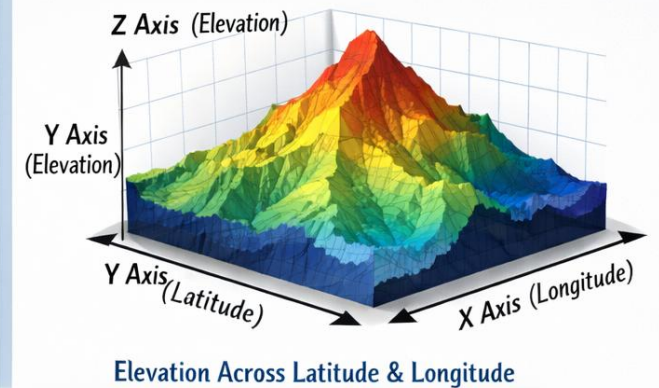
2D Graph

Two Axes: X (Horizontal)
Y (Vertical)
Shows Two Variables



3D Graph

Three Axes: X, Y, Z
Shows Three Variables



	Key Differences	3D Graph
Dimensions	2 (X, Y)	3 (X, Y, Z)
Axes	X and Y	X, Y, and Z
Data Variables	Two	Three
Visualization	Flat	Depth & Volume

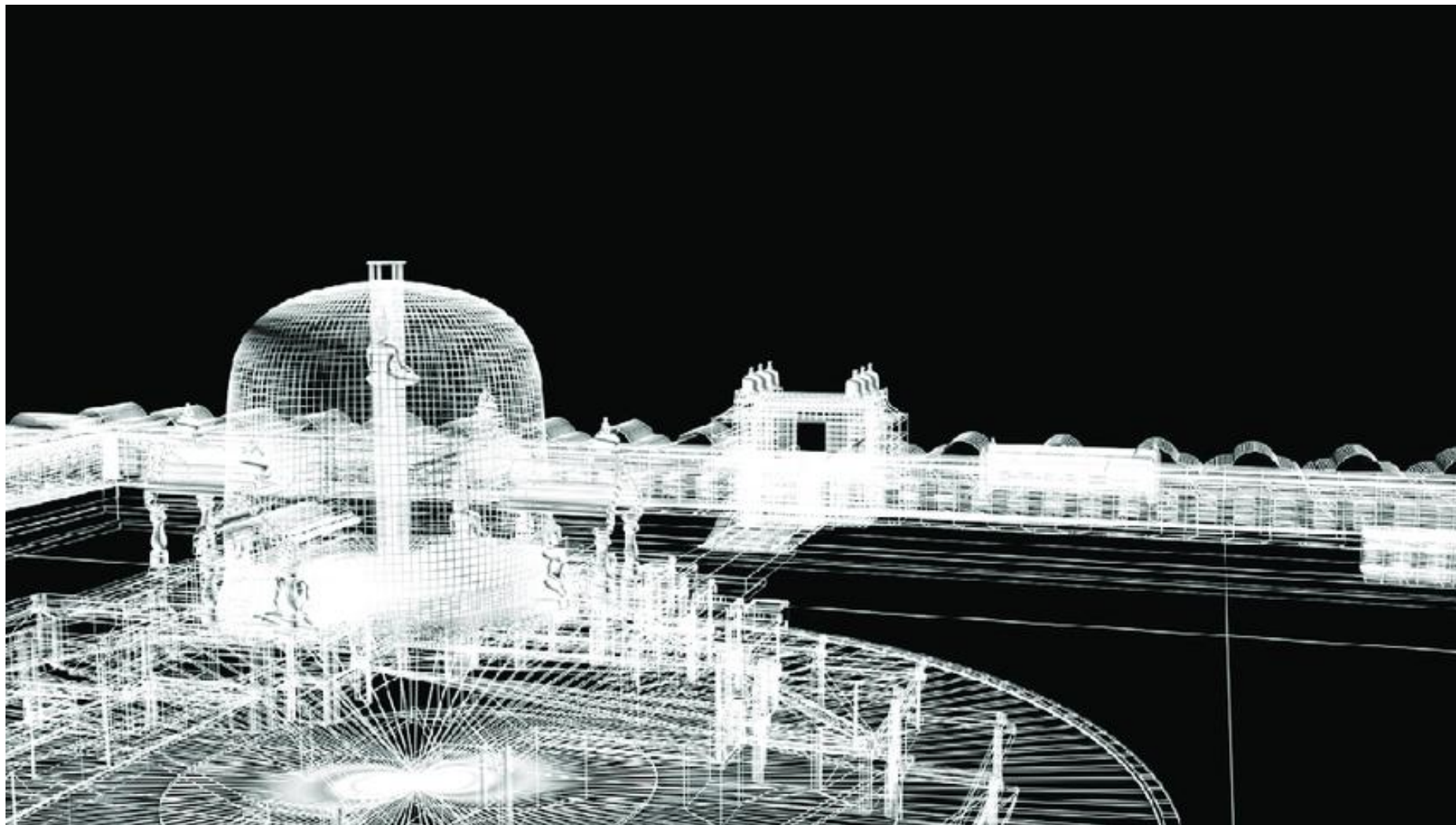
3D works in Archaeology



3D works in Archaeology



3D works in Archaeology



3D works in Archaeology



What a 3D video can show!



3D works in Archaeology



3D works Misuse in Archaeology



3D Modeling

Total Station and theodolite

Total Station and theodolite



Total Station and theodolite: Use in Archaeology & Heritage

•Theodolite

- Traditional site layout
- Basic angle measurement
- Small-scale excavations

•Total Station

- **3D site mapping**
- Precise recording of structures, features, and artifacts
- Integration with **GIS, CAD, and 3D modeling**
- Widely used in **Bangladeshi archaeological sites** today



Total Station and theodolite: Types of Theodolite

- Digital Theodolites:** Modern instruments that provide instant, easy-to-read electronic, LCD readouts of angles.
- Transit Theodolites:** A type where the telescope can be completely rotated (transited) in a vertical plane.
- Optical/Transit Theodolites:** Older, non-digital, or traditional models that rely on optical reading of scales.
- Photo theodolite:** A combined camera and theodolite used in terrestrial photogrammetry.
- Total Station:** An advanced, electronic version that combines a theodolite with an electronic distance meter (EDM).



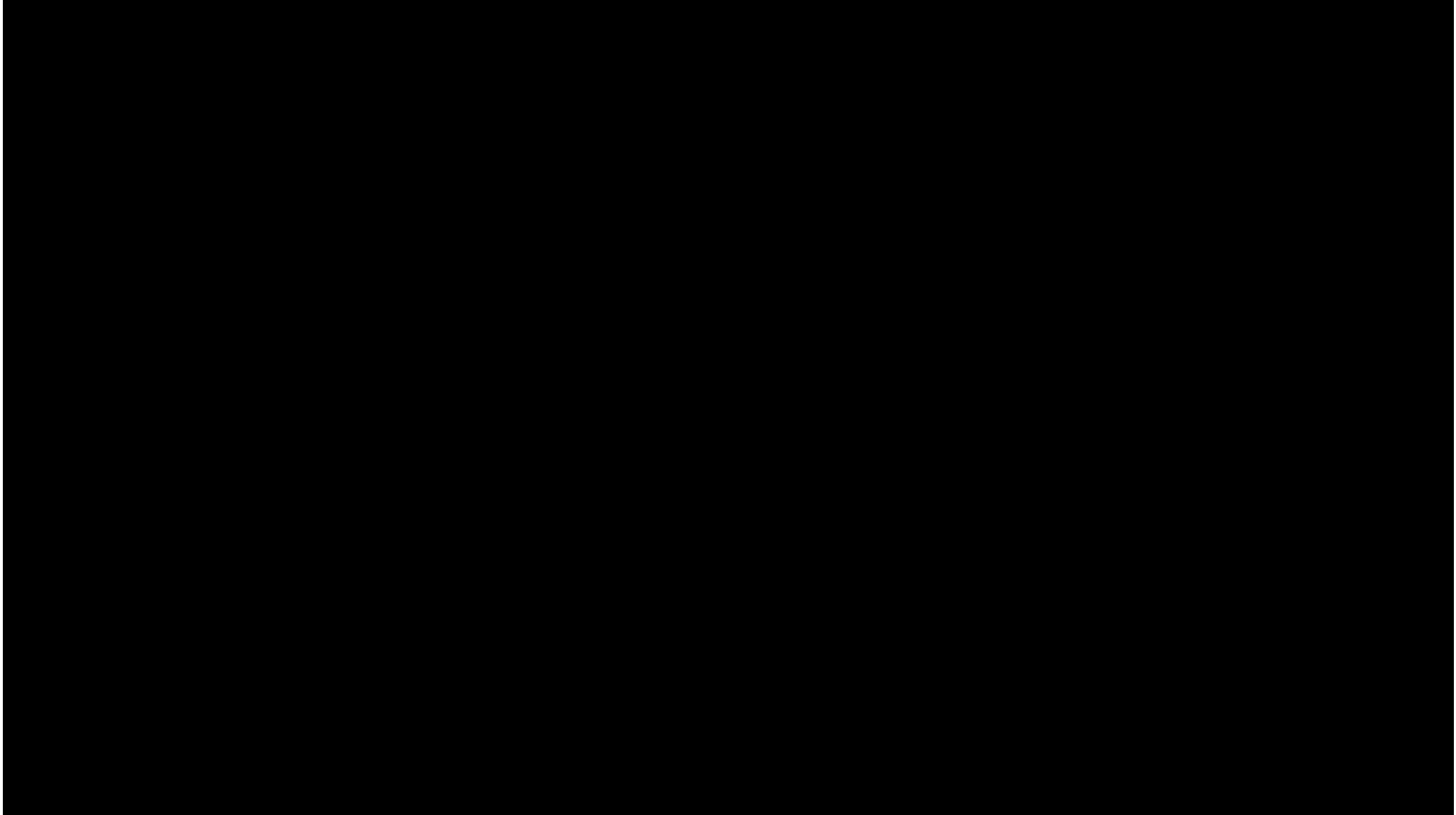
Difference between T. Station and Theodolite

Aspect	Theodolite	Total Station
Data output	Manual readings	Digital readings
Speed of work	Slower	Faster and more efficient
Technology level	Optical–mechanical	Electronic–digital
Cost	Relatively low	Expensive
Power requirement	<input checked="" type="checkbox"/> No battery needed (manual)	<input checked="" type="checkbox"/> Requires battery
Definition	An optical instrument used to measure horizontal and vertical angles	An advanced electronic instrument that measures angles, distances, and coordinates
Distance measurement	<input checked="" type="checkbox"/> Not directly (needs chain/tape)	<input checked="" type="checkbox"/> Electronic Distance Measurement (EDM) User-friendly with software integration
Ease of use	Requires more manual calculation	
Accuracy	Good, but depends on user skill	Very high accuracy
Data storage	<input checked="" type="checkbox"/> No internal storage	<input checked="" type="checkbox"/> Stores data electronically

A Case Study on digital documentation: Çatalhöyük



Digital documentation: A Case Study on Çatalhöyük



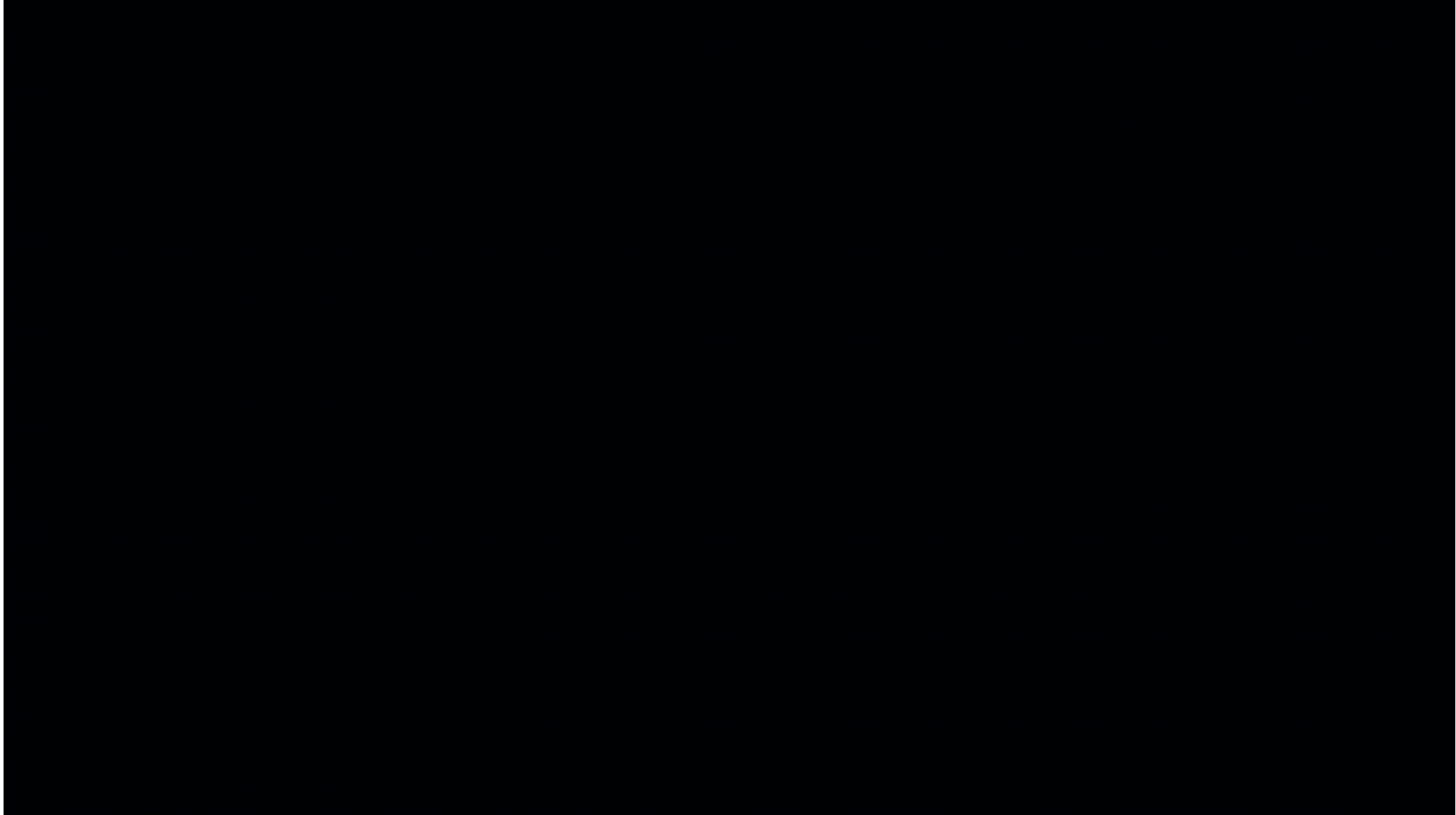
What a 3D video can show!



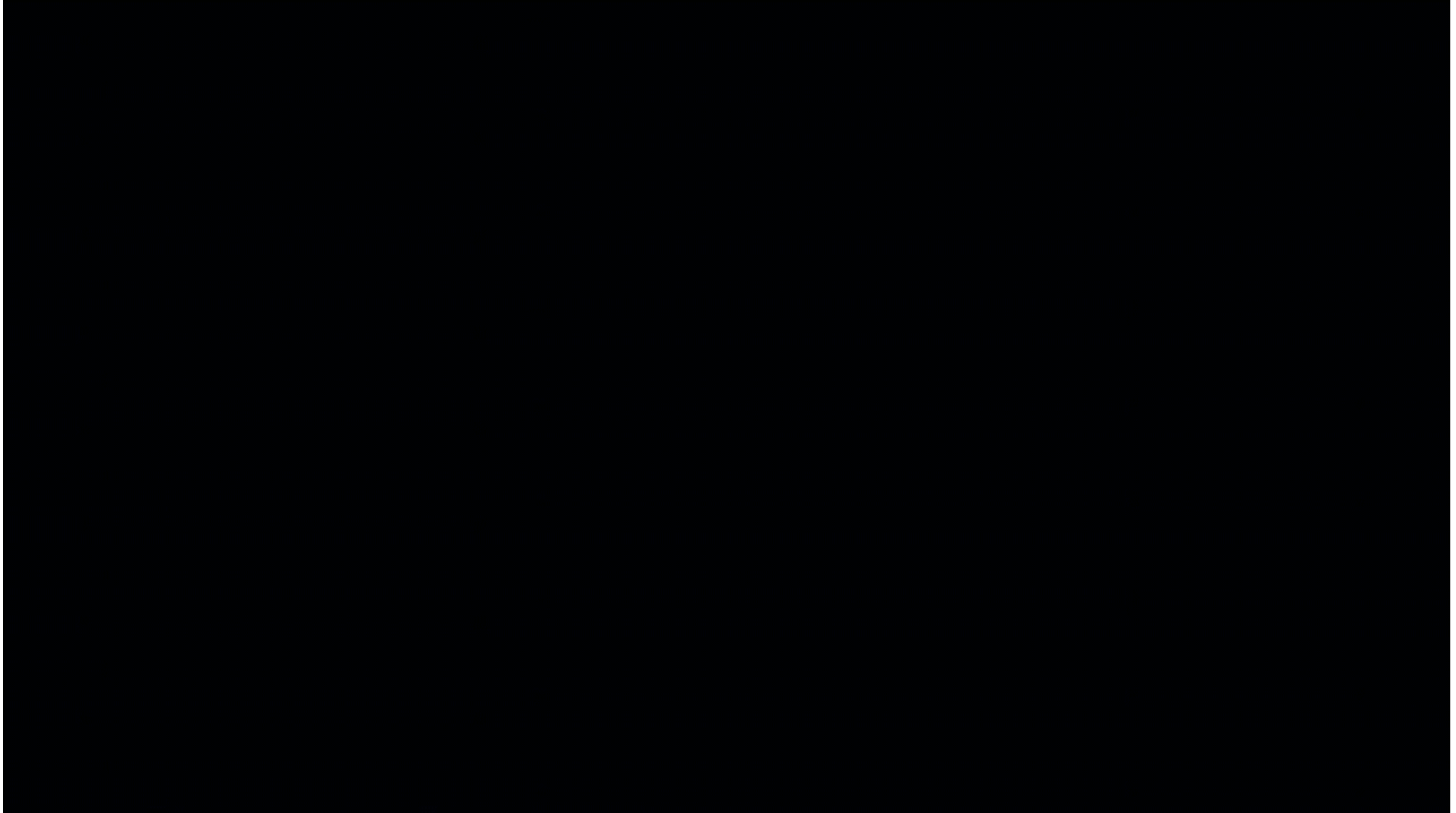
Digital documentation: A case study on Troy



Digital documentation: A case study on Troy



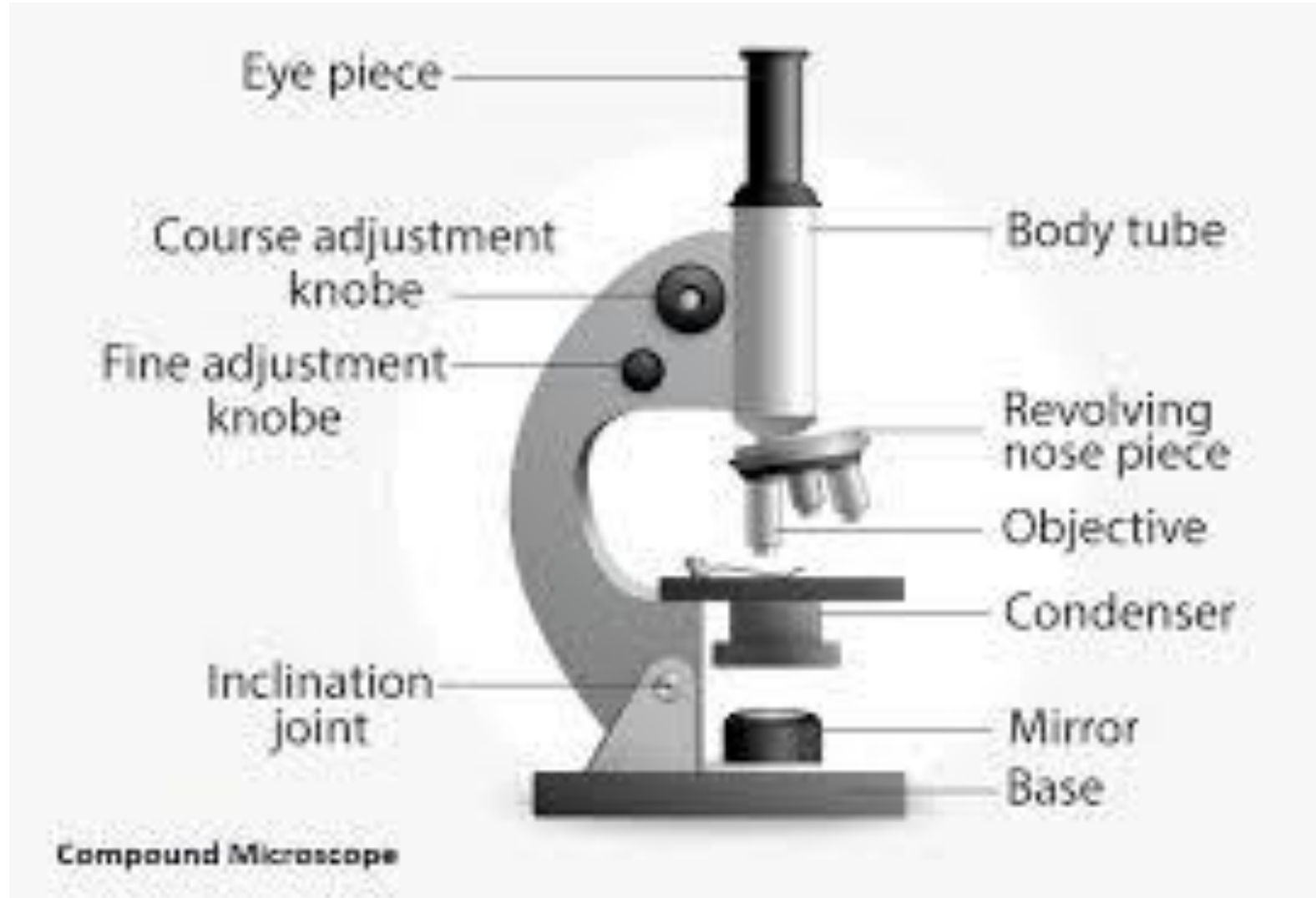
Digital documentation: A case study on Troy



Digital documentation: A case study on Troy



Microscopic Analysis in Archaeology



Microscopic Analysis in Archaeology

Thin Sectioning:

Thin sectioning is a specialized laboratory technique that cuts and grinds rock, mineral, soil, or ceramic samples down to a thickness of 30 (0.03 mm), typically mounted on a glass slide.



XRD

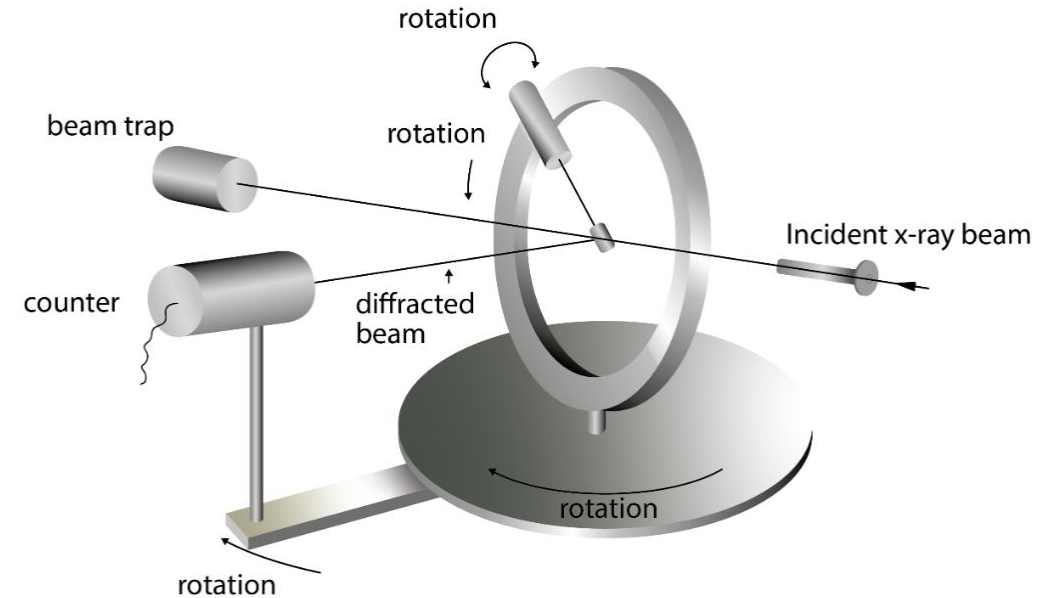
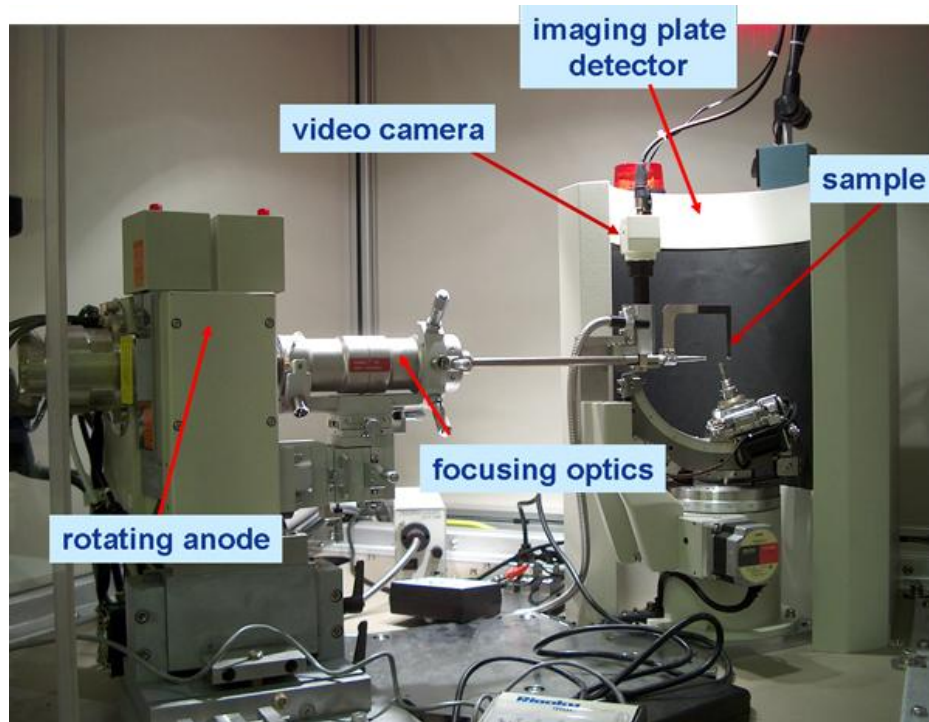
XRD stands for **X-ray Diffraction**. It is a scientific analytical technique used to identify and study the **crystal structure** of materials.

