

Muti-resource data management and sustainable development indicators related to the monitoring of cultural heritage
the case study of
Dazu Thousand-hand Bodhisattva Statue in China

Miaole Hou, Ph.D, Prof.

BUCEA

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Outline

1

Background

2

Muti-resource data management

3

Cultural heritage monitoring

4

Sustainable development indicator

4

Conclusion

1 Background

Why we need 3D Muti-resource data of heritage?



- Heritage is very important for all the civilization
- Some of heritages are being damaged and disappearing

1 Background---Damages to the culture heritage



earthquake



war



weathering



Fire

1 Background

Disasters often happened to the culture heritage.



□ Left : Bhimsen Tower in Nepa before 2015 earthquake

□ Right: Bhimsen Tower in Nepa is damaged in the earthquake

1 Background

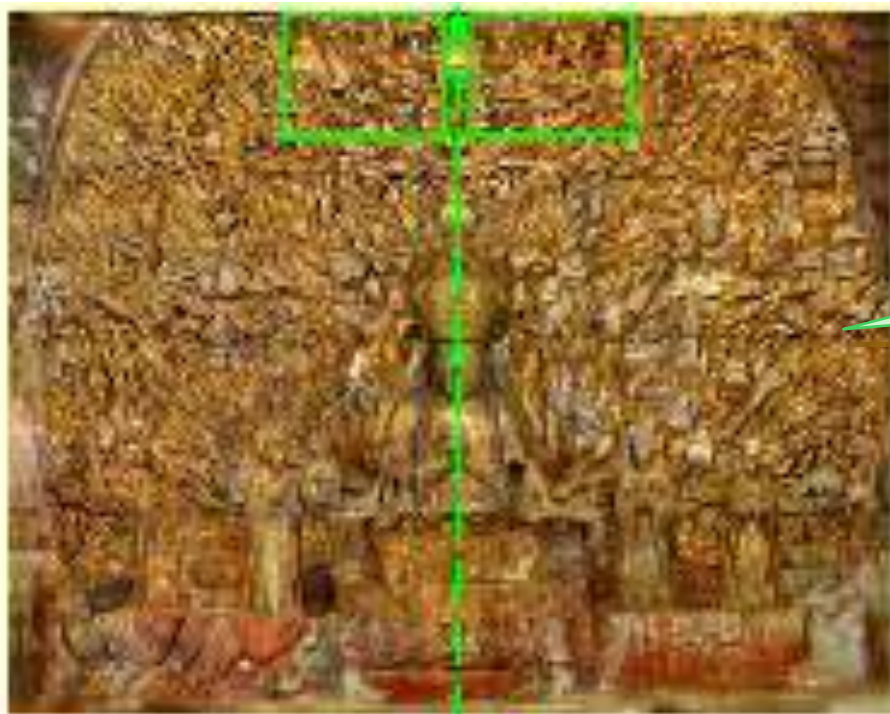


Yungang Grottoes - Wuhua Cave - cultural relics and microenvironment monitoring, record the temperature and humidity of the cave and cracking data.



Bailu church before and after the quake contrast image. (Wenchuan)

Dazu Thousand-hand Bodhisattva Statue in China



Width is 10.9

Height is 7.7



What Happened after 2012 Wenchuan Earthquake.



Gold foil case become unwrapped, fell off, or smoked.



Colorful paint began to crack and fade off as well.



The bedrock can also be broken or missing.

History Information and old photos



1941



1962

History Information and old photos



1985