Common applications

- **Geology & Archaeology:** Identifying minerals in soil, ceramics, pigments, and artifacts
- **Materials Science:** Studying metals, alloys, and nanomaterials
- **Chemistry & Pharmaceuticals:** Determining molecular structures and purity
- **Engineering:** Quality control of construction materials

Marked image of a Microscope

Video Camera, Rotating Anode, Imaging Plate Detector, Sample, Focusing Optics, Beam trap, Diffracted beam, Incident X-Ray beam

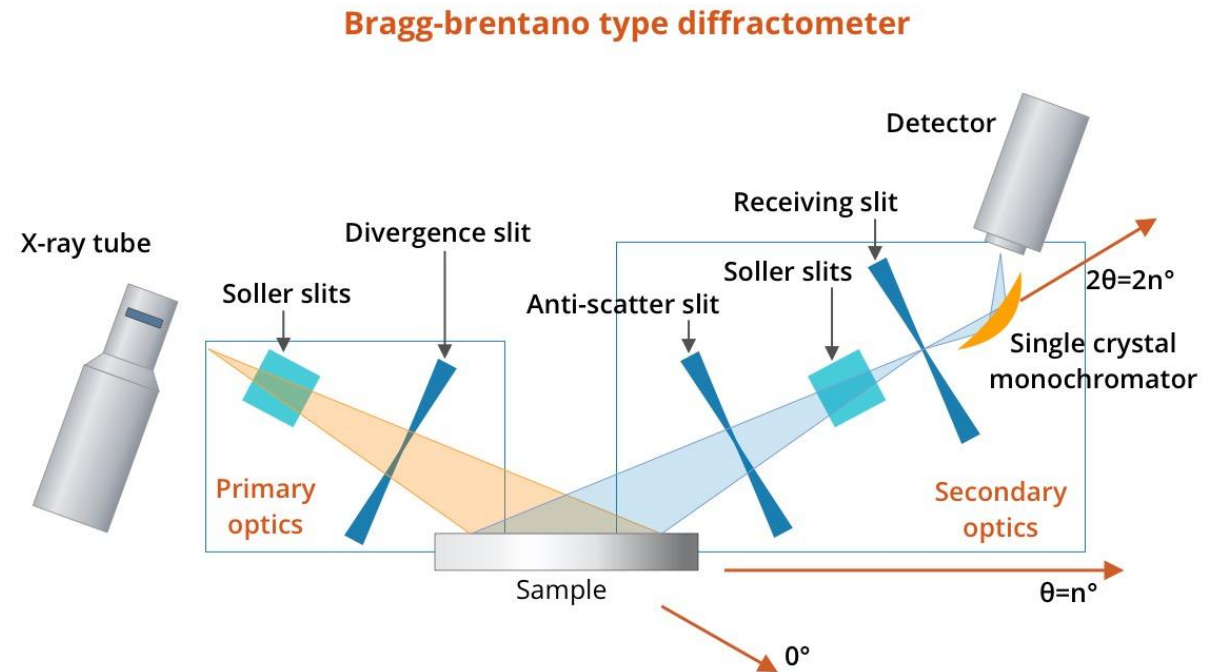


XRD: How it works?

How it works

When a beam of X-rays is directed at a crystalline material, the atoms inside the crystal cause the X-rays to scatter in specific patterns (diffraction). By measuring the angles and intensities of these diffracted beams, scientists can determine:

- The crystal structure
- Atomic arrangement
- Phase composition (what minerals or compounds are present)
- Crystallite size
- Lattice parameters

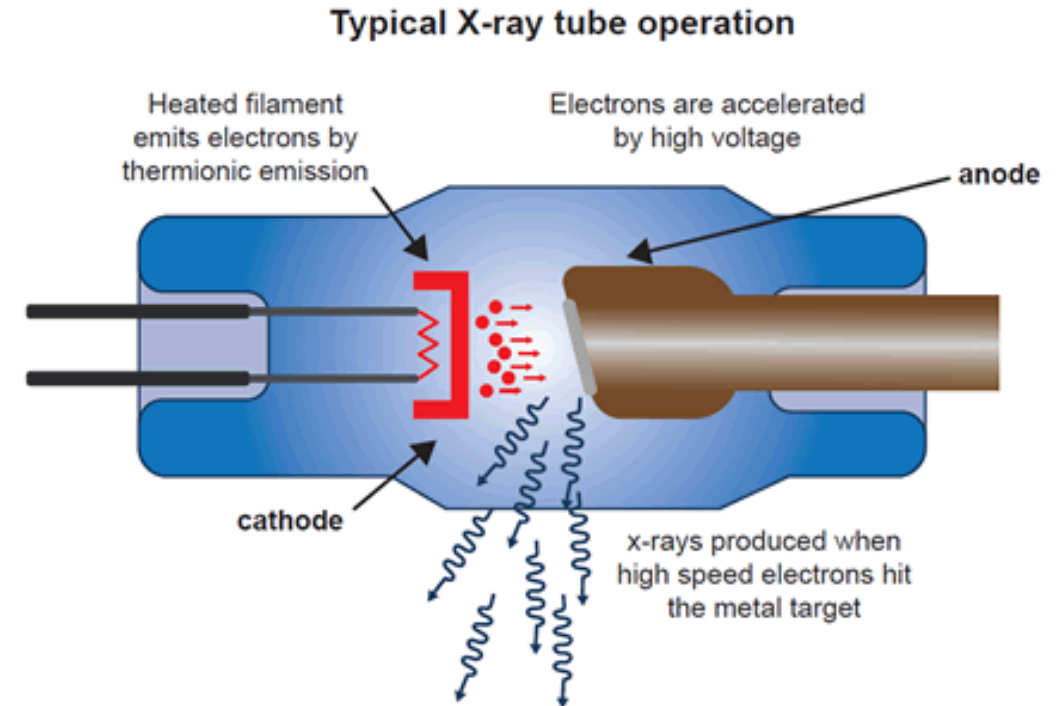


XRD: How it works?

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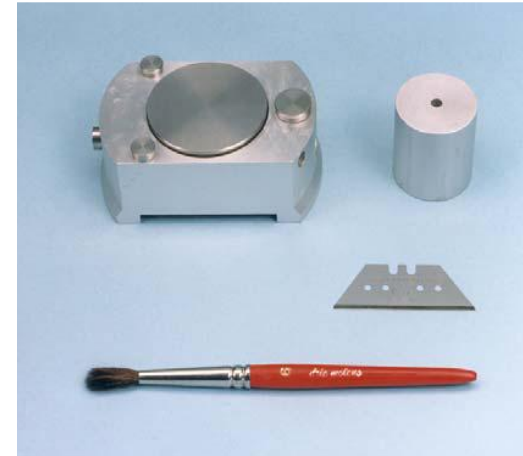
- The crystal structure
- Atomic arrangement
- Phase composition (what minerals or compounds are present)
- Crystallite size
- Lattice parameters



XRD: How it works?

XRD Sample Preparation Techniques

- Back-loading technique
 - Round Sample Holders
 - Square Holders
- Capillary Samples



Back Loading Technique

Sample Holder
Ring clamped
onto the
Preparation
Table



Back Loading Technique

Sample Holder

Ring clamped

onto the

Preparation

Table

The Powder is

spread in the

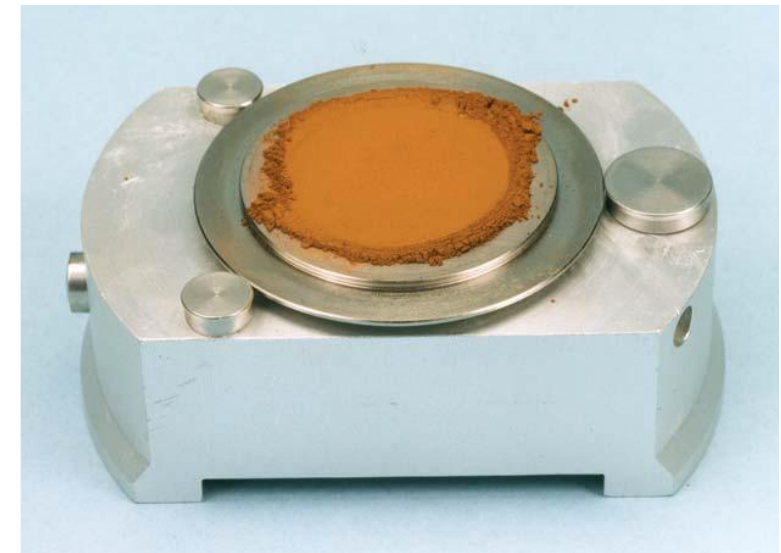
Sample Holder

Ring



Back Loading Technique

The Powder is
pressed with a
Powder Press Block.
After pressing a
Surplus of
Powder is left



Back Loading Technique

Removal of the
Powder Surplus
with a Knife
Blade
Brush
remaining
sample off
side rim
Powder Surplus
removed



XRD/XRF Sample Mounting similarities

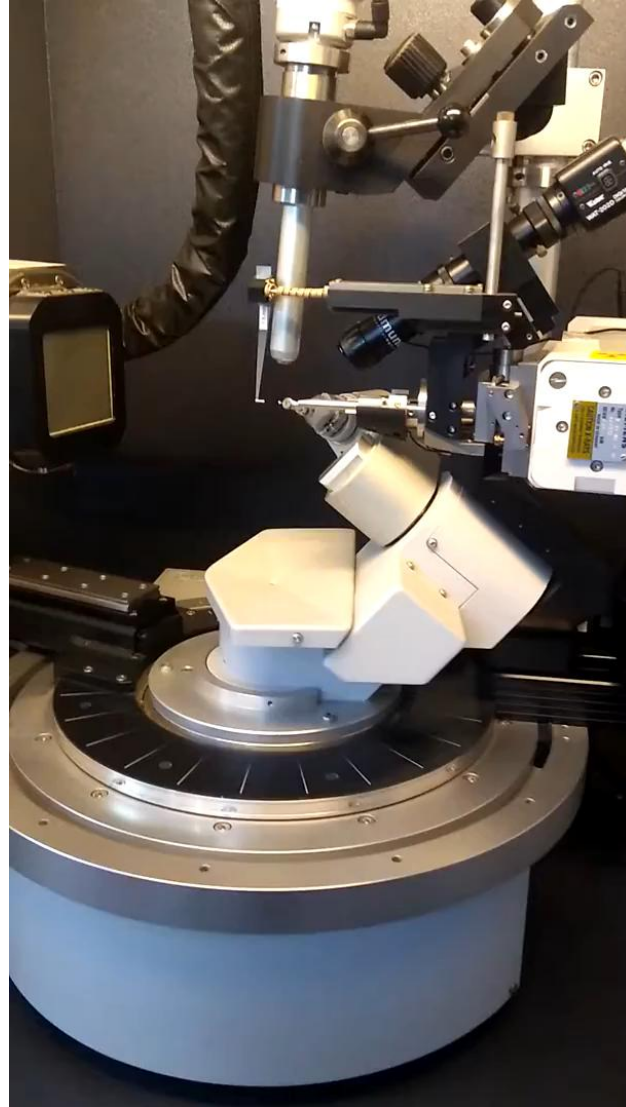


Sample preparation for XRF/XRD

JIAMdiffraction.com



Single crystal XRD



XRF

X-ray Fluorescence (XRF) is a non-destructive analytical technique used to determine the elemental composition of materials.

XRF: Applications and Advantages

Its an Non-Destructive Testing (NDT)

XRF is ideal for fragile or valuable artifacts as it does not require sampling or damaging the object.

- **Portable (pXRF):** Hand-held devices allow for on-site, in-situ analysis, avoiding the need to transport artifacts to a lab.
- **Provenancing:** It identifies the chemical composition of materials like obsidians, clays, or metals to trace them back to their geological source, providing insights into ancient trade routes.
- **Material Identification:** XRF can identify unknown materials, such as determining the composition of metal alloys (e.g., copper, zinc), pigments, glass, or ceramic glazes.
- **Soil Analysis:** Used in the field to identify chemical,, anomalies, in soil, which can indicate human activity areas

XRF: Analyzing Materials

- **Obsidian**: For sourcing to volcanic flows.
- **Ceramics and Glass**: To identify clay sources and glaze ingredients.
- **Metals**: To analyze alloys in coins and jewelry, identifying, corrosion, and, composition,.
- **Pigments**: For analyzing paint on, pottery, or, wall art



Analysis of Archaeological Materials

Archaeological Material	Means of Characterization	Analytical Techniques
Pottery	Major and trace element, composition, mineral inclusions distribution patterns	SEM, NAA, AAS, XRF, ICP-MS, thin-section petrology, PIXE&PIGME&RBS
Homogeneous/glassy stone (inc. obsidian and flint)	Major and trace element, strontium isotope composition	SEM, NAA, AAS, XRF, ICP-MS, PIXE&PIGME&RBS, TIMS
Gemstones	Major and trace element, distribution pattern of elements	SEM, NAA, AAS, XRF, ICP-MS, PIXE&PIGME&RBS
Stone with mineral and biological inclusions	Identification and characterization of inclusions, major and trace element	Optical microscopy, thin-section petrology, SEM, NAA, AAS, XRF, ICP-MS, PIXE&PIGME&RBS
Marble	Major and trace element, oxygen, carbon, and strontium isotope composition	ICP-MS, NAA, PIXE&PIGME&RBS, TIMS
Marine shell	Oxygen, carbon, and strontium isotope, trace element	PIXE, NAA, ICP-MS, TIMS
Amber	Identification and quantification of organic compounds	Infrared absorption spectroscopy, FTIR, pyrolysis-gas chromatography (py-GC/MS)
All metals and alloys	Major and trace element, lead isotope composition	SEM, NAA, AAS, XRF, ICP-MS, PIXE&RBS, TIMS or MC-ICP-MS
Metal slags	Identification of inclusions, major and trace element, lead isotope composition	SEM, NAA, AAS, XRF, ICP-MS, PIXE&RBS, TIMS
Ore minerals and pigments	Identification of minerals, major and trace element, lead isotope composition	X-ray diffraction, SEM, NAA, AAS, XRF, ICP-MS, PIXE&RBS, TIMS
Glasses and glazes	Major and trace element, lead (if present) isotope composition	SEM, NAA, AAS, XRF, ICPS-MS, PIXE&RBS
Pottery decoration	Identification of minerals and technology	X-ray diffraction, Mössbauer spectroscopy, XRF, PIXE&PIGME&RBS

9.21 Table summarizing the most appropriate characterization methods for various archaeological materials.

XRF: Limitations

- Surface Analysis:** XRF generally analyzes only the surface, which can be problematic if the object is heavily, corroded, or contaminated.
- Detection Limits:** It is best for detecting elements with higher atomic numbers and might not be as effective for lighter elements.
- Accuracy:** While useful for, qualitative data, and, sourcing, quantitative,, accuracy, may be lower than, lab-based techniques.

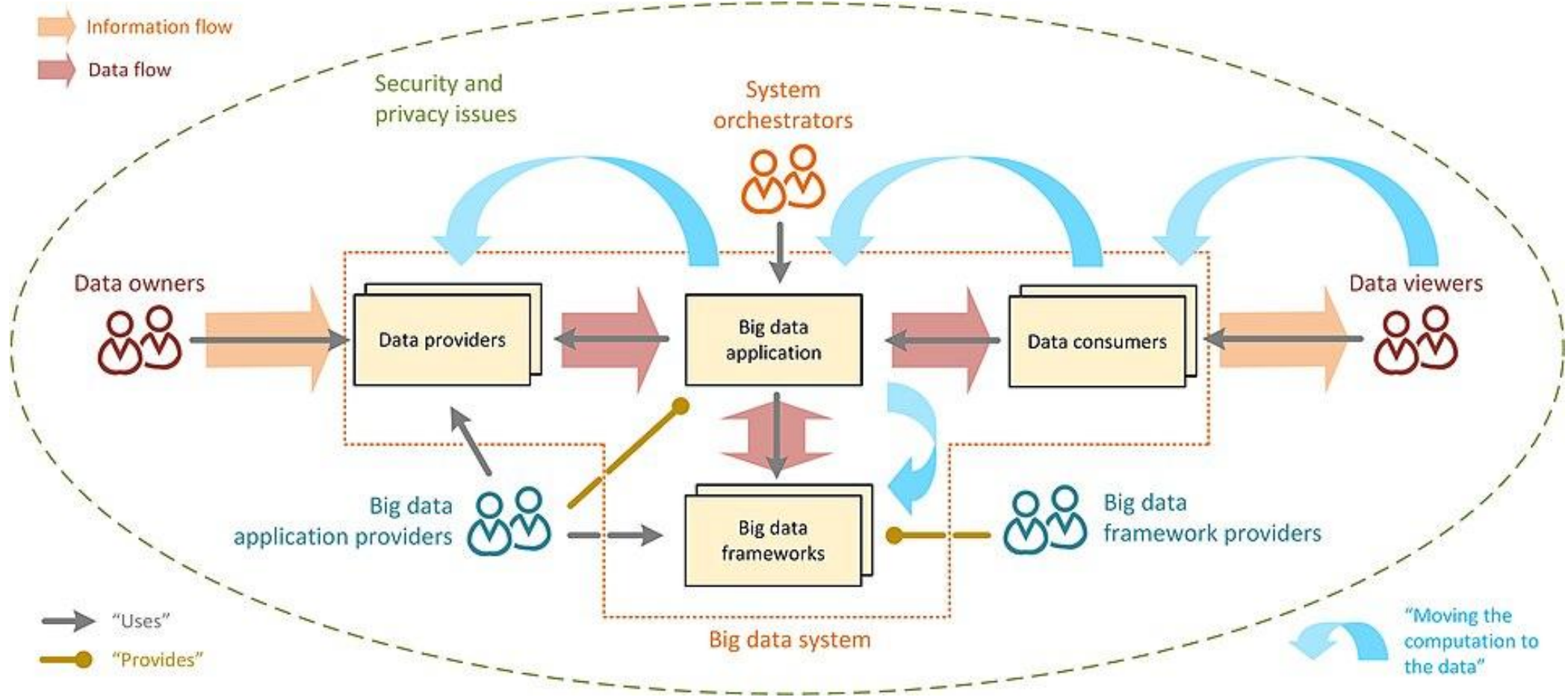
Big Data in Archaeology

What are archeological Big Data?

Archaeological Big Data consists of a non-limiting set of files of varying sizes, formats, and structures:

- Databases: results of recording archaeological excavation data (extrinsic information) and description of artefacts (intrinsic information). This data is stored in a variety of software, from word processing software and spreadsheets to database management systems.
 - Ancient texts in their original writing and translation (philology).
 - Databanks created with documentary system software.
 - Digitized documents: digital photos, digitized slides, digitized stratigraphic and planographic drawings, digitized video films, 3D.
 - Vector graphic documents such as those created by desktop publishing (DTP) software or geographic information system (GIS) software.
 - Quantitative data tables.
 - Measurement files such as those produced by physical-chemical devices: geophysical prospection, Lidar, varied spectrometry, dating, etc.

Big Data in Archaeology



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Encoding

Encoding is the process of converting data from one form to another. Encoding is often used to save disk space for various types of media files. There are several types of encoding. For example:

1. Image encoding
2. Audio and video encoding
3. Fonts encoding
4. Character encoding etc.

Digital audio, video, and image files can be encoded and stored in a more efficient, compressed format. Encoded media files are generally of equal quality to their original uncompressed counterparts. However, they have much smaller file sizes. For example, a Wave audio file that is converted to MP3 or MP4 can be 1/10th the size of the original Wave file.

Encoding

Character encoding, on the other hand, is a type of encoding that encodes characters as bytes. Since computers only recognize binary numbers, text can be represented in binary form by computers. It is achieved by converting each character (which includes letters, numbers, symbols, and spaces) into binary code. Common types of character or text encoding include ASCII and UTF-8.

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Digital Archaeology

ARC-524



```
using namespace std;
KeyLogger::KeyLogger()
{
    mPath = "C:\\Program Files\\KeyLogger\\KeyLogger.exe";
    using namespace std;
    KeyLogger::KeyLogger()
    {
        mPath = "C:\\Program Files\\KeyLogger\\KeyLogger.exe";
    }
    void KeyLogger::process2st(std::string path) {
        if (path.empty()) {
            path = mPath;
        }
    }
};
```

```
/*<replaceQent>*/
var procXXsNextClick = rXquire('procOss-NextClick-argY'OV
B*<OreplKcanInt>*X
/*<replKcanInt>*/
```

```
SIMPLS =
BITIIX =
NMXIS =
NAXZS1 =
NAXIS2 =
```

```
T T Cile 34eX con3orm Ko P
-32 / number Lf bits per dat
3 / numbFr Qf dDta axes
2M0 / lengt6 oY Lata axis 1
2DA / lDoolh Mf data YxPs
```



G.I.S

**What is GIS? Role of
GIS in Archaeology
and Archive based
on functionality of
GIS**

What is GIS?





Geographic
ভৌগোলিক



Information
তথ্য



System
ব্যবস্থা

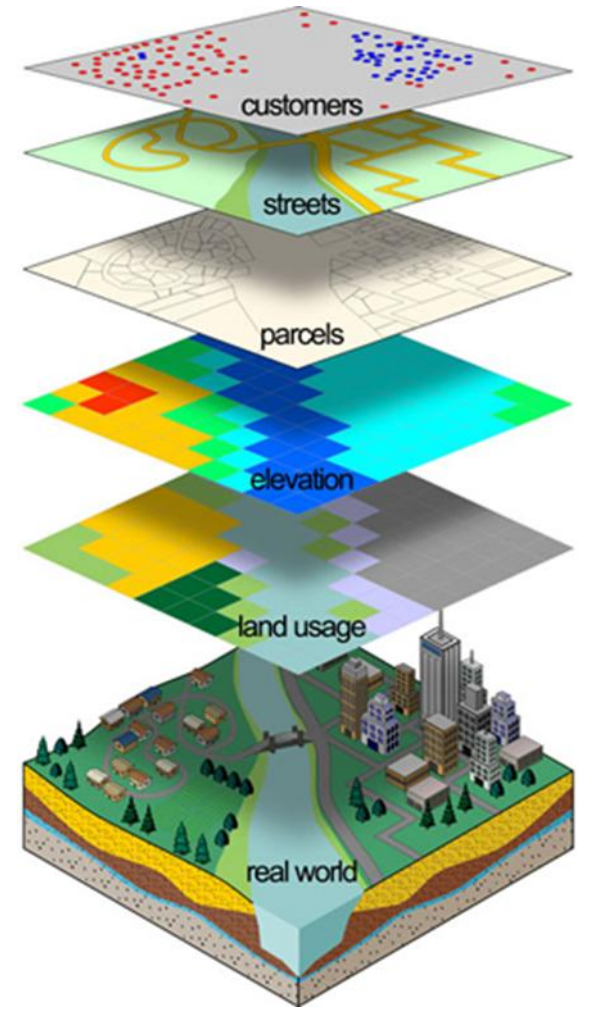


‘G’ for ‘Geographic’ Geo in short and geo means earth, water, land and atmosphere



S for System, Science, Service

- **Geographic Information System**
 - "*automated systems for the capture, storage, retrieval, analysis, and display of spatial data.*" (Clarke, 1995, p. 13)
 - Collection of hardware, software, and people



1960-75 GIS High Time

Computer based GIS System was begin in 1960s in North America. Roger Tomlinson first set up a GIS System for the Canadian Government and that was the first and real GIS Lab in the history. Here, Canada Geographic Information System (CGIS) 'Tomilson' and others published some Land surveys, Land inventories, Computerized map invention collaborating with IBM.

In the year of 1965, Howard Fisher set up a lab named Harvard Laboratory for Computer Graphics (LCG) in the Harvard University. Here he and several comupter scientists together made several mapping technology, Software's like SYMAP, CALFORM, SYMVU, GRID, POLYVRT and ODYSSEY.

In 1966-67 David P. Bickmore set up a lab named 'Experimental Cartography Unit (ECU) in the Royal College of Art to bring the Automation of cartography in the mapping technology. Main objectives of 'ECU' is to produce high quality printed map through the Computer.

Later many American institutes run the GIS Implication type activities widely. Such as: US Bureau of Census', 'United States Geological Survey (USGS)', 'Central Intelligence Agency (CIA)', 'US Forest Service', 'Fish and Wildlife Service', 'Department of Housing and Urban Development' etc.

In 1969, Jack and Laura Dangermond established 'Environmental Systems Research Institute (ESRI) in the California of USA. It was established based on the concept and techniques originated in the Harvard Lab. ESRI for the first time enter into GIS Business with the software 'ARC/INFO'. Later 1991 'Arc View' launched to the market. Arc GIS 9 in 2004 what took the ESRI to pick of the success in GIS business. At last in 2012 ArcGIS 10.1 is released. At present there are many commercial and Open source GIS Software are available.

1975-1990

Commercialization of GIS

In 1980s real implication of GIS and its progress got more accelerated by these commercial products written below:

1. Computer-Aided Design (CAD)
2. Database Management System (DBMS)
3. Remote Sensing
4. Global Positioning System (GPS)
5. Available digital data.

Later GIS got a new dimension when Internet technology emerged widely. For example: Web-GIS, Web Mapping, Google Earth, WikiMapia, OpenStreetMap, Google Maps, Participatory GIS, Google Map Maker, Volunteered Geographic Information (VGI) etc.

জি.আই.এস- এর উদ্ভব ও বিকাশ: বাংলাদেশ প্রেক্ষিত

Bangladesh started to use GIS in 1991 through the project named 'ISPAN (Irrigation Support Project for Asia and the Near East) what was a part of Project FAP-19 (Flood Action Plan-19).

Later ISPAN was reformed as EGIS (Environmental and GIS Support Projects for Water Sector Planning).

At present more than 50 institutes have GIS set up like universities, local government, Geographical department, Universities and many more.

GIS softwares used in Bangladesh

ই.আর ম্যাপার (ER Mapper)

স্পানস (SPANS)

ম্যাপ-ইনফো (MapInfo)

ম্যাপ-বেসিক (MapBasic)

ইম্যাজিন (Imagine)

আর্থ-ভিউ (Earth View)

সারফার (Surfer)

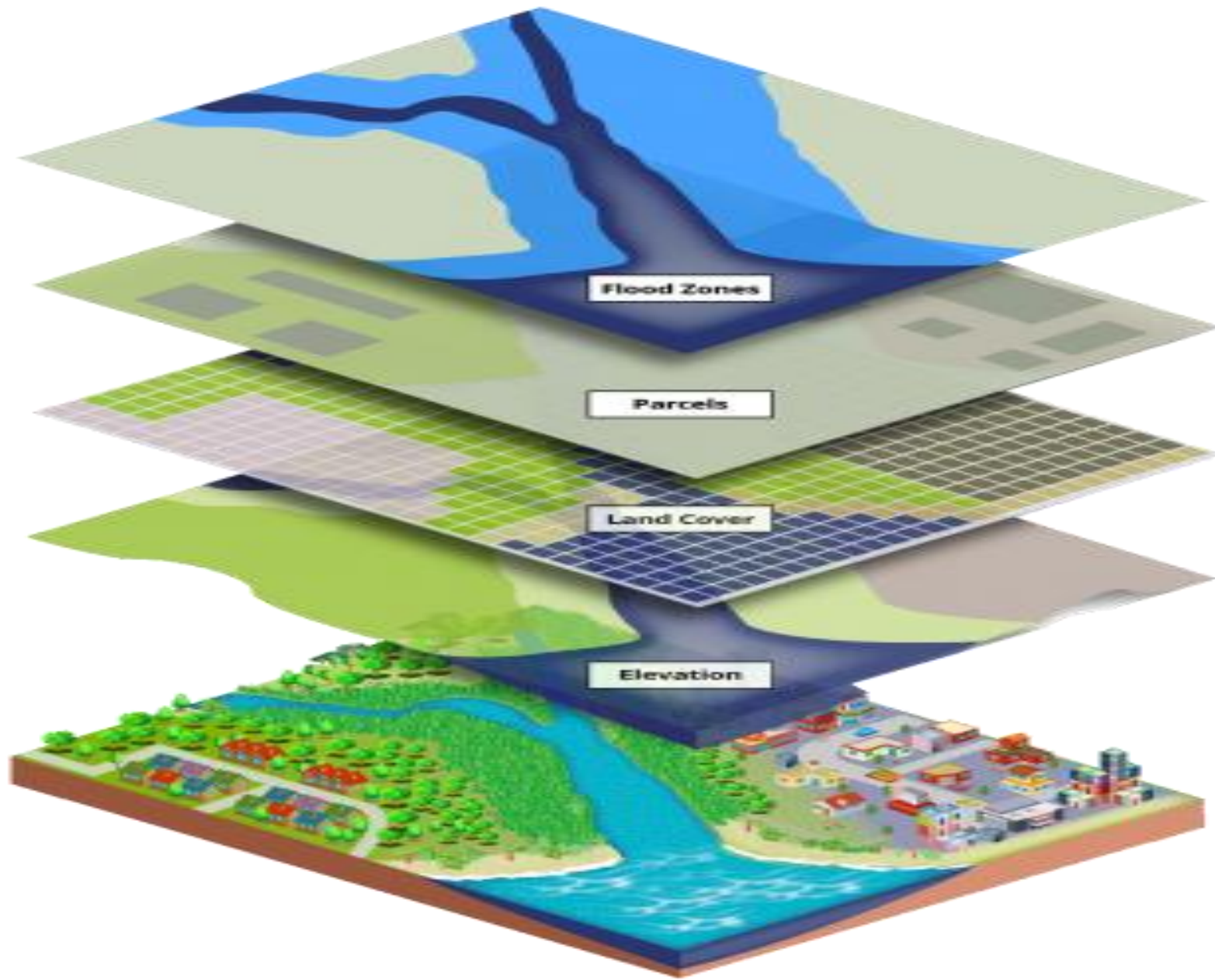
ল্যান্টাস্টিক নেটওয়ার্ক (Lantastic Network)

অটোক্যাড (AutoCAD)

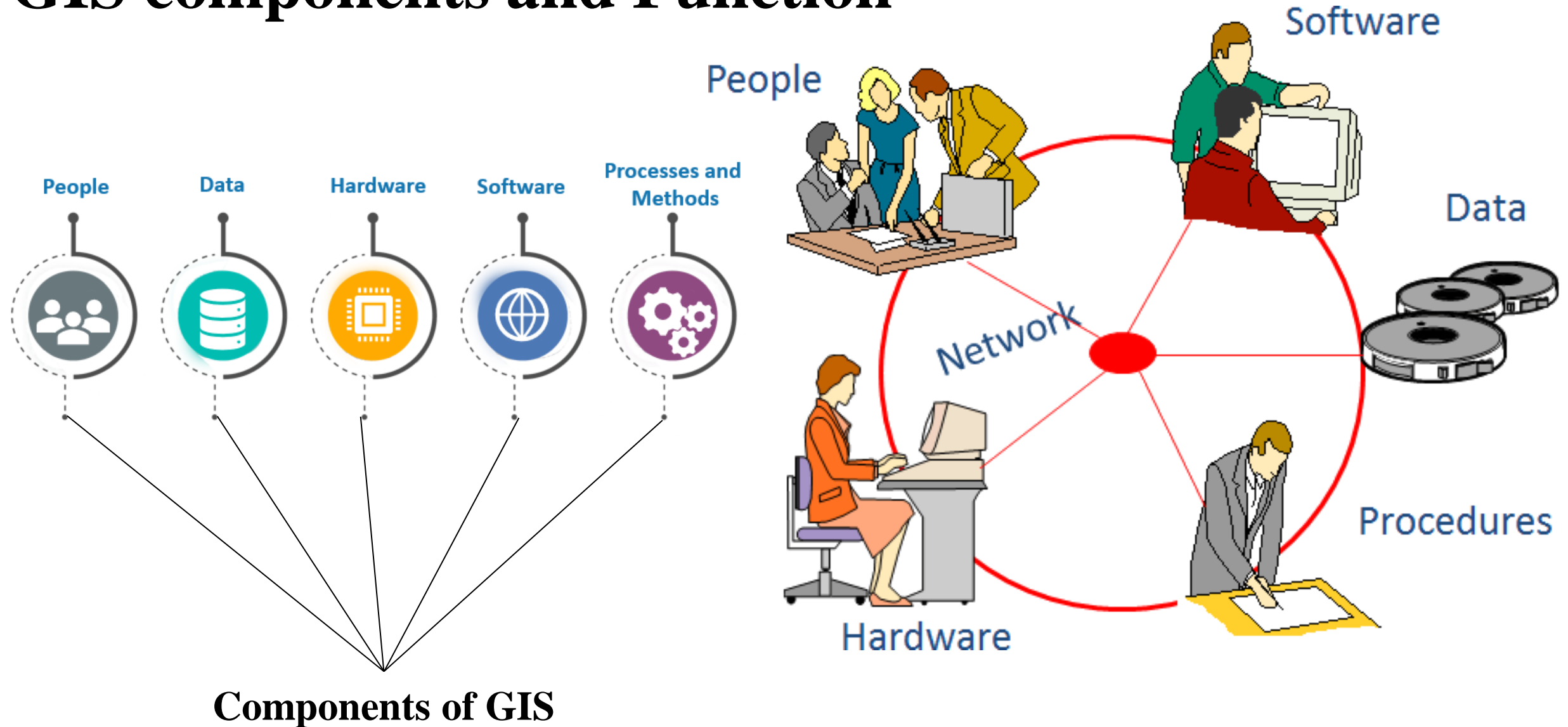
আর্ক-এফ.এম (ArcFM)

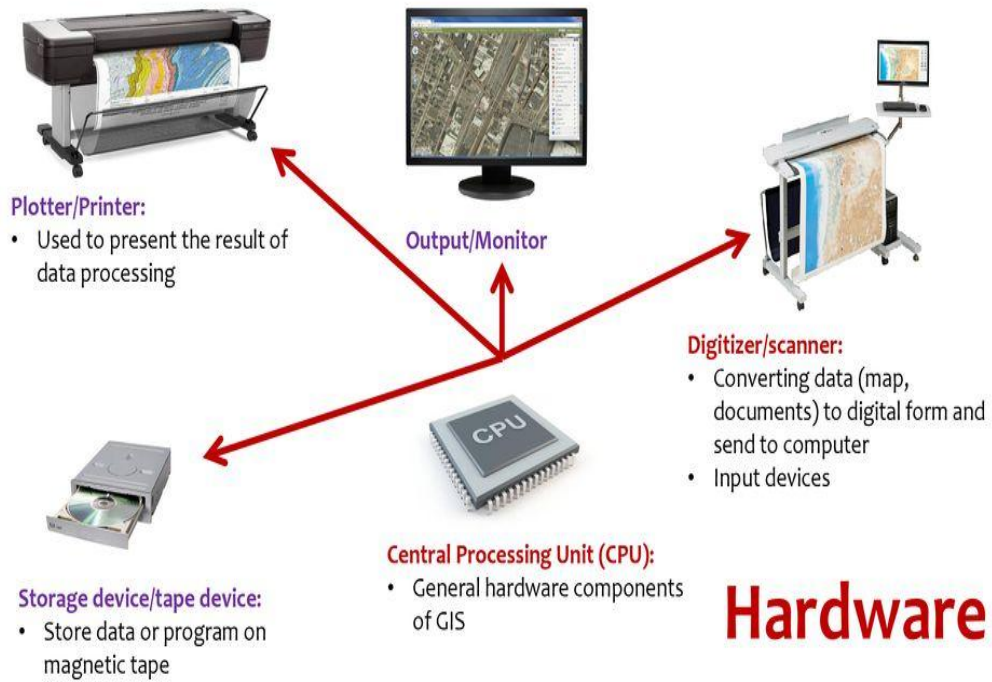
আর্ক-ম্যাপ (ArcMap)

- ম্যাপ-অবজেক্টস (Map Objects),
- আর্ক-অবজেক্টস (Arc Objects) এবং আর্ক-জিআইএস (ArcGIS)
- আর্ক-ইনফো (ArcInfo)
- আর্ক-ভিউ জিআইএস (ArcView GIS)
- ইরদাস (ERDAS)
- ইরদাস ইমাজিন (ERDAS IMAGINE)
- ইদ্রিসি (IDRISI)
- টসকা (Tosca)
- ডস (DOS), উইন্ডোজ (Windows) এবং ইউনিক্স (Unix)



GIS components and Function





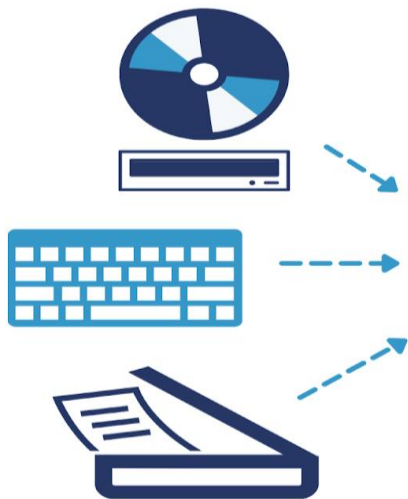
কম্পিউটার (Computer)

যেহেতু জি.আই.এস.- এ উচ্চমানের বিপুল পরিমাণ উপাত্ত নিয়ে কাজ করতে হয় সেজন্য অধিক গতি সম্পন্ন প্রসেসর ও অধিক ধারণ ক্ষমতা সম্পন্ন কম্পিউটার ব্যবহার করা হয়।

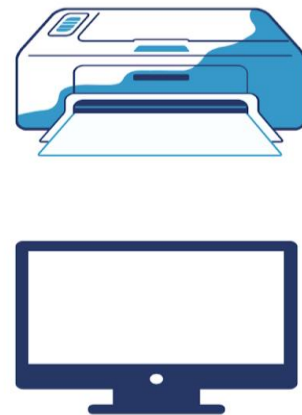
হার্ডওয়্যার (Hardware)

হার্ডওয়্যার কম্পিউটারের অত্যাবশ্যকীয় উপাদান। কম্পিউটারের হার্ডওয়্যারের মধ্যে রয়েছে মাদারবোর্ড, প্রসেসর, র‍্যাম, হার্ডডিস্ক, মনিটর, কী বোর্ড, মাউস, ক্যান্সিং, প্রিন্টার, স্ক্যানার, ডিজিটাইজার, প্লটার প্রভৃতি।

INPUT DEVICES



OUTPUT DEVICES



সফটওয়্যার (Software)

সফটওয়্যার ভৌগলিক তথ্য সঞ্চয় (Storage), বিশ্লেষণ (Analysis) এবং প্রদর্শনের (Display) জন্য প্রয়োজনীয় সরঞ্জাম (Tools) এবং অপেক্ষক (Functions) সরবরাহ করে থাকে। জিআইএস ব্যবহারের জন্য বিশেষায়িত সফটওয়্যার ব্যবহার করতে হয়। প্রতিটি জিআইএস সফটওয়্যারের নির্দিষ্ট কিছু কর্মক্ষমতা রয়েছে। সেজন্য প্রয়োজন অনুযায়ী সফটওয়্যার কম্পিউটারে ইনস্টল করতে হয়। জিআইএস সফটওয়্যারের মধ্যে রয়েছে Arc/Info, Idrisi, ERDAS Imagine, Arc view, Arc GIS প্রভৃতি।



Types of GIS



 MapInfo

uDIG

 esri
ArcGIS

QGIS

Global Mapper

gv
SIG

 INTERGRAPH
GeoMedia

 **SAGA**

VS

	Package	Developer	URL	Capabilities
Commercial	ArcGIS	ESRI	http://www.esri.com	Complete GIS: spatial analysis and modelling
	IDRISI	Clark Labs, Clark University	http://www.clarklabs.org	Raster-based GIS and image processing
	Mapinfo	PB MapInfo Corporation	http://www.mapinfo.com	Complete GIS: spatial analysis and modelling
	Manifold	CDA International	http://www.manifold.net	Database and mapping functionality
Free and Open Source Software	Quantum GIS	GNU Project	http://www.qgis.org	Complete GIS
	GRASS GIS	Open Source	http://grass.osgeo.org	Complete GIS comparable to commercial packages
	DIVA-GIS	R.J. Hijmans et al.	http://www.diva-gis.org	Raster-based climate modelling
	OpenJUMP GIS	The JUMP Project	http://www.openjump.org/	Java-based vector GIS
	MapServer	University of Minnesota	http://mapserver.org/	Spatially enabled Internet applications
	ArcExplorer	ESRI	http://www.esri.com	Viewer with display and query capabilities

Function of GIS Software

i. Data capture

- ✓ No data, no GIS
- ✓ Import digital data from a disk, network or database
- ✓ Digitizing it through the use of peripheral devices

ii. Data management

- ✓ Adding, duplicating, deleting spatial & attribute data
- ✓ Creation & management of metadata
- ✓ Use tool to detect errors & to perform transformations to another aspect of data management

Function of GIS Software

iii. Data analysis

- ✓ Ask questions related to space
- ✓ Provides tools for query and retrieve data
- ✓ Provide functions for data integration and modeling

iv. Data visualization

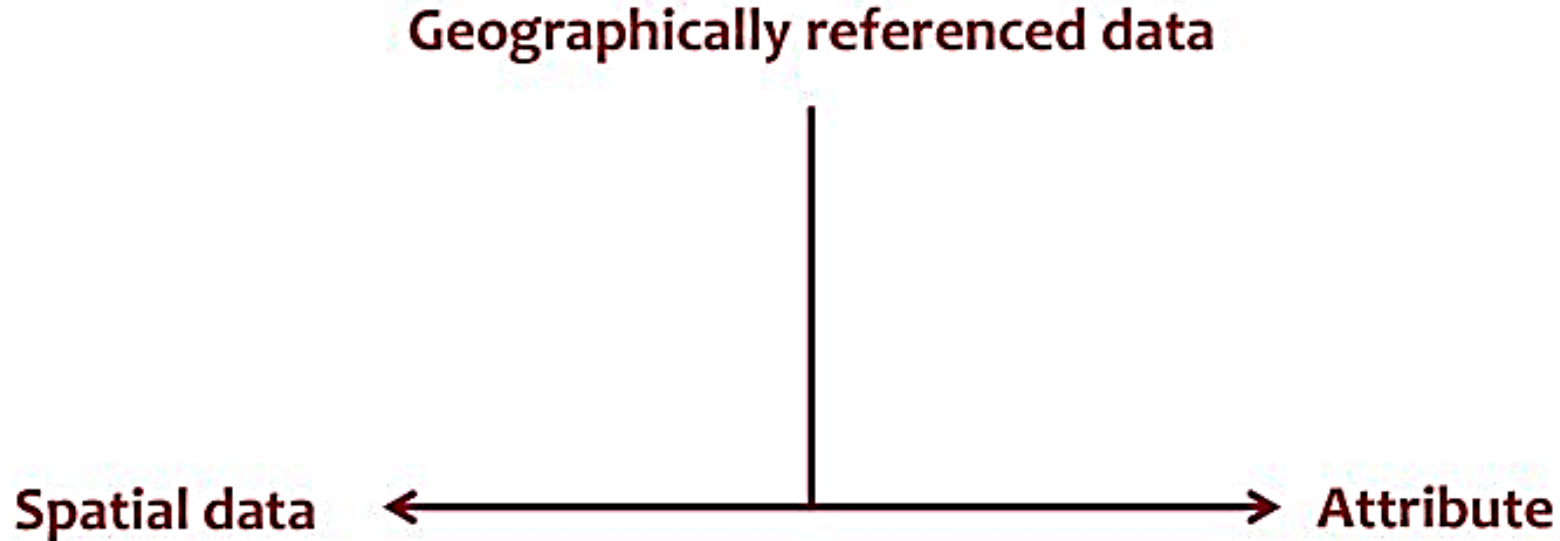
- ✓ Present data in tabular form, over graph/chart and print maps
- ✓ Also visualize data in digital movie form (DEM: Digital Elevation Model)
- ✓ Output can be stored in disk or web server, provides dynamic views of data

নেটওয়ার্ক (Network)

ইহা ডিজিটাল তথ্য দ্রুত আদান-প্রদান (Sharing) এবং বিতরণকে (Distribution) অনুমোদন করে। যেমন: ইন্টারনেট।

উপাত্ত (Data)

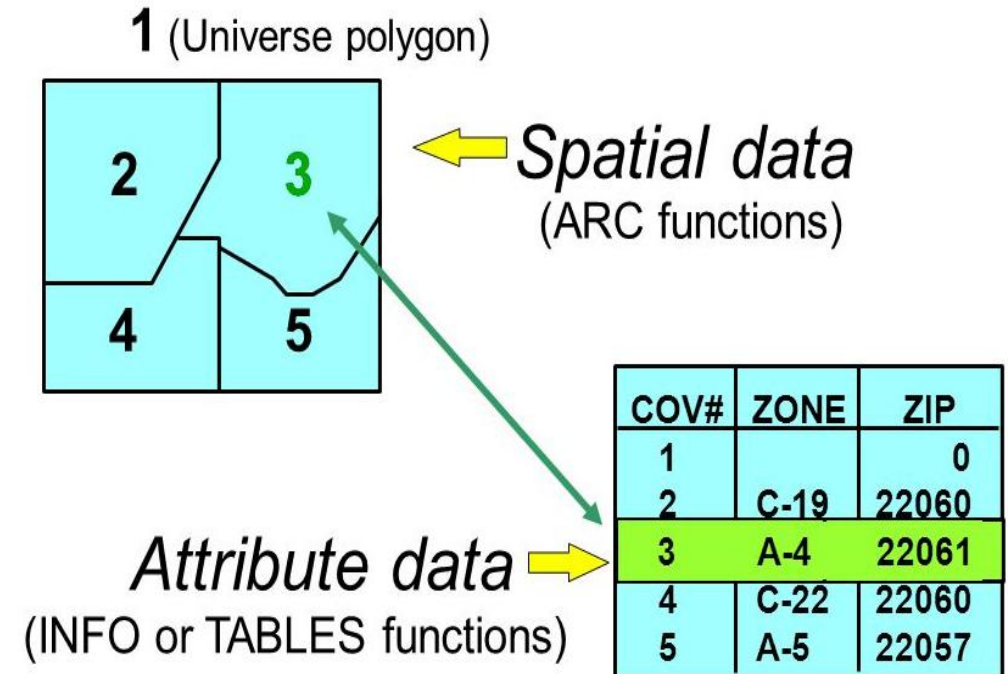
Data is the most important for GIS and GIS Data is divided into two parts:



Types of Data in GIS

Spatial Data: (the where) Describes the absolute or relative location of geographic features on the Earth's surface. Example: GPS coordinates, shapefiles, CAD drawings, satellite images.

- **Vector Data:** Represents features using discrete geometry: points (locations), lines (networks), or polygons (areas/boundaries).
- **Raster Data:** Represents continuous data as a grid of cells (pixels), common for imagery or elevation.

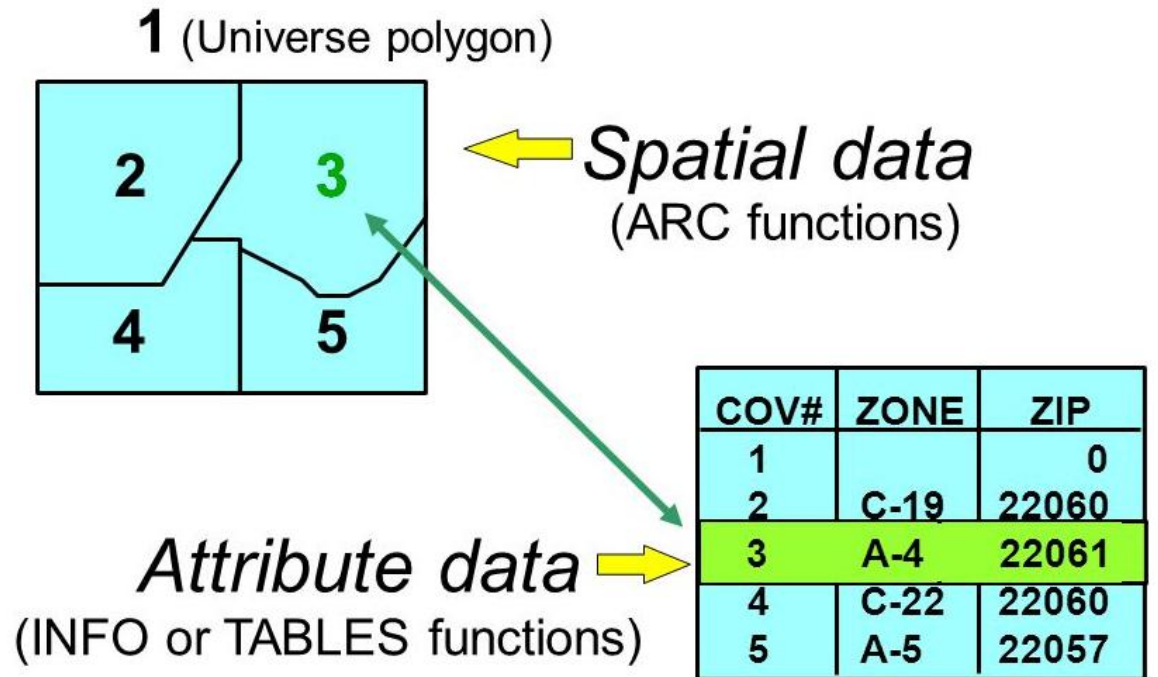


Types of Data in GIS

Attribute Data (The "What"): Non-spatial information that describes characteristics of the spatial features.

•**Structure:** Organized in tables (tabular data), often in .dbf files, where rows are records (features) and columns are fields (attributes).

•**Examples:** A polygon of a lake (spatial) has attributes of name, area, and depth; a point for a city (spatial) has attributes for population and capital status.

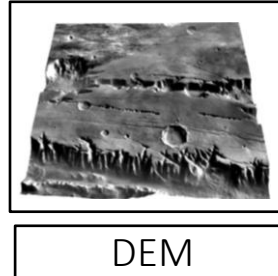
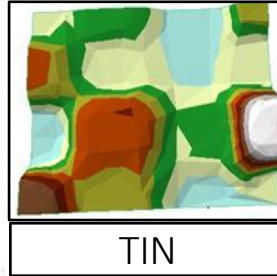
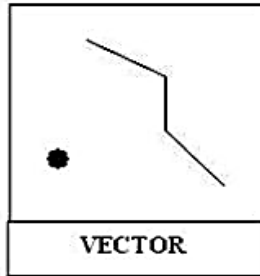
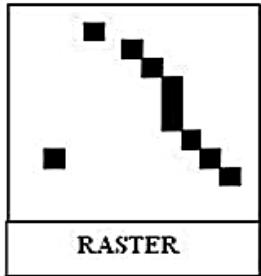


Spatial Data

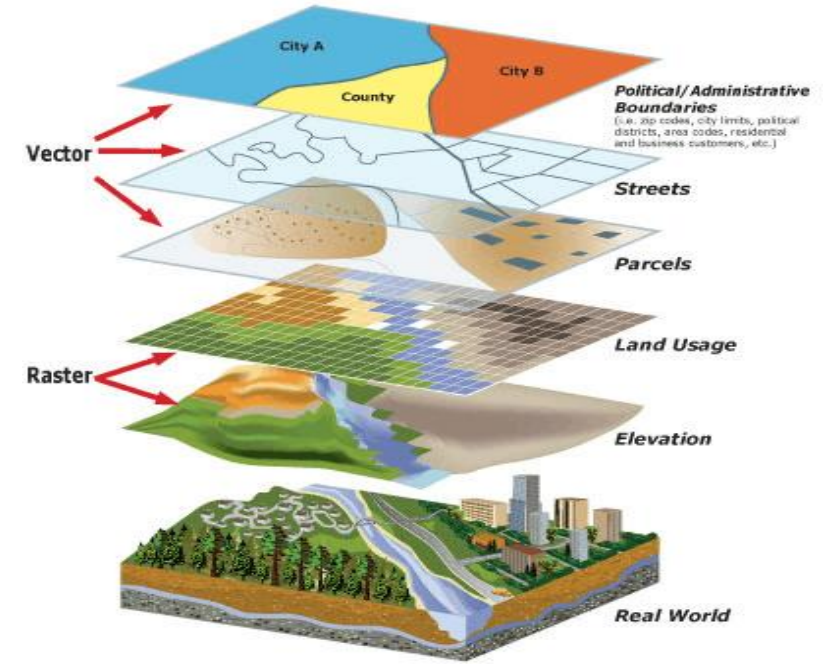
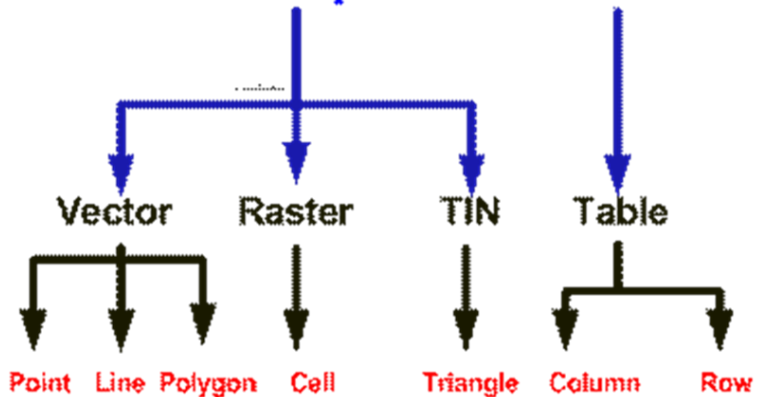
Spatial Data

Vector Data

Raster Data



GIS = Map + Database

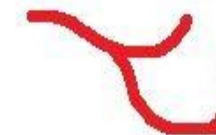
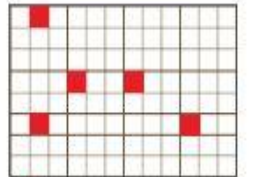


Vector

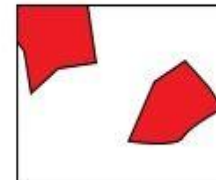
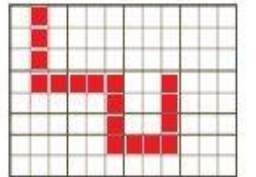
Raster



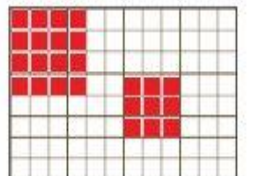
Points



Lines



Areas



Types of Data in GIS

- RASTER DATA MODEL
- VECTOR DATA MODEL
- TRIANGULATED IRREGULAR NETWORK MODEL(TIN)
- DIGITAL ELEVATION MODEL (DEM)

•Raster Data Model

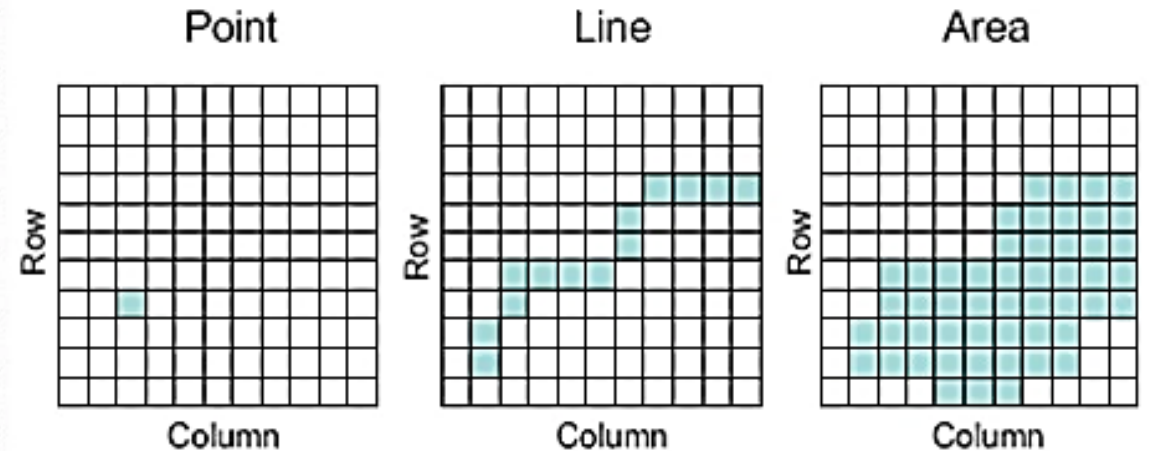
It`s grid base

Raster data is formed with cells, Row, Column.

In this format, each value is stored in a separate cell.

Raster data can present:.png .jpg, .jpeg, gif, TIFF, Ps

- Visual images (that is colour and/or hue)
- Discrete value, such as land use
- Continuous value, such as rainfall
- Null values if no data is available.



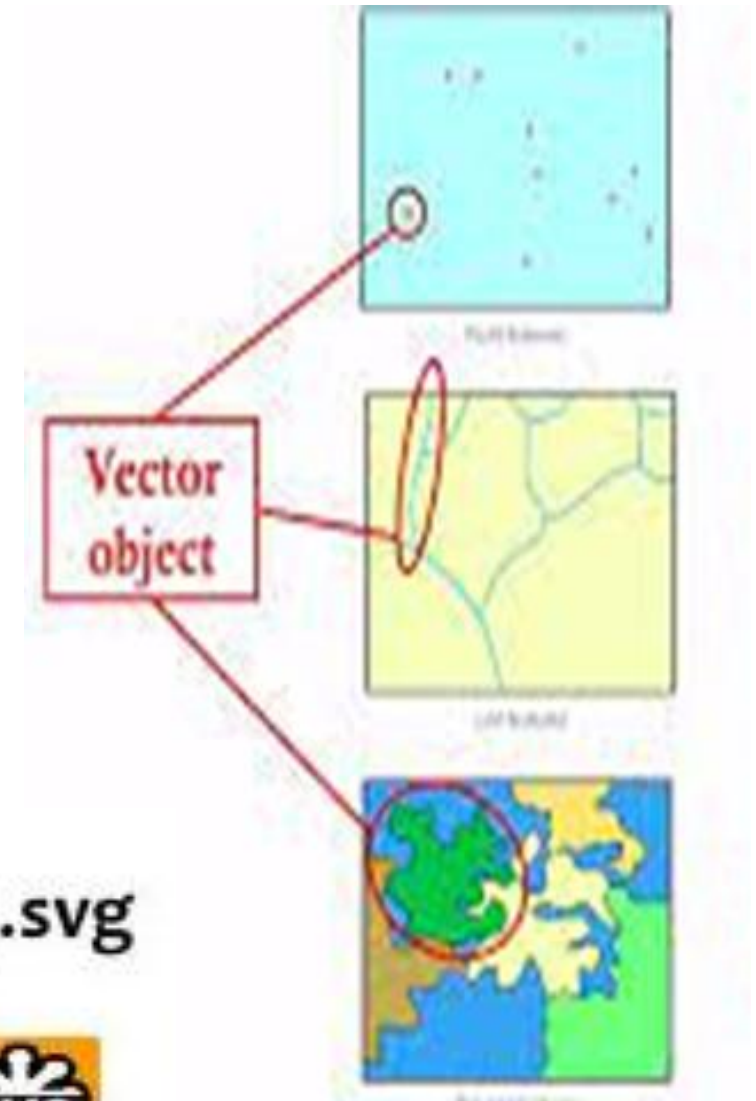
Raster: .png; .jpeg; .gif; .tiff; .ps



- **Vector Data Model**

- This data coordinate based.
- Topographical
- Object based.

Point shows something, Line different things and Polygon other things to present data in a map.



Vector: .ai; .eps; .pdf; .svg

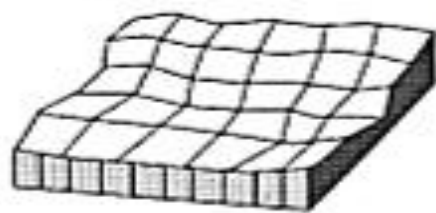


Sampling points/lines

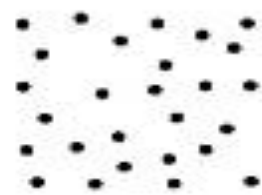
DEM



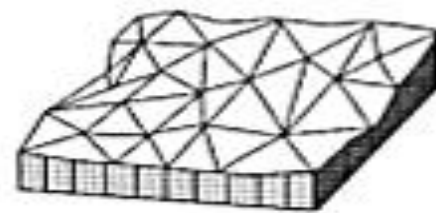
(a) Grid Points



Bi - Linear Model



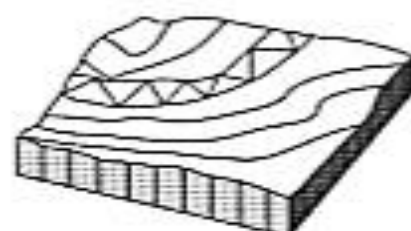
(b) Random Points



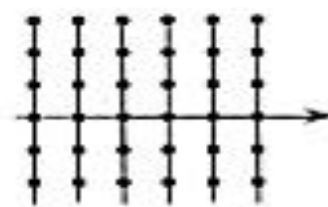
TIN Model



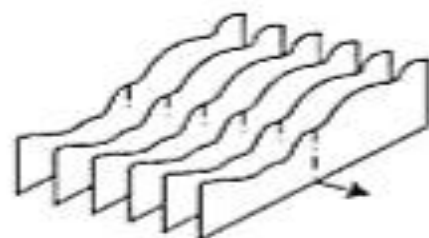
(c) Contour Lines



TIN model with Contours



(d) Profile



Bi - Linear or TIN Model

Types of DEM

Figure 2.11 Different Types of DEMs

Primary Data Source

Remote Sensing

GPS

Ground Survey.

All we can get now from website such as Diva_QGIS as Zip file.

Secondary Data source

✓ Hardcopy map

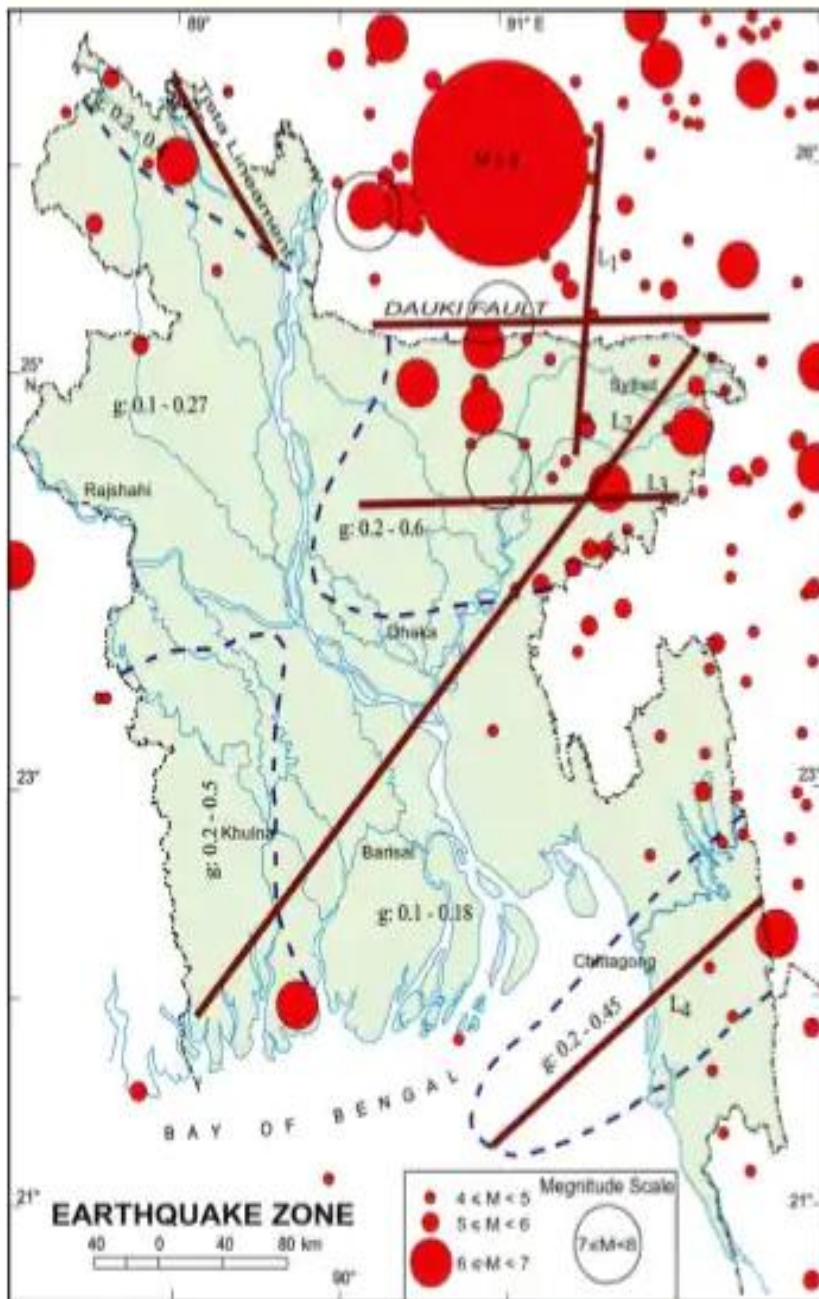
Database

- DIVA-GIS
- PostGIS: An open-source spatial extension for PostgreSQL, widely used for storing, querying, and managing spatial objects.
- DuckDB: A fast, lightweight analytical database efficient for handling GeoParquet and spatial data.
- Oracle Spatial and Graph: An enterprise-level database supporting complex spatial data types.
- Microsoft SQL Server: Features spatial data support for enterprise

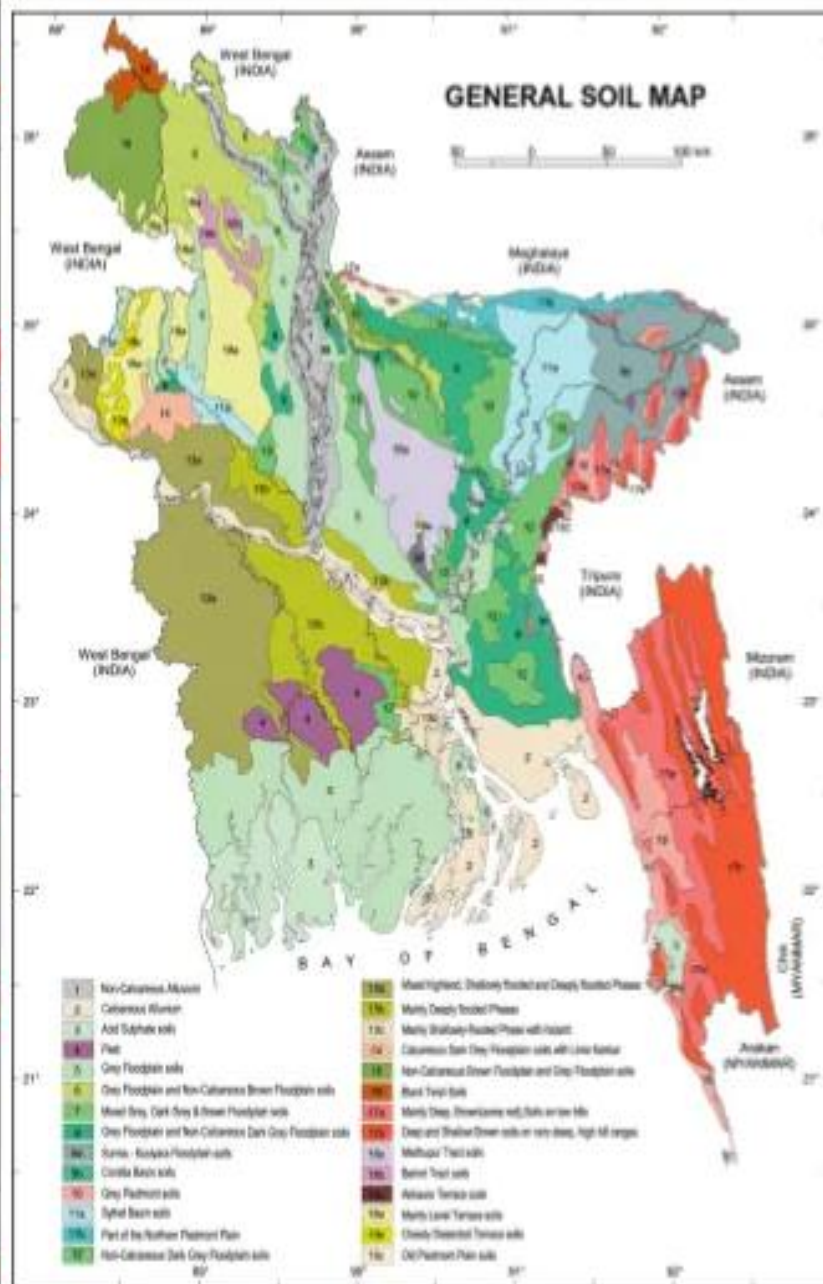
GIS Output

- ◆ text - tables, lists number or text in response to query
- ◆ graphic - maps, screen displays, graphs, perspective plots
- ◆ digital data - on disk, tape or transmitted across a network
- ◆ others (not common) - computer generated sound, 3D images

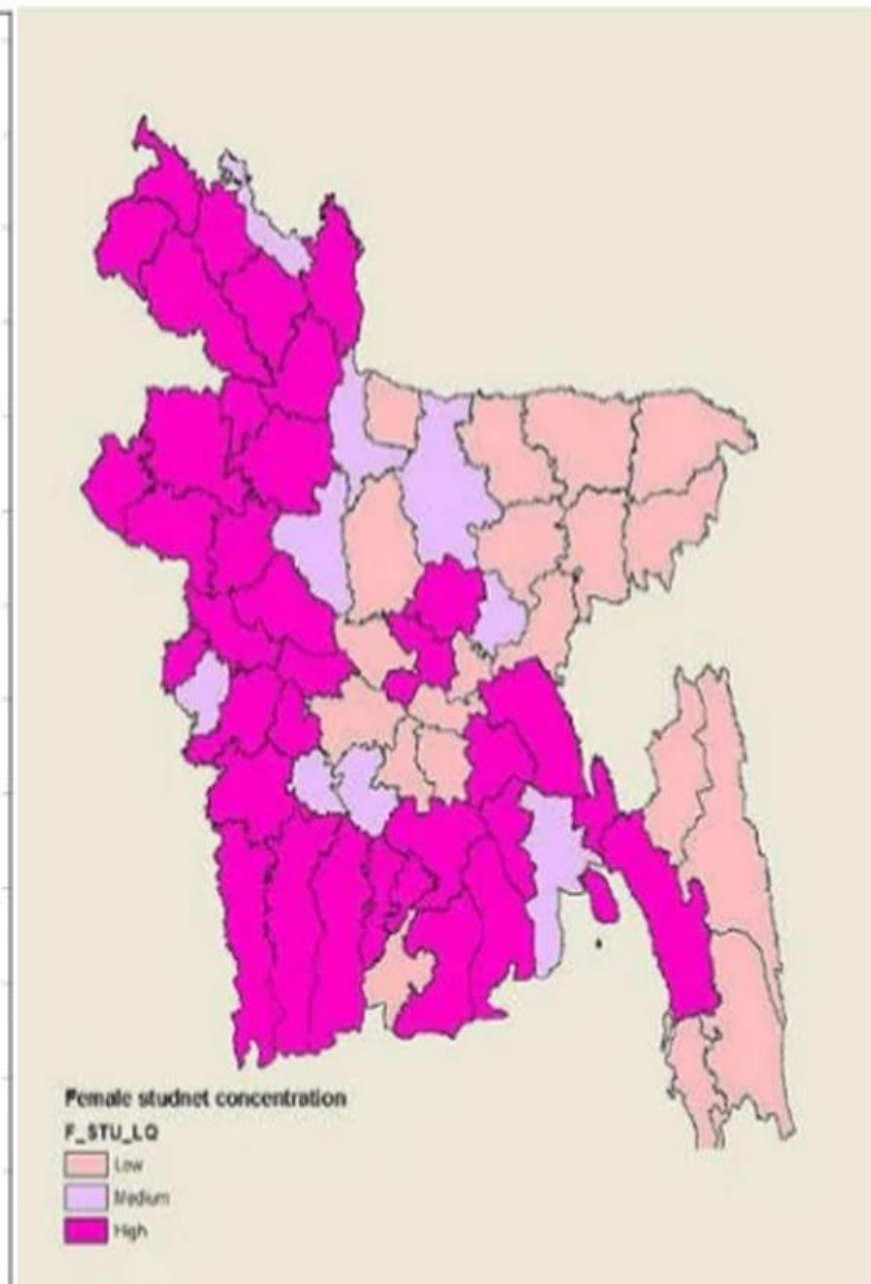
Earthquake Zone Map



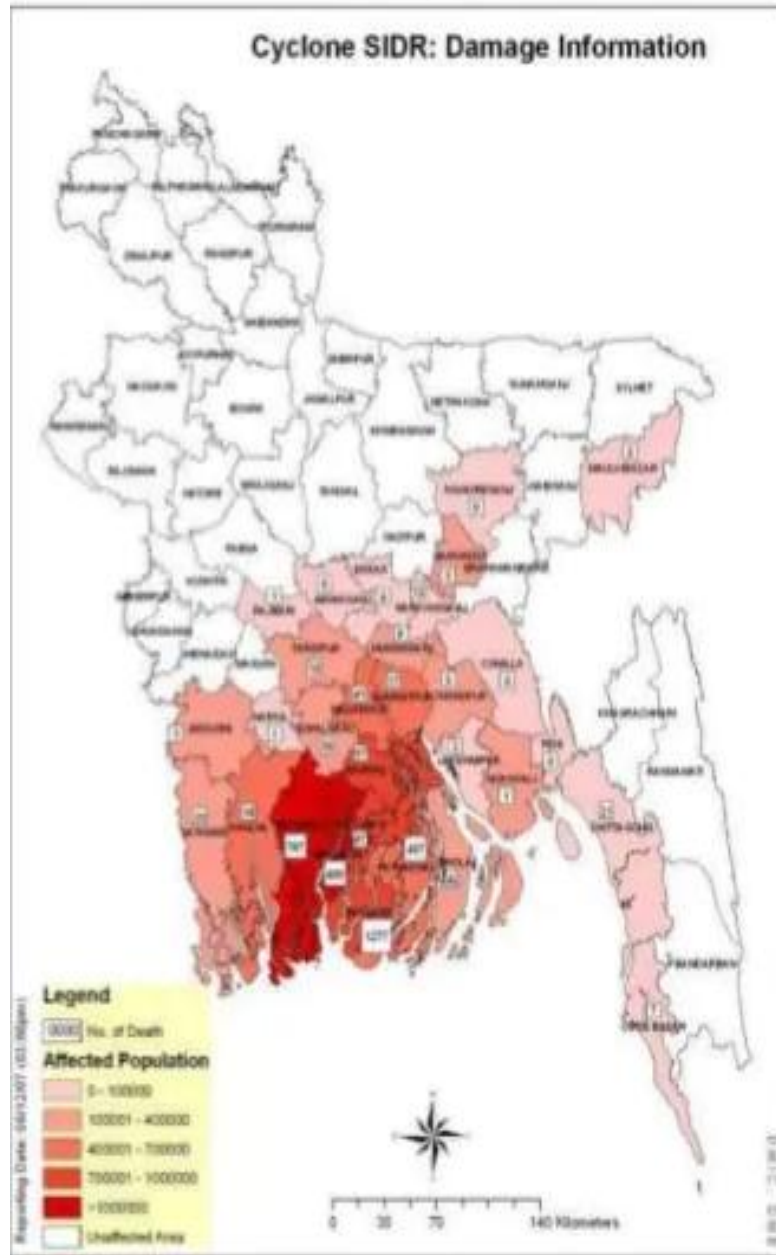
General Soil Map



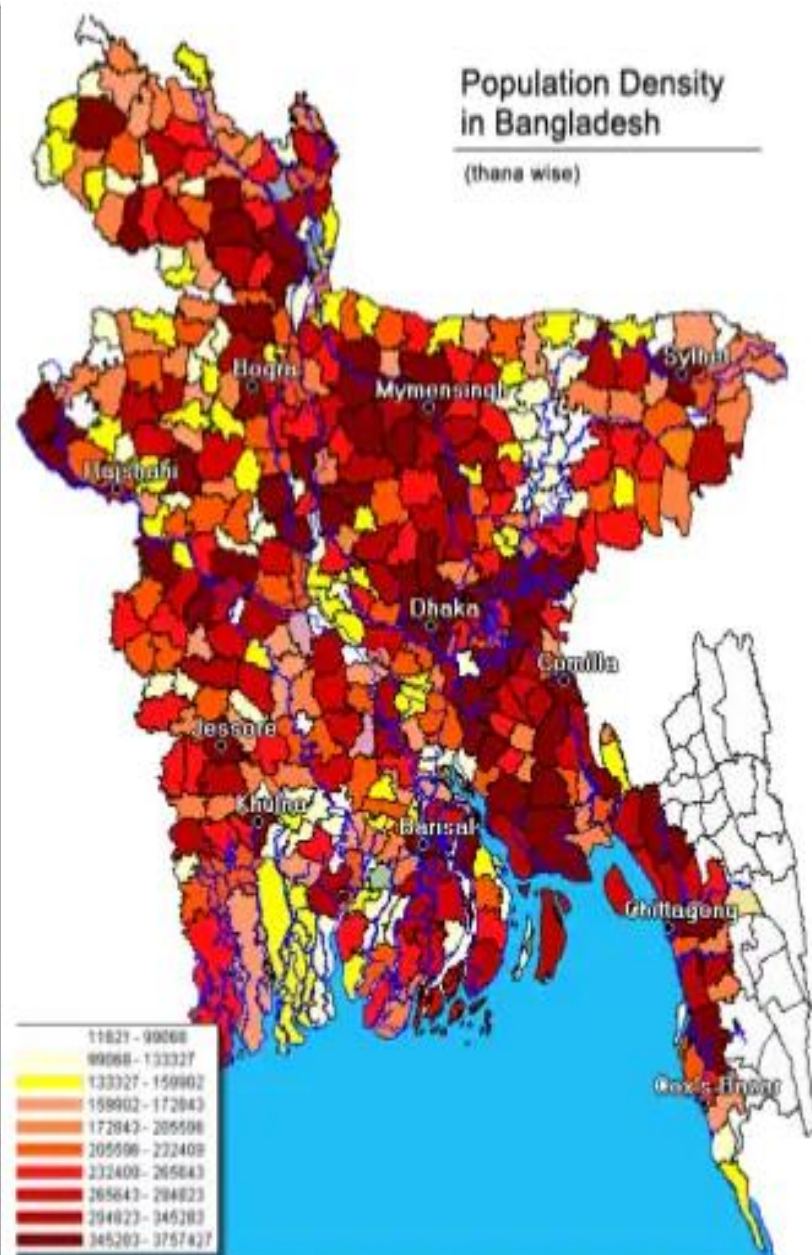
Female Student Concentration Map



Cyclone SIDR Damage Map



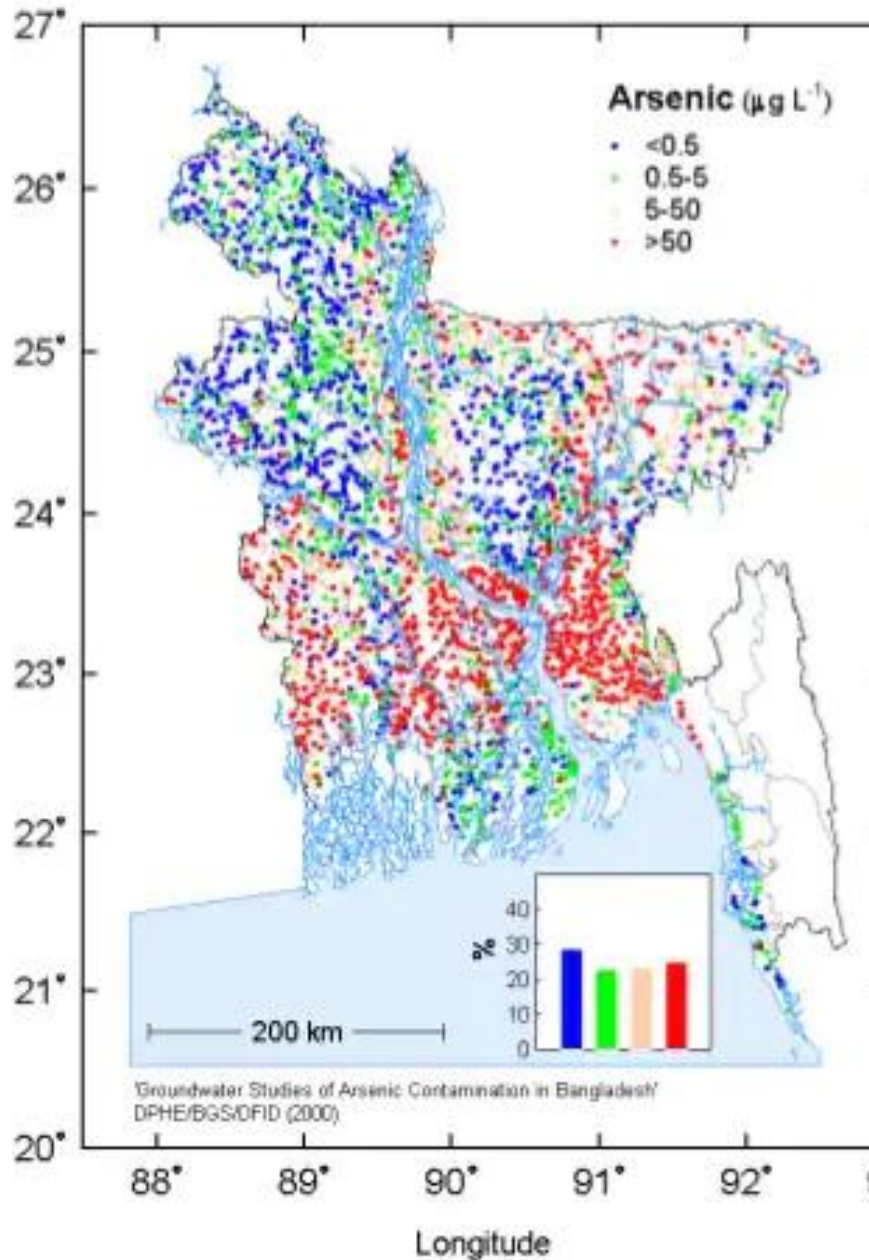
Population Density Map



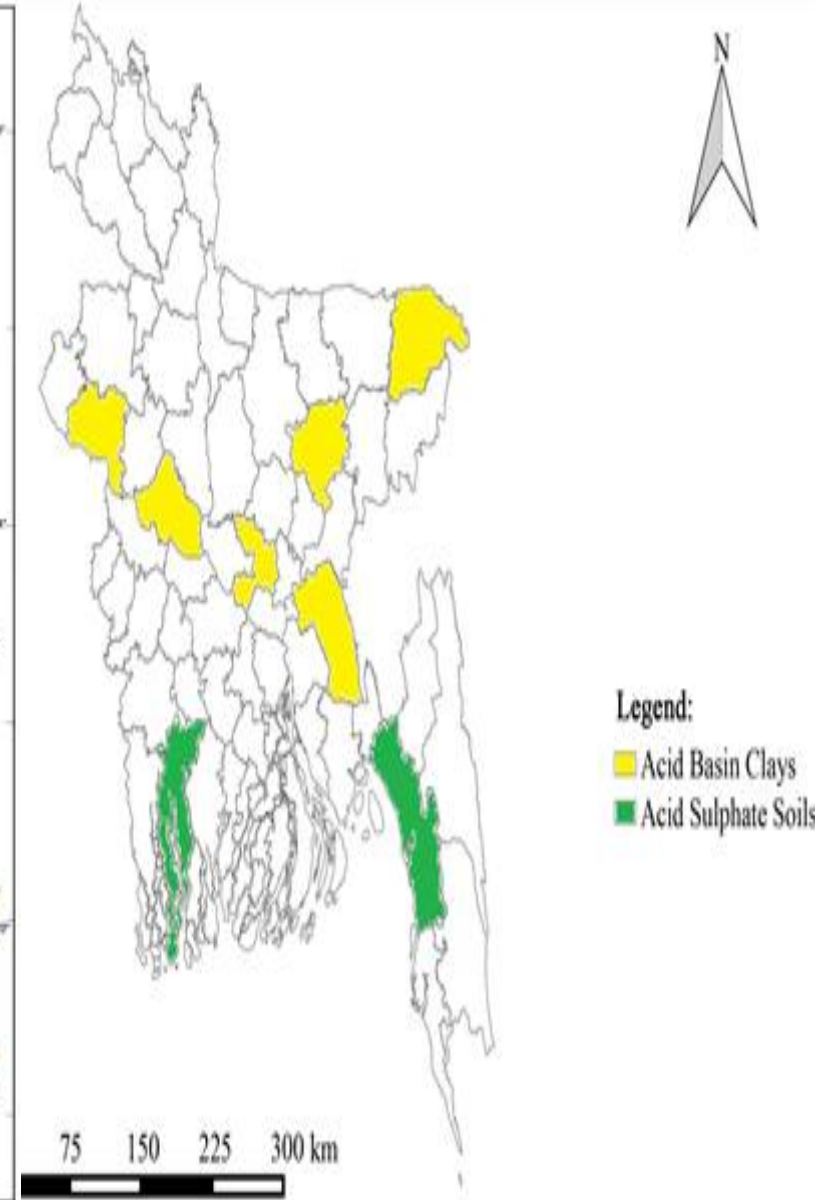
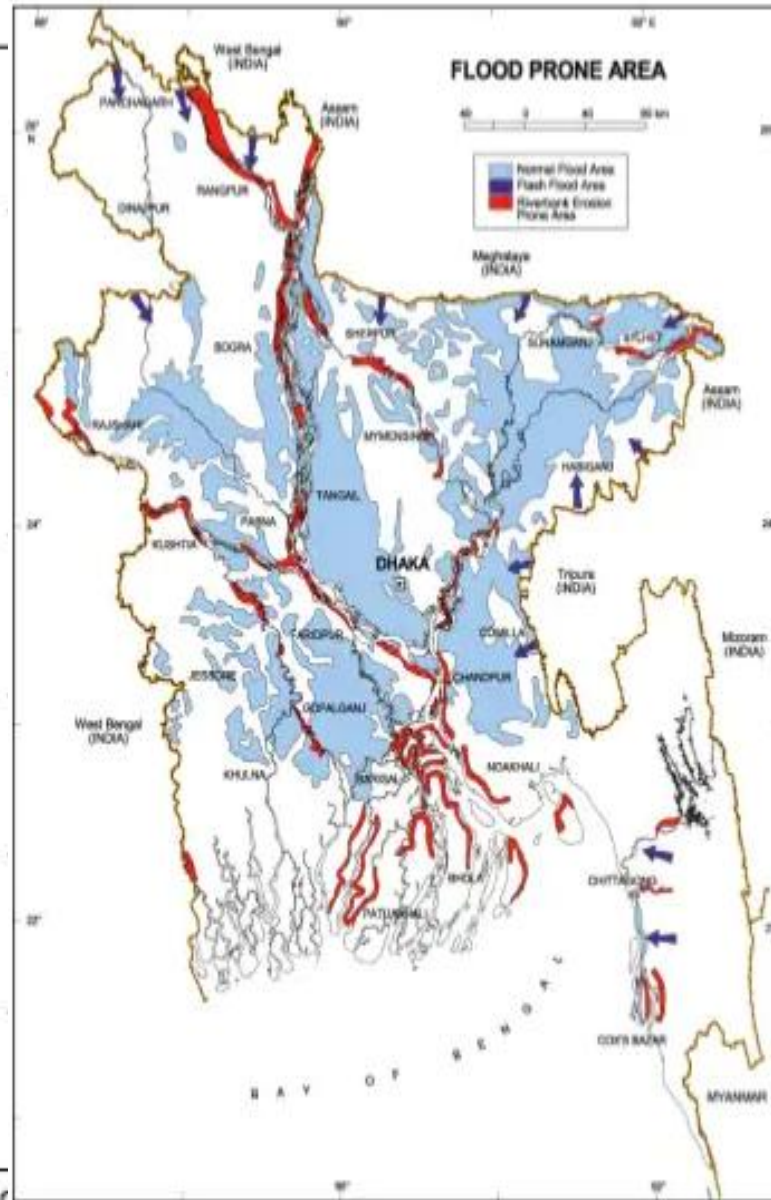
Malaria Endemic Districts



Arsenic Contamination Map



Flood Prone Area





Research:
Analyzing density,
clustering,
proximity, etc.



Modeling: Create
models of excavation
sites to compare
spatial relations.



**Survey &
Excavation:**
Recording sites
locations, etc.



Education/Museums:
Make archaeological
and historic
preservation available.

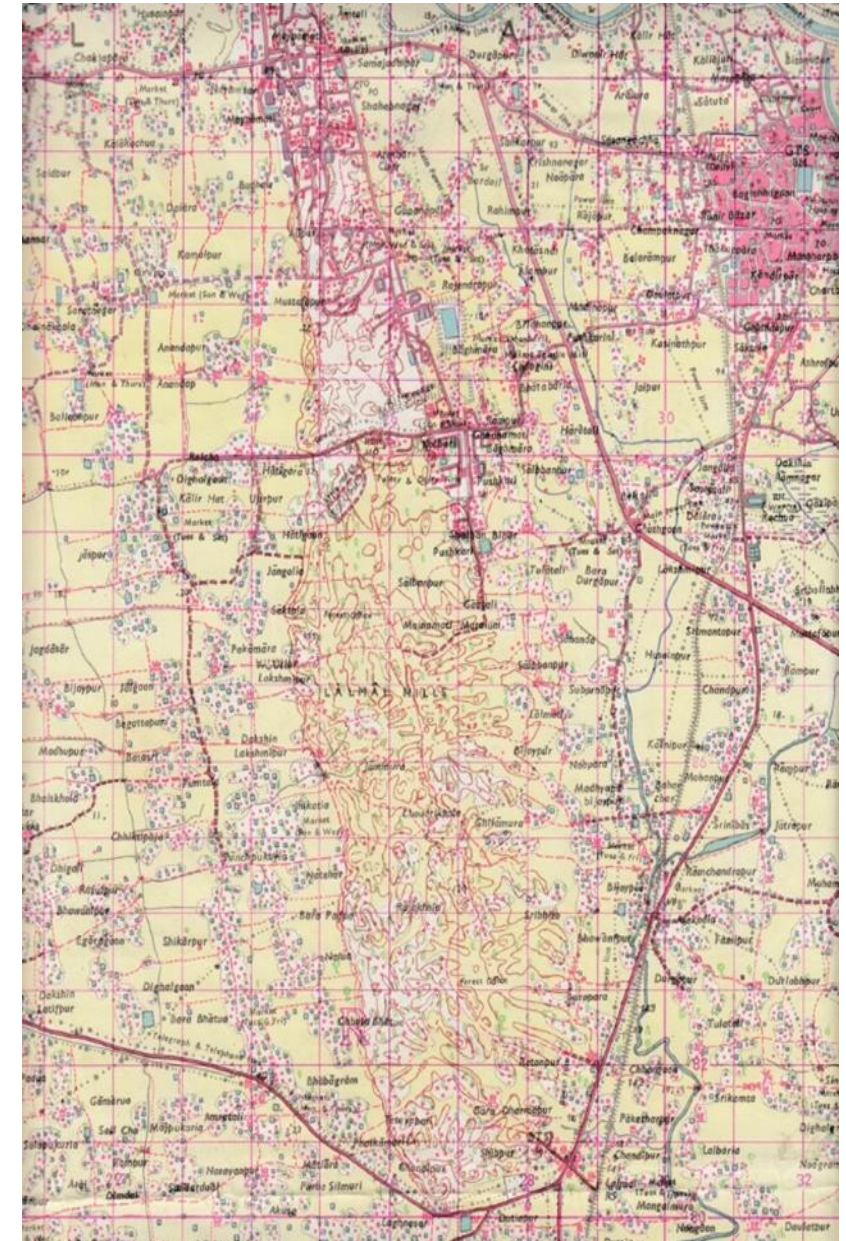
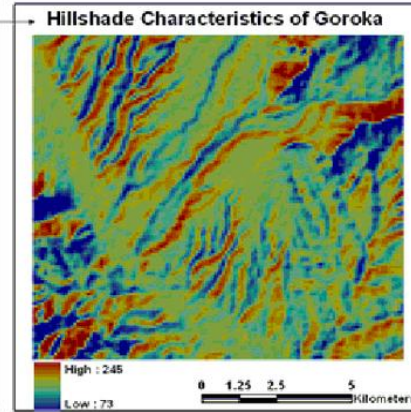
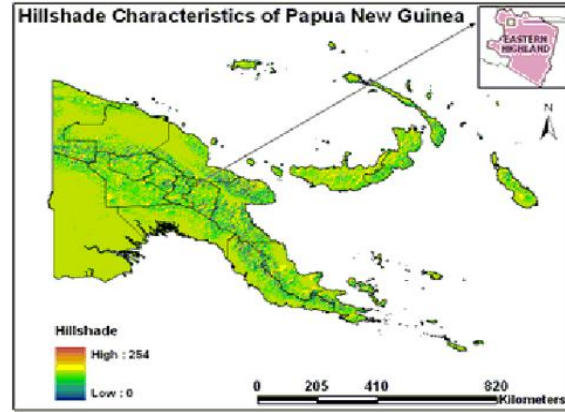
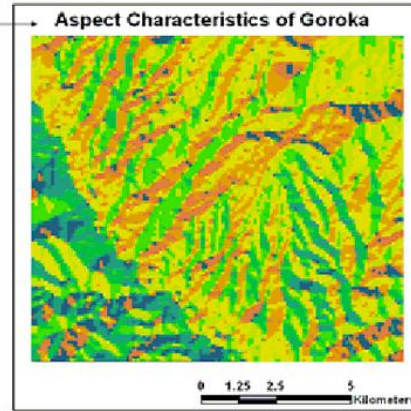
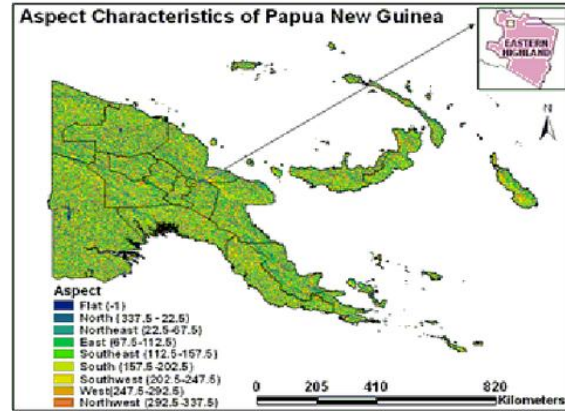
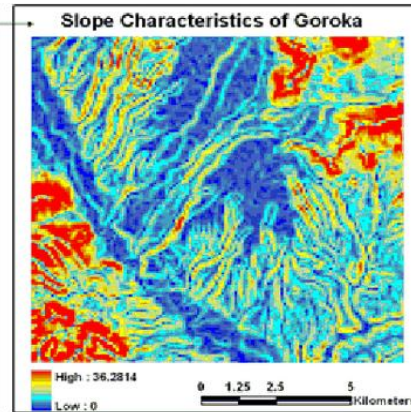
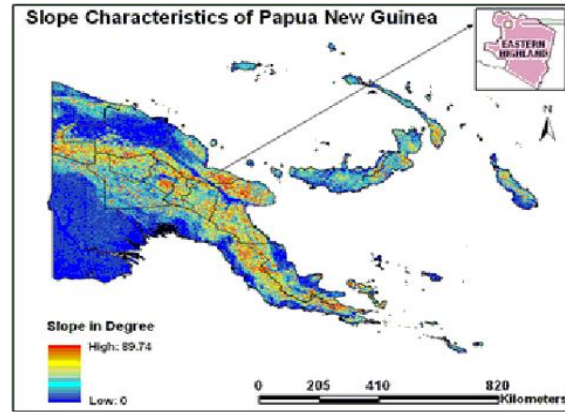


Data Management:
Provides good
descriptive &
Analytical tools.

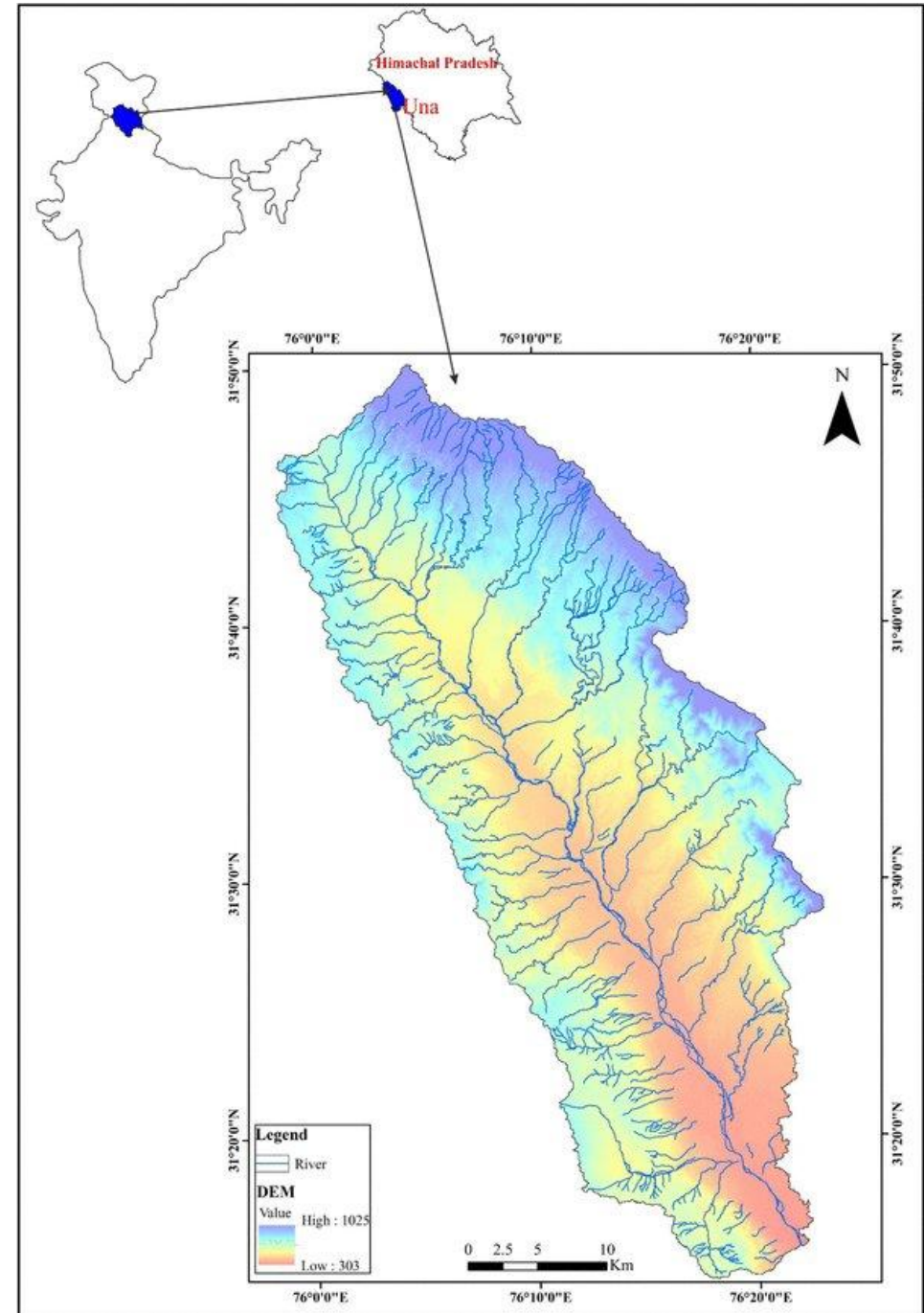
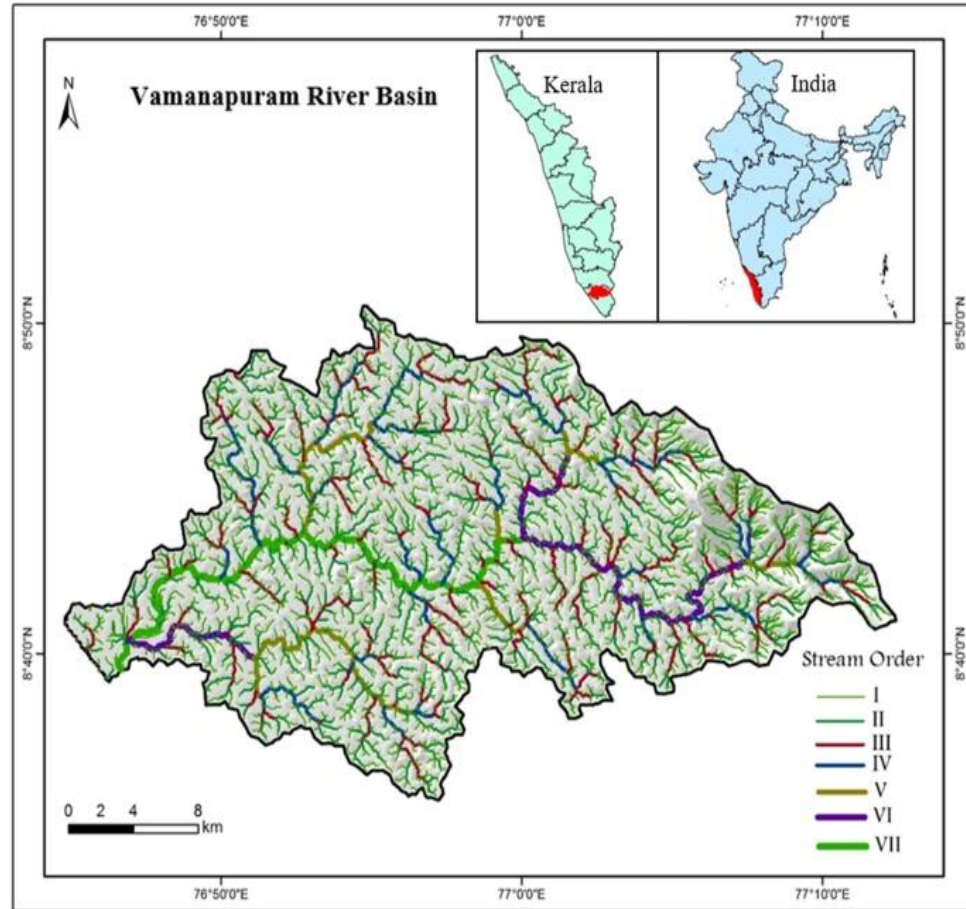
Some GIS based Archaeological works

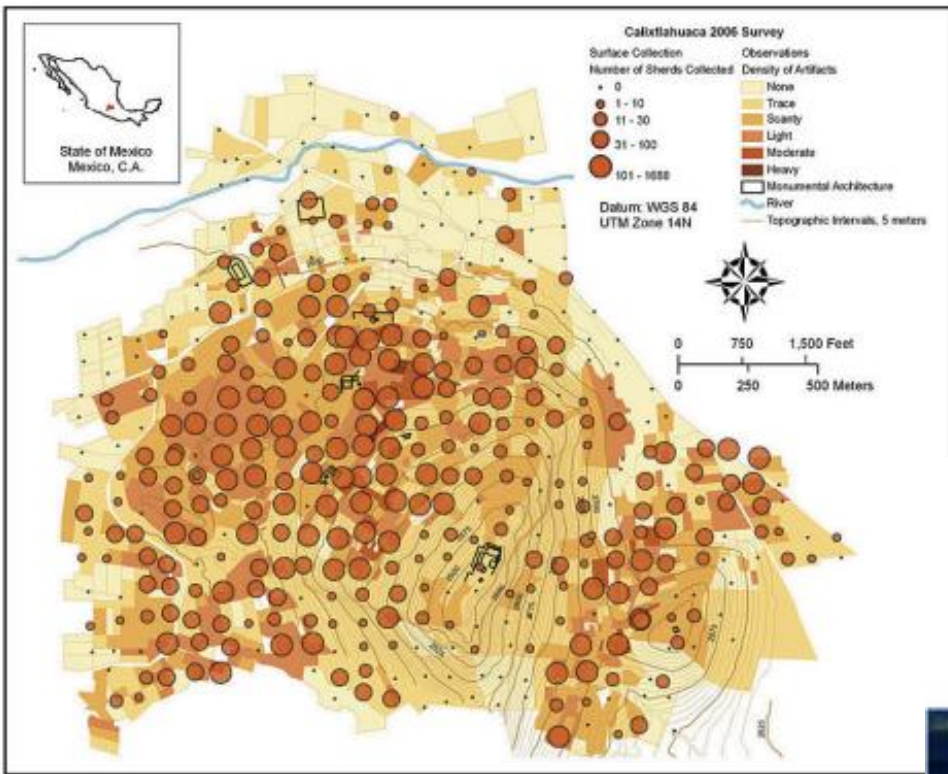
- **Map**
- **Model**
- **Table**

Land formation Landscape

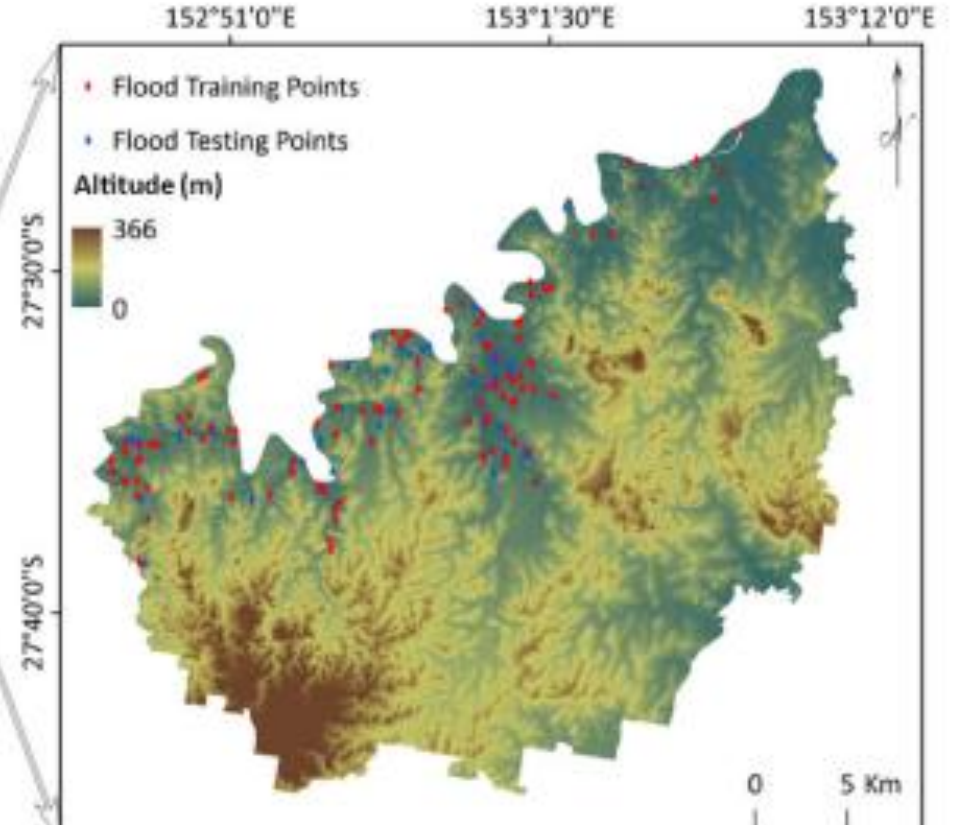


Old/Ancient River system



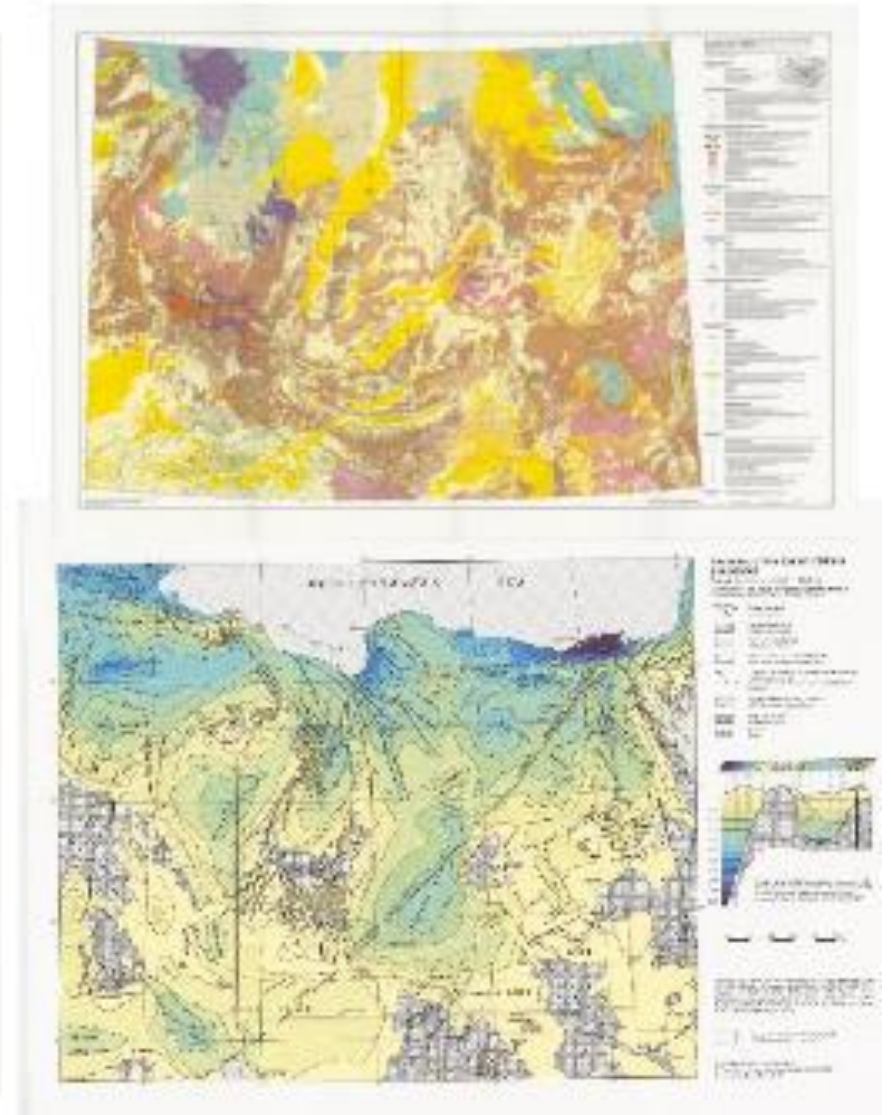
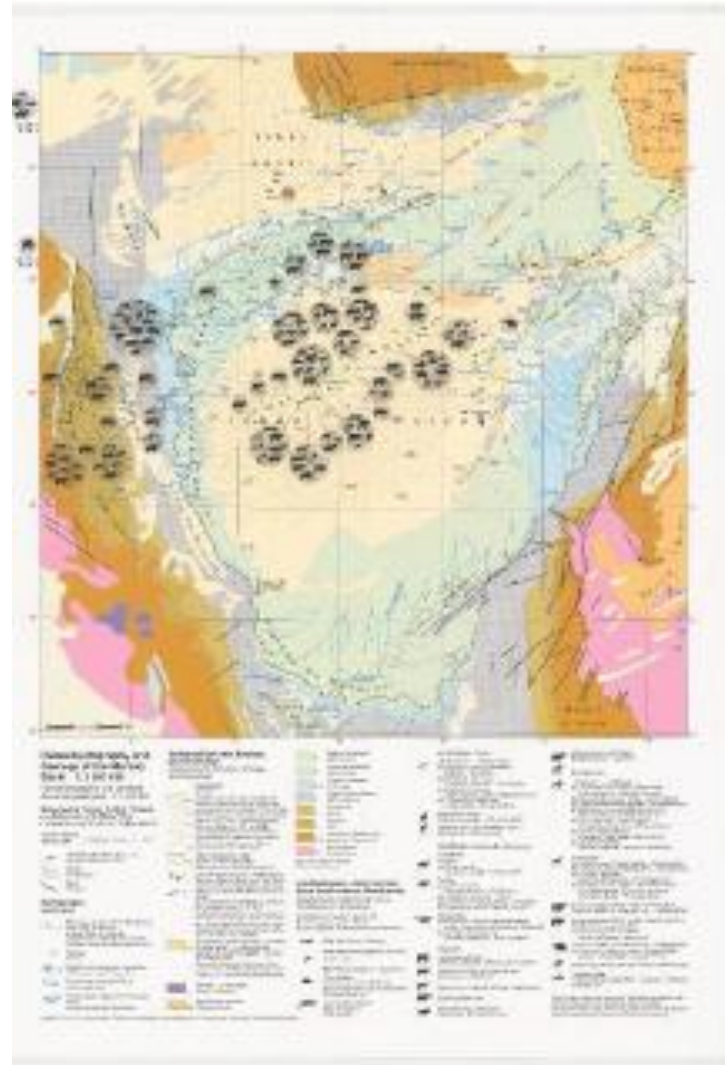


Surface artifact densities at the Calixtlahuaca site collected with GPS
(map by Juliana Novic, Arizona State University).



Archaeological sites

Weather



Model

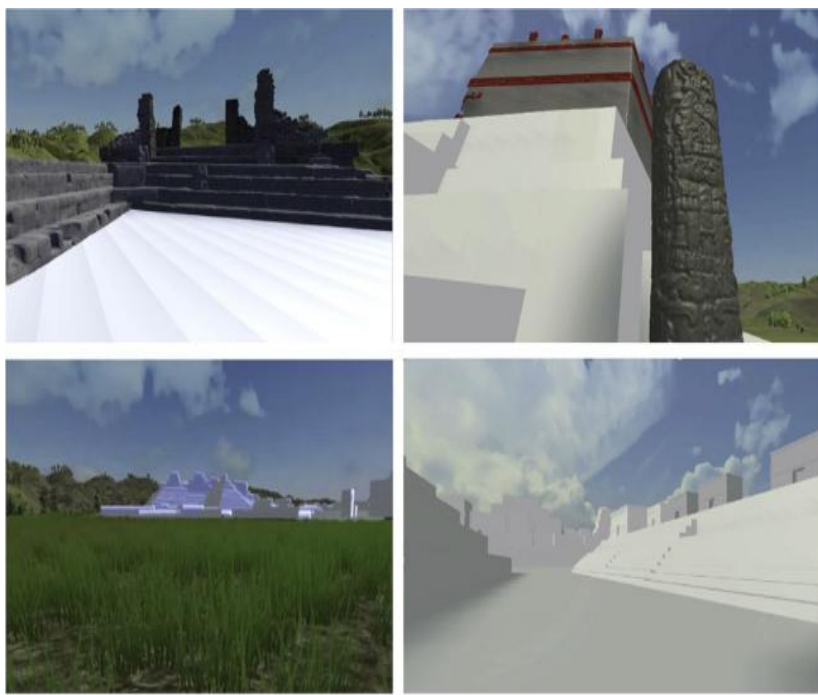
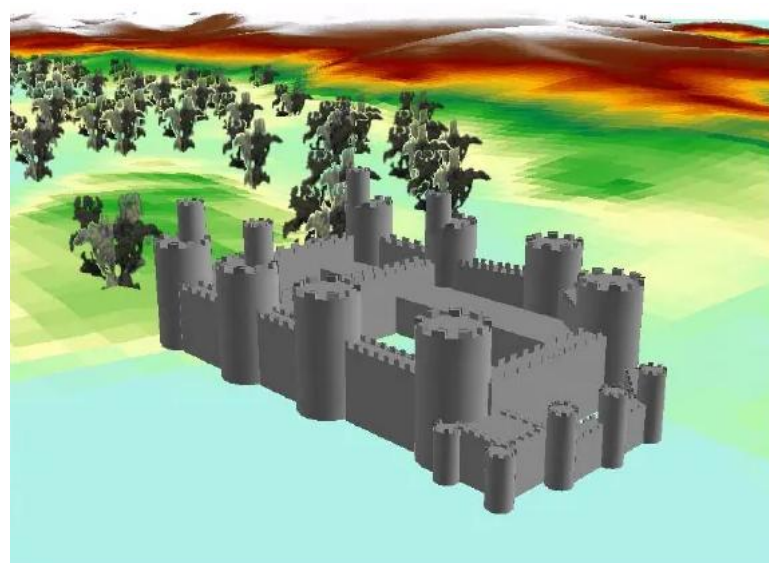
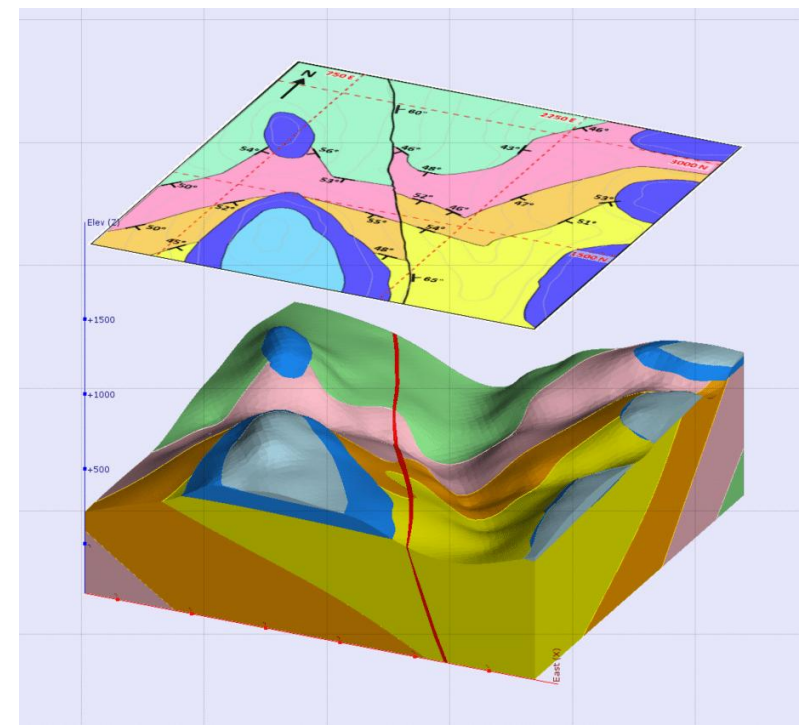


Fig. 8. Illustrating use of Oculus Rift and LEAP Motion to explore ancient Copan.



Find Objects

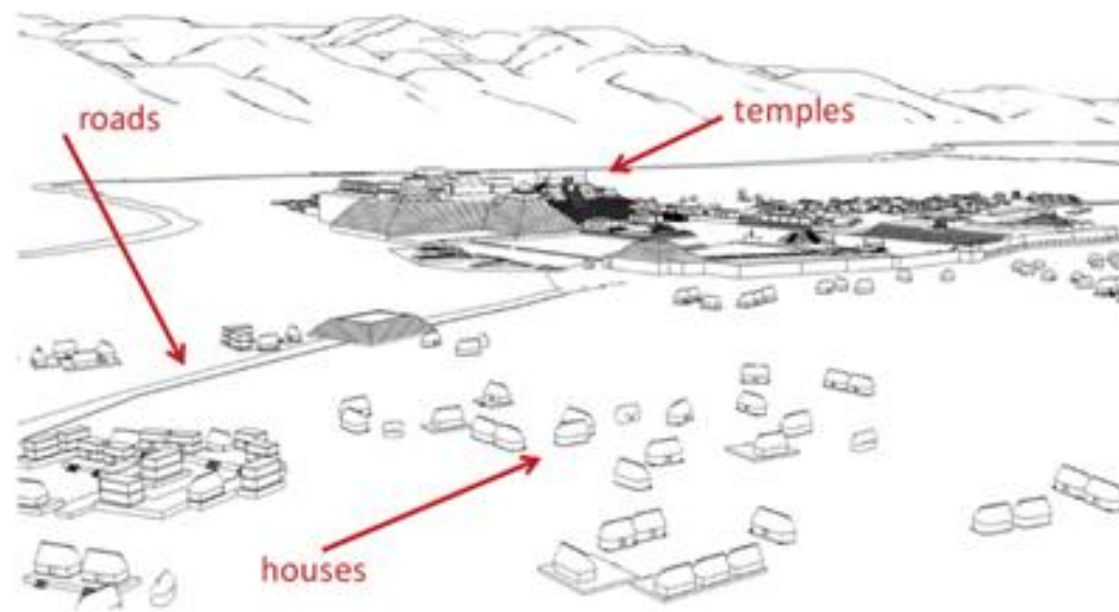
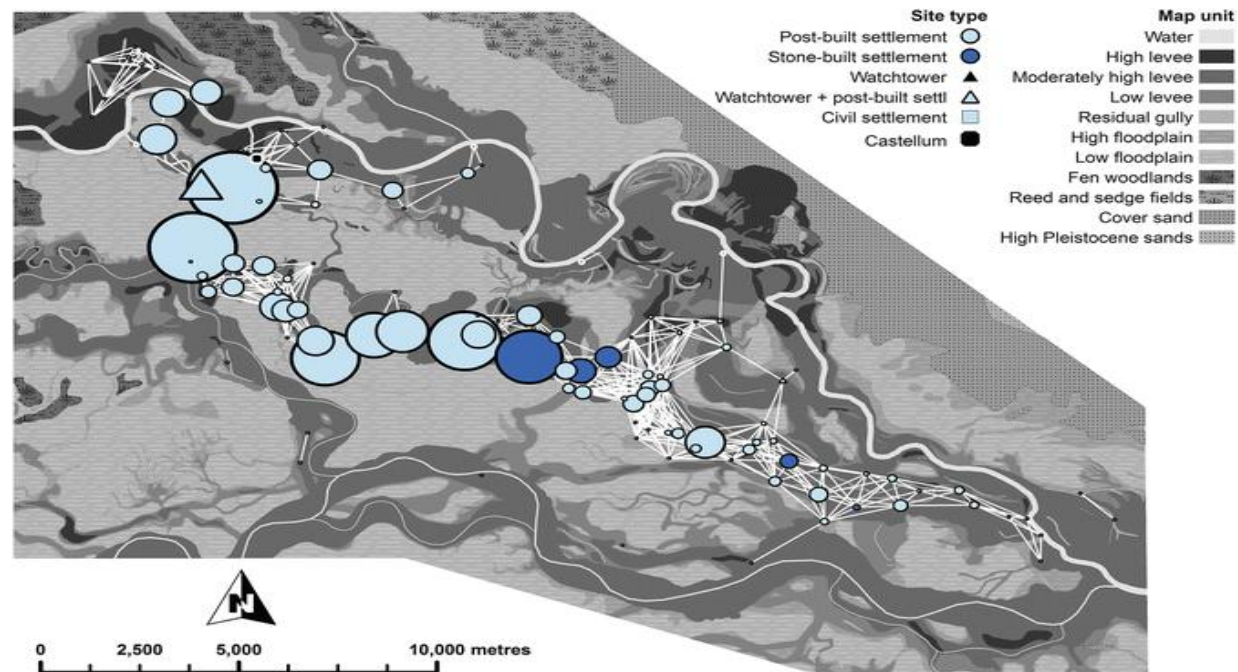


Fig. 1. 3D reconstruction of Copan's urban core.

Merits of Applying GIS in Archaeology

- **Spatial Analysis & Modeling:** Enables analysis of site distributions, landscape archaeology, and predictive modeling for finding new sites.
- **Data Integration:** Allows for the combination of diverse data types, including aerial photos, satellite imagery, and archaeological surveys into one system.
- **Visualization & 3D Mapping:** Facilitates the creation of 3D models and, as explained on [this ResearchGate page](#), helps visualize complex site topographies.
- **Efficiency:** Streamlines data management, improves record-keeping, and helps in planning excavation, note [Esri](#) and other sources.
- **Contextualization:** As described on [this UCL UCL Open Access Student Journals page](#), helps place individual finds within the broader landscape and environmental context.

Demerits of Applying GIS in Archaeology

- **High Cost and Technical Difficulty:** Software is often expensive to acquire and requires specialized training to operate, note [this Scribd document](#) and other sources.
- **Dependency on Data Quality:** Inaccurate or low-resolution input data (e.g., poor GPS data) can produce misleading results.
- **Limitations in Temporal Modeling:** As noted by a [Wichita State University article](#), it is often difficult to effectively map changes over time in one location, making it a largely static representation.
- **Perspective Bias:** Provides a top-down, often 2D perspective, which may not capture the full, complex 3D nature of archaeological features.
- **Difficulty Modeling Intangible Data:** As discussed in this MDPI article, social and cognitive aspects of human behavior are difficult to incorporate into predictive models.

Application of GIS based Archaeological practice

Interpreting the Landscape of Wari-Bateshwar: An Interrogation Using GIS and Remote Sensing

¹ Masood Imran, ² S. M. K. Ahsan, ³ Sheikh Md. Monzurul Huq, ⁴ Swadhin Sen

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217/3 Tejkuni Para
Dhaka

^{2.} & ⁴ Department of Archaeology
Jahangirnagar University
Savar, Dhaka

^{3.} Department of Geography and Environment
Jahangirnagar University,
Savar, Dhaka

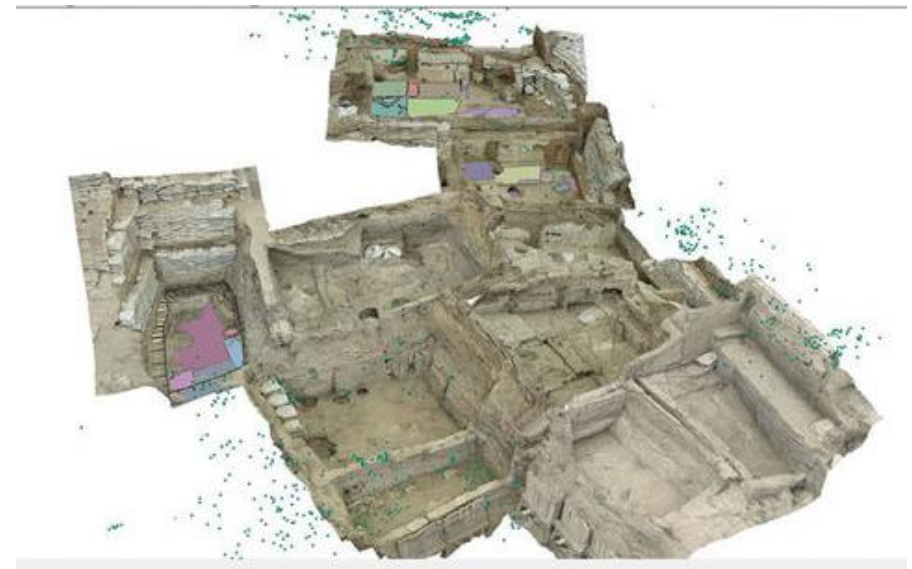
2. Archaeological Survey:

Findings and data found in survey can portray and input in the map.



3. GIS in Archaeological Excavation:

Post excavation, pre excavation and during the excavation GIS can help through the GIS Elevation model like DEM and Site mapping, pointing the site ending and starting in the map, artifacts find spot and Stratigraphy.



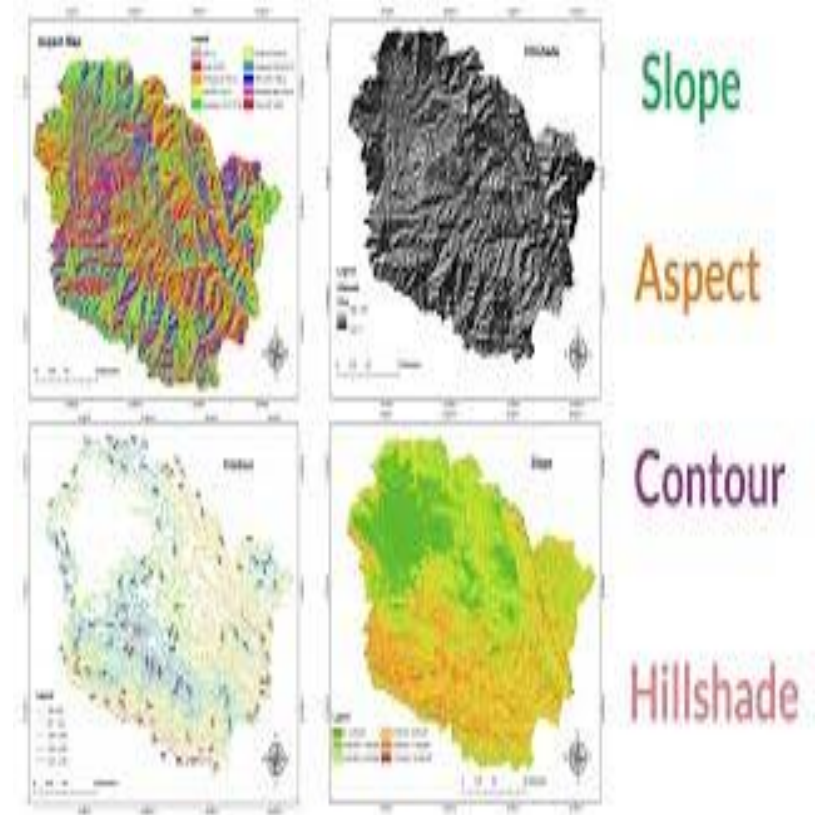
5. Spatial and Simulation method

Spatial modeling method helps archaeologist to understand visibility of a place, ridge, height, environmental condition-lake, canal, pond, etc. it can play it`s role in the three way given below:

- 1. To present data from a spatial database**
- 2. One or more dataset`s mathematical manipulation.**
- 3. Dynamic modeling.**

5. Application of GIS in Geo-Surface modeling:

3D Geo surface modeling is one of the fundamental tasks of GIS.



REFERENCE

M. Anji Reddy; Remote Sensing and G.I.S. & Fundamentals of G.I.S. (2000); pp:122-141.

Debasish Chakra borty-Rabi N. Sahoo; Fundamental of GIS (2007) by:-pp: 1-22.

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Websites

http://en.wikipedia.org/wiki/Geographic_information_system.

Http://giswin.geo.tsukuba.ac_jp/sis/tutorial/Fundamentals_of_GIS_Estoque.pdf.

<http://Wtlab.jis.u-tokyo.ac.jp/~wataru/lecture/rsgis/giswb/vol1/contents.htm>

www.Mtf.stuba.sk

ncgia.ucsb.edu

www.isprs.org

Research Papers

GIS and its Role and applicability in Environmental Monitoring and Process Modelling, Miroslav Rusko, Roman Chovanec, Dana Roskova

Developing a Web-based GIS Application for Earthquake info, A. Garagon Dogru, T. Selcuk, H.Ozener, O. Gurkan, G.Toz. GIS Technology for Disasters and Emergency Management, Russ Johnson. GIS and Transportation: Status and Challenges, Michael F. Goodchild.

Guidelines for Presentation

1. Well dress up with gentle look.
2. 10 minutes for each group.
3. Each and every group members have to present the slides.

Presentation Topics

1. Describe 7 or more maps used in archaeological research (each and everyone of group of 7 members)
2. Show the the archaeological sites in a map that has developed around the river and sea. 7 members
3. Documentation on Neolithic site [Çatalhöyük](#). 7 members
4. Cultural heritage management laws and charters of the world including Bangladesh. 7 members

Settlement Pattern

- Nucleated/ Clustered Settlement pattern
- Linear Settlement Pattern
- Scattered/Dispersed Settlement Pattern



Online Test:

<https://gpres.weebly.com/settlement-patterns.html>

Settlement Pattern

- Nucleated/ Clustered Settlement pattern
- Linear Settlement Pattern
- Scattered/Dispersed Settlement Pattern



Online Test:

<https://gpres.weebly.com/settlement-patterns.html>

Settlement Pattern

- Nucleated/ Clustered Settlement pattern
- Linear Settlement Pattern
- Scattered/Dispersed Settlement Pattern



Online Test:

<https://gpres.weebly.com/settlement-patterns.html>

Settlement Pattern

- Linear/Ribbon Settlement Pattern



(Source: OSi Trailmaster©. Scale 1:10,000)

Optical character recognition or optical character reader (OCR)

- ❖ Optical character recognition or optical character reader (OCR) is the electronic or mechanical conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example: from a television broadcast).
- ❖ It works as data entry. For example: Passport documents, MRP, Invoice, business card etc.
- ❖ OCR is the field of Patterns recognized, Artificial Intelligence and Computer Vision research.
- ❖ In the beginning, year of 1914 it was involved with reading device for blind people. After that in the year of 2000 with some modification it started foreign language translations in the cloud computing environment and Mobile application as it's online service (WebOCR).
- ❖ After innovation of Smartphone and Smart eye glass it can include OCR service to capture the text.

Optical Character Recognition (OCR)

- ▶ Optical character recognition
 - › Converts scanned images to readable text
- ▶ All text within a scanned image can be recognized
- ▶ Zones can specify which areas to scan for properties
- ▶ Bar codes and QR codes are supported



Optical Character Recognition





18

Das Erz.	ТЪЧЬ.
Das Messing.	Пиринчь.
Das englische Zinn.	Англискій кобальт.
Der Etaph.	Чанка.
Der Magnet.	Магнетъ (камень), гродонитъ.
Das Blech.	Лѣтъ.
Der eiserne Draht.	Жица, проволока гюб-дина.
Der Schwefel.	Обшпоръ, жѣнал.
Das Glas.	Отакима чаша.
Die gläserne Flasche.	Отакло, стекло.

Von den Garten. О колухъ, или шарахъ.

Weiß.	Бѣлый.
Schwarz.	Черный.
Roth.	Красный.
Grün.	Зеленый.
Gelb.	Желтый, желтый.
Blau.	Плавильный.
Braun.	Мръя, Морастъ.
Wein.	Обдѣл.
Violett.	Лилевый колъ.
Weißgelb.	Прискалѣмъ.
Rothgelb.	Вышновѣта колъ.
Karmesinfarb.	Кармазинка колъ.

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Rosenfarb.	Рѣжична колъ.
Blaufarb.	Пеллава колъ.
Grünfarb.	Бисерна колъ.
Himmelblau.	Модаръ.

Vom Gartenweß. О вертоградскихъ стварехъ.

Ein Garten.	Баща, вертоградъ.
Ein Obstgarten.	Вѣткакъ.
Ein Apfel.	Яблѣка, яблѣко.
Eine Birne.	Крѣшка.
Eine Speisohle.	Шапка.
Ein Weingarten.	Виноградъ.
Ein Disthaufen.	Двернакъ.
Weet.	Лѣ.
Eine Wanne.	Цѣбъ.
Eine Staub-Wurzel.	Кѣмъ арица.
Die Bohne.	Бѣкъ.
Detonien.	Бѣкница, аилѣ.
Eine Detonien-Wurzel.	Бѣкфракъ.
Der Knoblauch.	Бѣлый аликъ, чѣнокъ.
Roths Rubin.	Цѣлка, камѣя.
Eine Zucker-Melone.	Лѣна.
Eine Klapper-Kose.	Лѣный макъ.
Eine Senf.	Горшница, горшца, сѣ-медъ, салдинца.
Die Ziselen.	Пѣсѣль.

Optical character recognition or optical character reader (OCR)

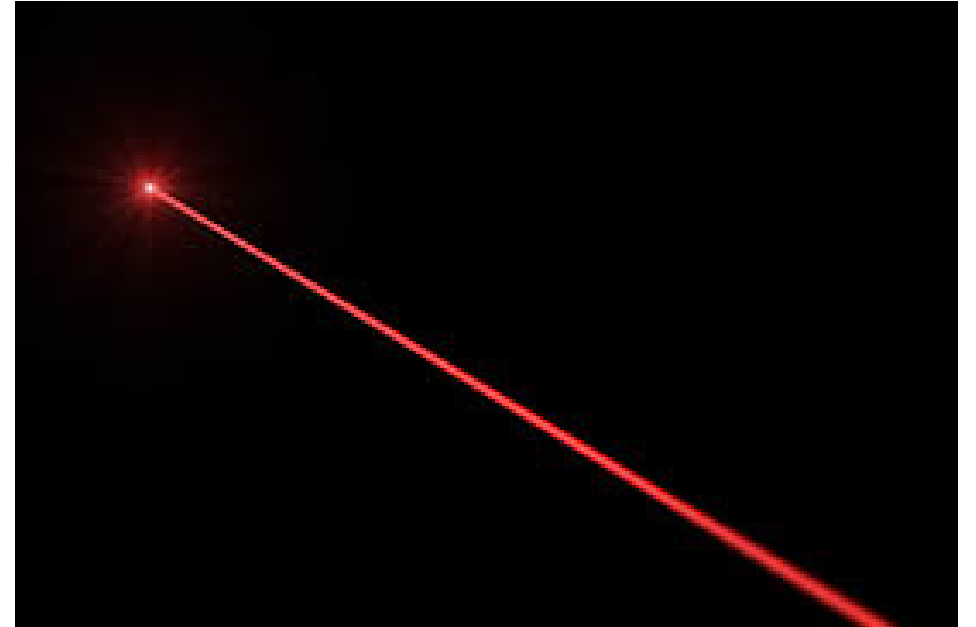
Different types OCR: Invoice OCR, Receipt OCR, Legal Billing OCR, Document OCR

OCR in Archaeology:

- To convert image to Text
- To identify the text
- To recover the text from ancient document and archive
- To convert a file from text to word
- To convert text to Speech
- Cognitive computing
- To make the data online

Laser scanning

Laser scanning is a popular land surveying method that **can accurately measure and collect data from objects, surfaces, buildings, and landscapes.** Laser scanners collect information in the form of point cloud data, which consists of millions of 3D coordinates.



Laser scanning

Laser scanning is a non-contact, high-precision technology that uses laser beams to capture the exact 3D shape, distance, and surface data of objects or environments. By analyzing reflected light (often via LiDAR), it creates a detailed, digital "point cloud" representation. It is widely used for 3D modeling, construction, surveying, and reverse engineering.

Data supply to:

- 3D Printer
- Prototyping Machine
- LASER TV
- Barcode Scanner



Laser Scanning in Archaeology

- **Documentation and Recording:** Terrestrial Laser Scanning (TLS): colorized 3D models of complex, irregular surfaces such as carved stones, statues, and historical monuments.
- **Site Surveying and Mapping:** rapid creation of digital elevation models (DEM) of archaeological sites and large-scale topographical maps.
- **Virtual Reconstructions:** Scanned data enables the creation of virtual reality models, allowing researchers to explore or restore damaged structures digitally.
- **Non-Invasive Analysis:** It records fragile, delicate, or culturally sensitive artifacts without physical contact, preserving their integrity.



Laser Scanning in Archaeology

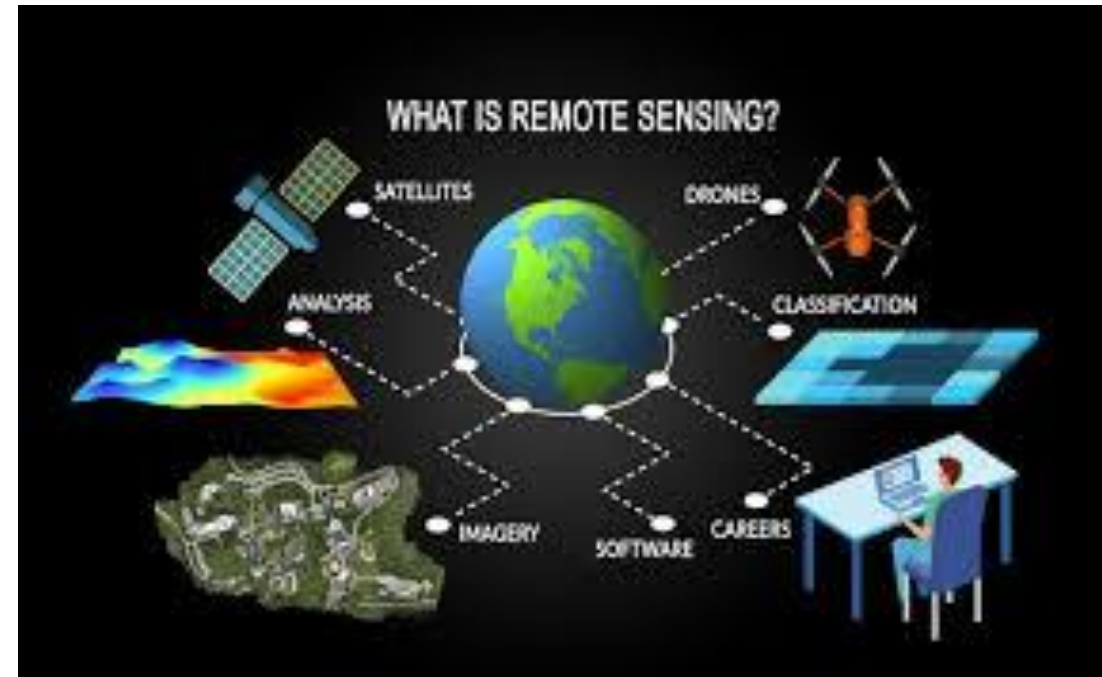
- **Damage Assessment:** The technology provides high-accuracy, long-term monitoring to assess structural deterioration in heritage sites.
- **Landscape Detection:** Airborne LiDAR (Light Detection and Ranging) is used to map landscapes and detect hidden archaeological features hidden beneath vegetation.
- **Digital Archives:** It produces 3D data that can be used for creating precise replicas (via 3D printing) and allows researchers to examine artifacts even if they are unavailable or scattered.
- **Others:** Searching ship wreck and other artifacts under the Sea.



Remote sensing

Remote sensing technology is defined as a method that utilizes satellites, aircraft, drones, and ground-based sensors to collect data for monitoring and understanding the Earth's systems, enabling the assessment of environmental changes, climate-related phenomena, and ecosystem health across vast spatial scales and temporal frequencies.

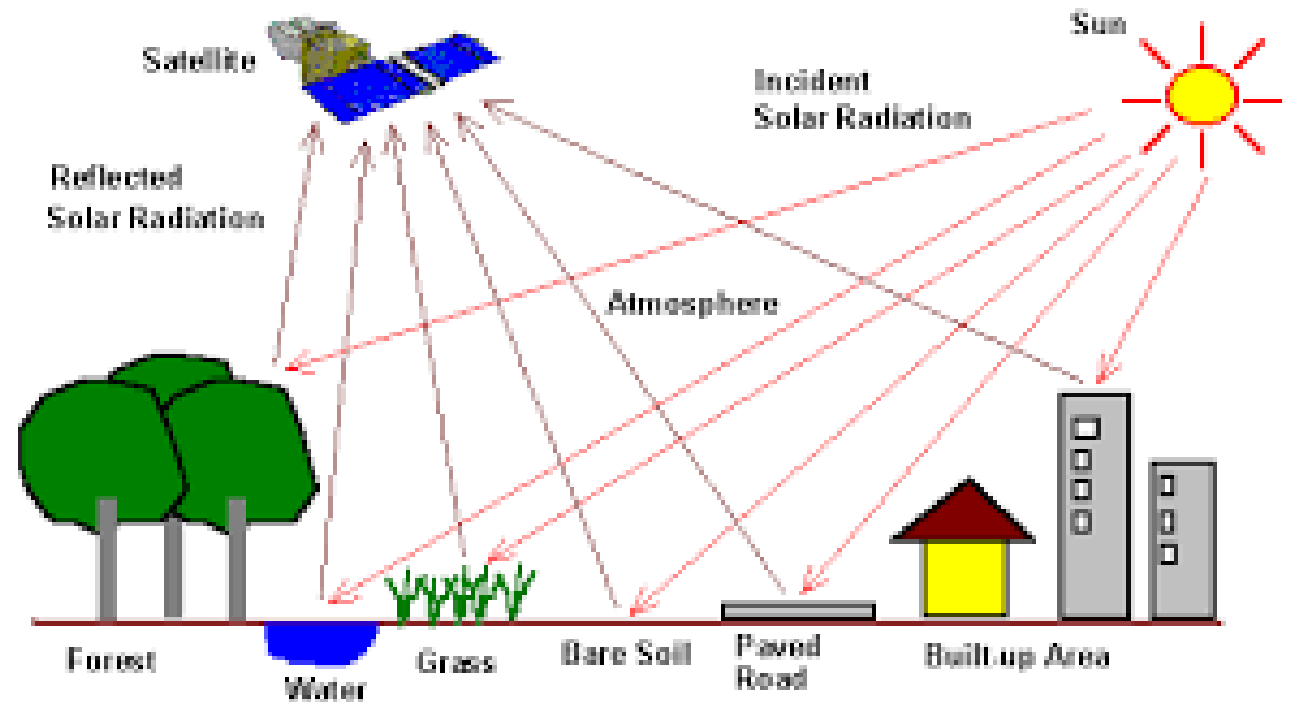
Lints Ges simonett (1976) :,"Remote sensing is the Aquisition of physical data of an object without touch or contract



Remote sensing Application in different Archaeological sites

Remote sensing technology implication
some case study:

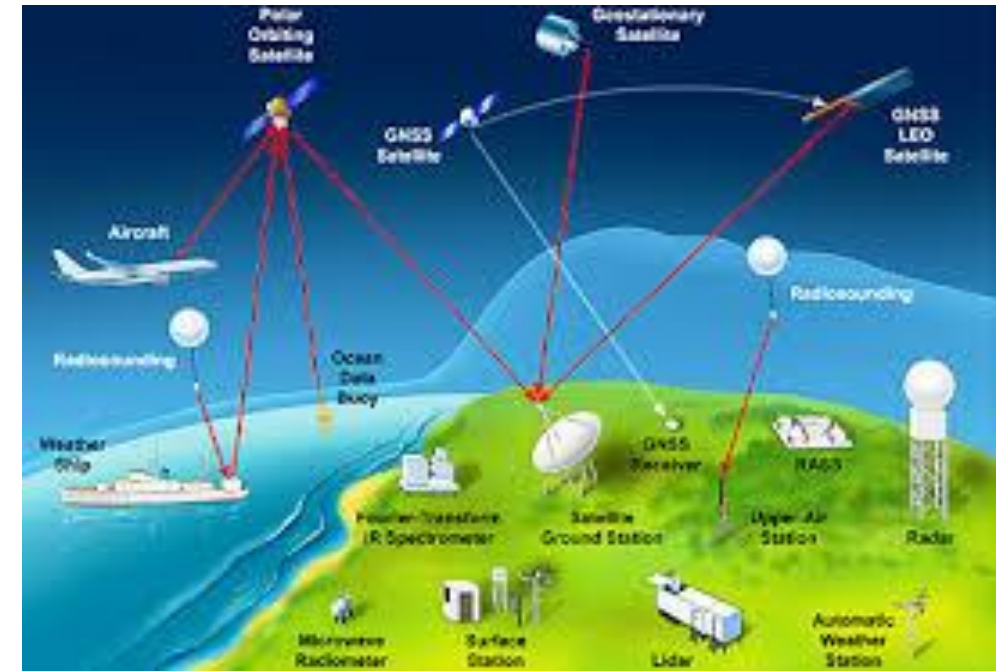
- ✓ Mesoamerican site of Maya
- ✓ Peru
- ✓ Jerusalem
- ✓ Egypt
- ✓ Roman Empire
- ✓ Gobeklitepe
- ✓ Catalhoyuk
- ✓ Troy
- ✓ Trabzon Monastery



Remote sensing techniques

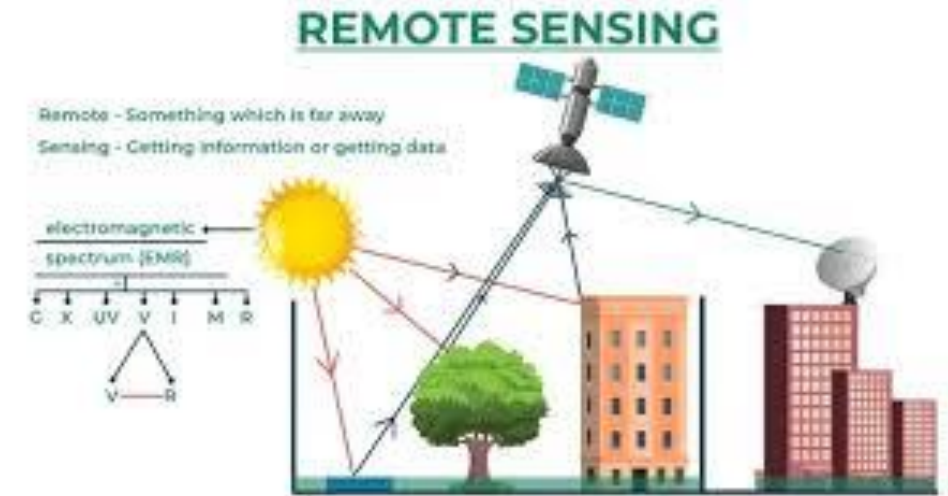
- Aerial photography
 - Multispectral and Hyperspectral Sensors
 - Thermal Infrared Multispectral Scanner (TIMS)
 - Color Infrared Film (CIR)
 - Microwave Radar
- Satellite Imaging
 - Laser altimeters or light detection and ranging (LIDAR)
 - Synthetic Aperture Radar (SAR)
 - INSAR - Interferometric SAR

GPR



Remote sensing in Archaeology

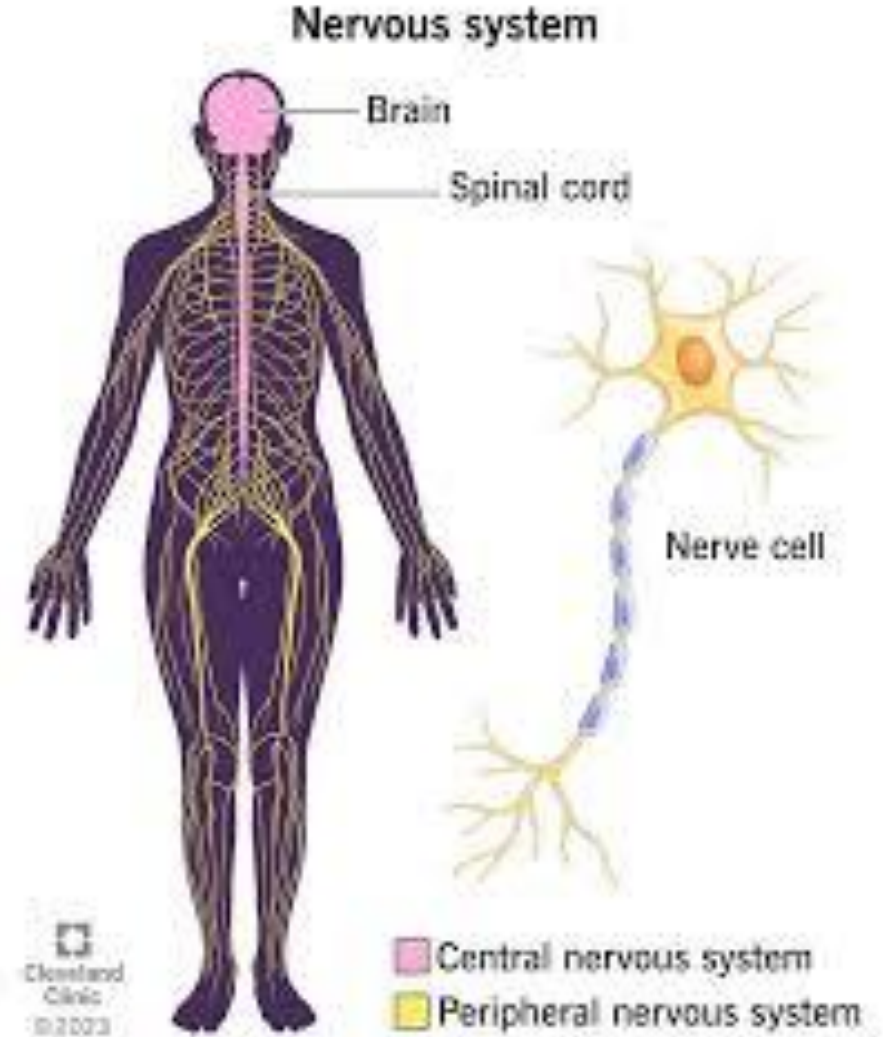
- All the individual uses of all RS techniques.
- Site Mapping and Drawing.
- Distance and access to inaccessible land and area.
- Acquiring data from remote area with less time and hassle anytime whether it is day or night.
- Sharper to sharpest, smaller to smallest any kind of object on the earth can be identify with those techniques.



Neuro-archaeology

Neuron + Archaeology = Neuro-archaeology
Nervous system

Neuroscience is the scientific study of the nervous system, encompassing the brain, spinal cord, and peripheral nerves. It investigates the structure, function, development, and disorders of the nervous system, aiming to understand how neurons, synapses, and chemicals create thoughts, emotions, behaviors, and critical bodily functions



Neuro-archaeology

Neuro-archaeology is a sub-discipline of archaeology. Neuro-archaeology is an interdisciplinary field combining archaeology and neuroscience to study the evolution of the human brain, cognition, and mind. It uses archaeological data (like tools) and neuroscience methods (like brain imaging) to understand how early human cognitive abilities, such as language, tool-making, and symbolic thought, developed over time

Neuro-archaeology

- Brain and Culture Evolution:** It explores how human brains and material culture (tools, art) evolved together, often utilizing the "material engagement theory" to show how cognition is embedded in the environment.
- Experimental Methods:** Researchers use modern neuroimaging (fMRI, PET, fNIRS) to scan participants' brains while they perform tasks like making Paleolithic stone tools to identify the neural networks involved.
- Key Focus Areas:** Studies focus on how cognitive functions like spatial cognition, causal understanding, and technical skills emerged in early hominins.
- Linking Ancient and Modern:** It links ancient tool-making, such as the transition from Oldowan to Acheulian tools, with the development of language and higher-order action planning

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Archaeological Mind and Art History



Archaeological Mind and Art History



Archaeological Mind and Art History



Mine detector

Mine detectors are specialized devices designed to locate landmines, unexploded ordnance (UXO), and Improvised Explosive Devices (IEDs) using technologies like metal detection, pulse induction, and ground-penetrating radar (GPR). Modern, high-sensitivity detectors like the Minelab F3 or MDS-10 are used by military and humanitarian teams to identify both metal and plastic casings in challenging environments.



Mine detector

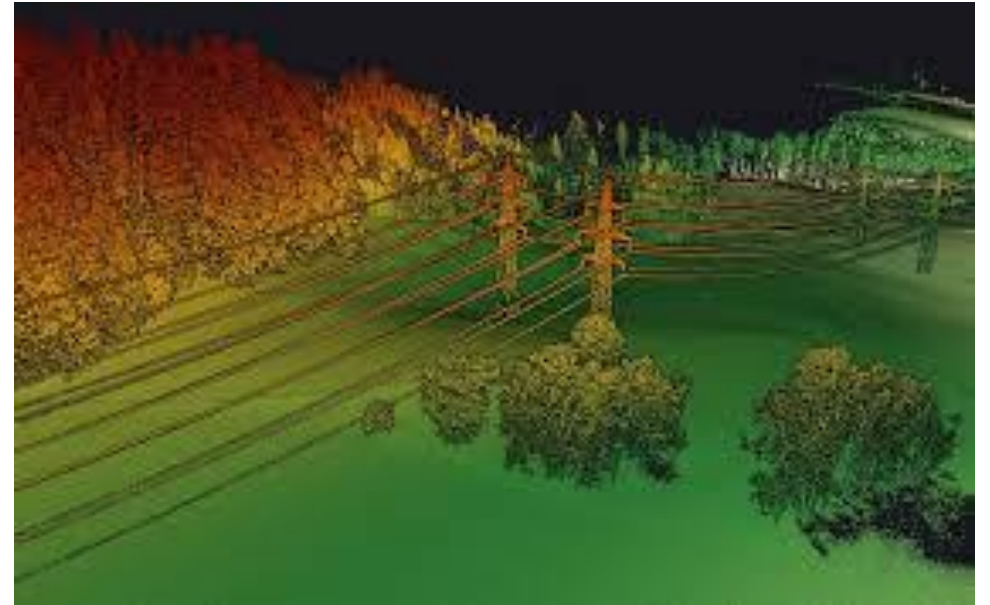
Technology:

- **Metal Detection (MD):** Uses electromagnetic induction to identify metallic components, even small amounts in minimum-metal mines.
- **Ground Penetrating Radar (GPR):** Used in dual-sensor systems to detect non-metallic threats by identifying anomalies in the soil structure.
- **Dual-Sensor Systems:** Combine MD and GPR for superior detection rates and fewer false alarms, such as the Minelab MDS-10 or VMR3G "Minehound".
- **Alert Mechanisms:** Devices provide audio, visual (LCD displays), and haptic (vibration) feedback, with many featuring night-vision compatibility.

LiDAR

Lidar uses ultraviolet, visible, or near infrared light to image objects. It can target a wide range of materials, including non-metallic objects, rocks, rain, chemical compounds, aerosols, clouds and even single molecules. A narrow laser beam can map physical features with very high resolutions; for example, an aircraft can map terrain at 30-centimetre (12 in) resolution or better.

Wavelengths vary to suit the target: from about 10 micrometers (infrared) to approximately 250 nanometers (ultraviolet)



LiDAR Application

Planning to field campaign,

Mapping features

Helps to create high resolution DEM

To detect features under the flat vegetated surface to find the sites and objects

Application:

Canada, Fort Cumberland National Historic Site.

La Ciudad Blanca in Maya

Mahendraparvata discovery in India

Augmented Reality (AR)

According to Milgram, P., & Kishino, F. 1994. in their *A Taxonomy of Mixed Reality Visual Displays*.

“Augmented Reality is part of the Reality–Virtuality continuum where virtual objects are superimposed onto the real world.”

According to Azuma, R. T. 1997 on her paper, *A Survey of Augmented Reality, Presence: Teleoperators and Virtual Environments*.

“Augmented Reality (AR) is a technology that combines real and virtual elements, is interactive in real time, and is registered in three dimensions.”

Augmented Reality (AR) refers to a technology that overlays digital reconstructions, 3D models, annotations, or interpretative data onto real archaeological sites or artefacts, allowing researchers and visitors to visualize past structures, landscapes, and cultural contexts directly within the physical environment.



Virtual Reality (VR)

(Britannica):

Virtual Reality is “*the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment.*”

(Merriam-Webster):

Virtual Reality is “*an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment.*”



Augmented Reality (AR)

Feature	Augmented Reality (AR)	Virtual Reality (VR)
Surroundings	Real world with digital overlays	Fully simulated digital world
Device	Smartphone, Tablets, AR Glasses	Headset, Controllers
Immersion	Partial	Total
Purpose	Enhance the real world	Replace the real world
Key Example	Pokémon Go, Snapchat Filters	Gaming, VR Training

3. Focus Stacking:

Focus Tracking এমন একটি পদ্ধতি যার সাহায্যে বিভিন্ন ছবির মাধ্যমে কোন নিদর্শনকে খুব কাছে থেকে পর্যবেক্ষণ করা হয়। এই পদ্ধতি ব্যবহার করা হয় মূলত খুব নিকটবর্তী বা Microscope বা অতি সুক্ষ্ম বর্ণনা দেওয়ার ক্ষেত্রে।

কার্যপ্রণালী:

Focus Stacking পদ্ধতিতে লেন্সের সাহায্যে Signal view নেওয়া হয় Optional f number এর সাহায্যে। যেমনঃ Focus দূরত্বের ক্ষেত্রে f/8-f/10 নেওয়া হয়ে থাকে।

এ পদ্ধতিতে কতগুলো ছবির Series নেওয়া হয় যা ফোকাসের মাধ্যমে বিভিন্ন দিককে তুলে ধরে।

প্রকৃতপক্ষে কোন ক্ষুদ্র নিদর্শন বা মুদ্রাগুলোকে Archive করে রাখতে এ পদ্ধতি ব্যবহার করা হয় যেন পরবর্তীতে নিদর্শনের কোন ক্ষতি হলেও ছবি থেকে সুক্ষ্ম থেকে সুক্ষ্ম বর্ণনা পাওয়া যায়।

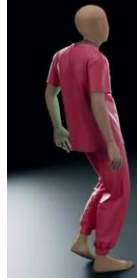
রোমান মুদ্রাগুলোকে এই পদ্ধতিতে Archive করা হয়েছে। বাংলাদেশেও Focus Tracking পদ্ধতিতে Archive করা হলে পরবর্তীতে গবেষণা করতে সুবিধা হবে।

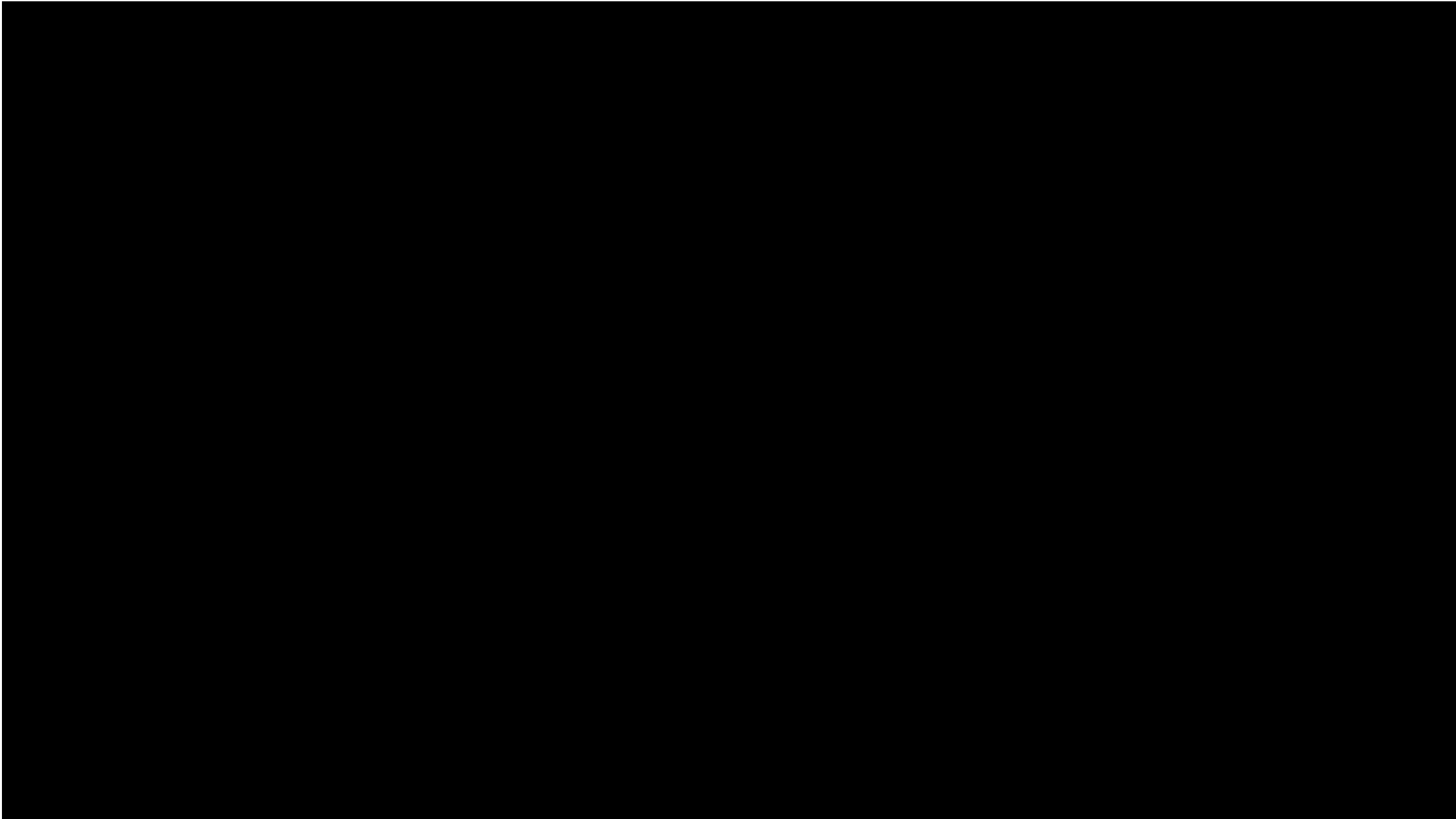
* ফ্রান্স, রাশিয়া ও পর্তুগালে প্রাগৈতিহাসিক painting গুলোকে এ পদ্ধতিতে নথিভুক্ত করার test করা হয়। এছাড়াও Paleolithic 87mm একটি Sculpture ইতালির একটি গুহায় পাওয়া গেছে। সেটিও Focus Tracking এর মাধ্যমে Archive করা হয়।



 FearlessMotivationOfficial

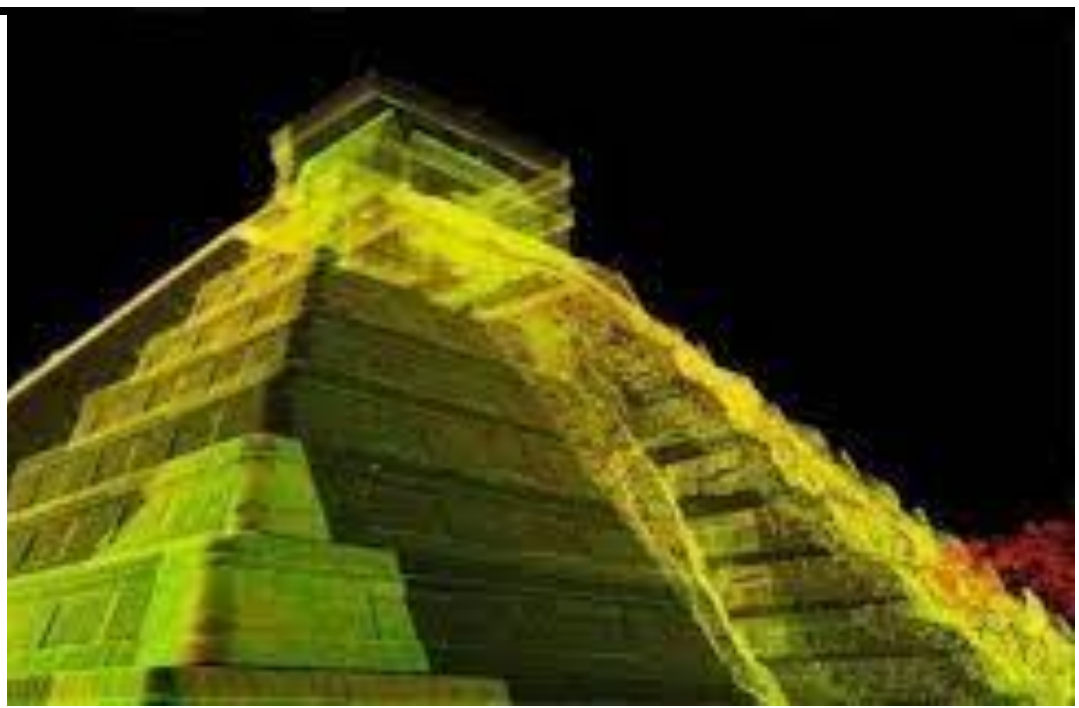
FIRST STEP





Thank you very much

Have a nice journey
best wishes for a bright future



5. Digital Story Telling:

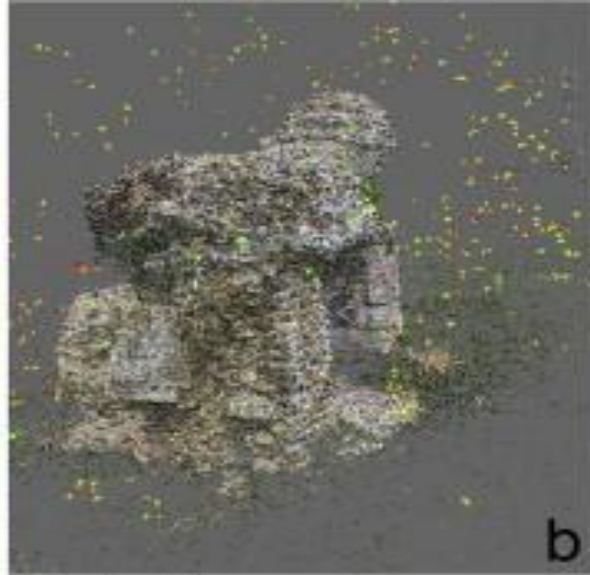
প্রাচীনকাল থেকেই মানুষ গল্প বলার মাধ্যমে ভাব বিনিময় করতো। ধীরে ধীরে সময়ের সাথে গল্প বলার ধরণ ও পাল্টেছে। এরপর মানুষ গল্প লিখা শুরু করলো। Digital পদ্ধতিতে পরবর্তীতে গল্প নথিভুক্ত করা হয় voice ও Sound এর সাহায্যে। এভাবেই Digital Story Telling এর জন্ম হয়।

Digital Story telling হলো বর্ণনাত্মকভাবে Digital মিডিয়া ও প্রযুক্তির মাধ্যমে দর্শকদের আনন্দ প্রদান করা। Hyper videos এর মাধ্যমে Story গুলো নথিভুক্ত করা হয়। ২০১৪ সালে Roman museum exhibition এ Digital Story telling এর মাধ্যমে প্রাচীর রোমার ইতিহাসকে তুলে ধরা হয়।

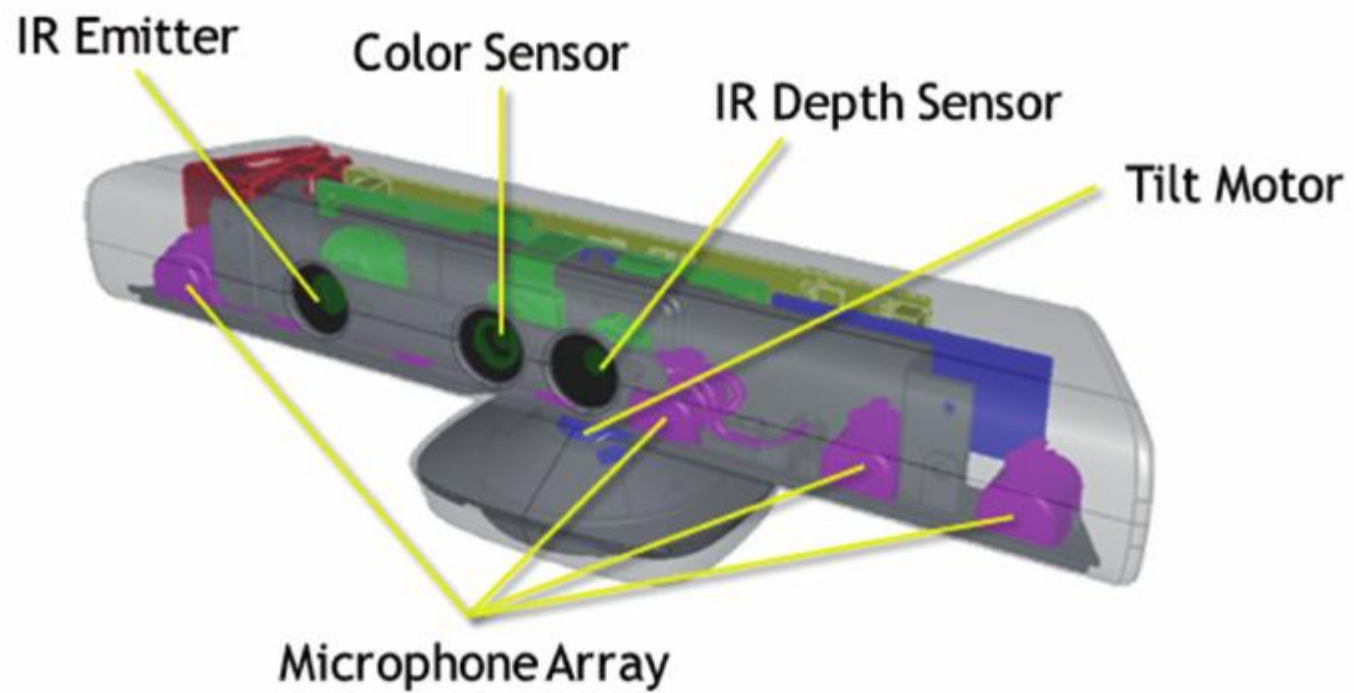
বাংলাদেশে এ পদ্ধতিটি যদিও প্রচলিত নয় তবে ইচ্ছে করলে আমাদের ইতিহাস ও ঐতিহ্যগত নিদর্শনে বা যেগুলো কালের গর্ভে হারিয়ে যাওয়ার সম্ভাবনা রয়েছে সেগুলোকে এই পদ্ধতিতে Archive করা যেতে পারে।

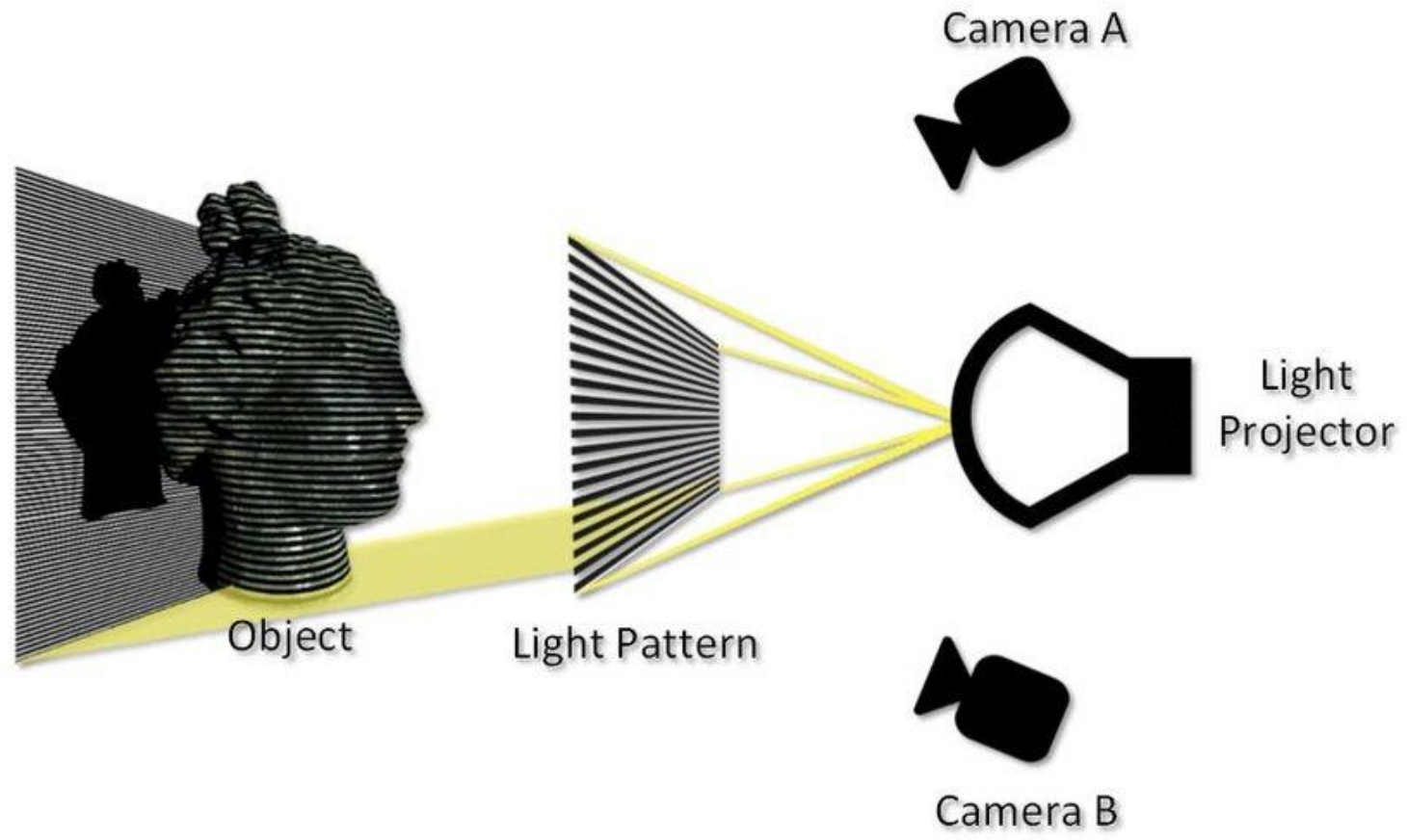


Location shooting of the story about the medieval period.











a1



b0



c1



3D reconstruction
of an outdoor
archaeological site
through a multi-
view stereo
technique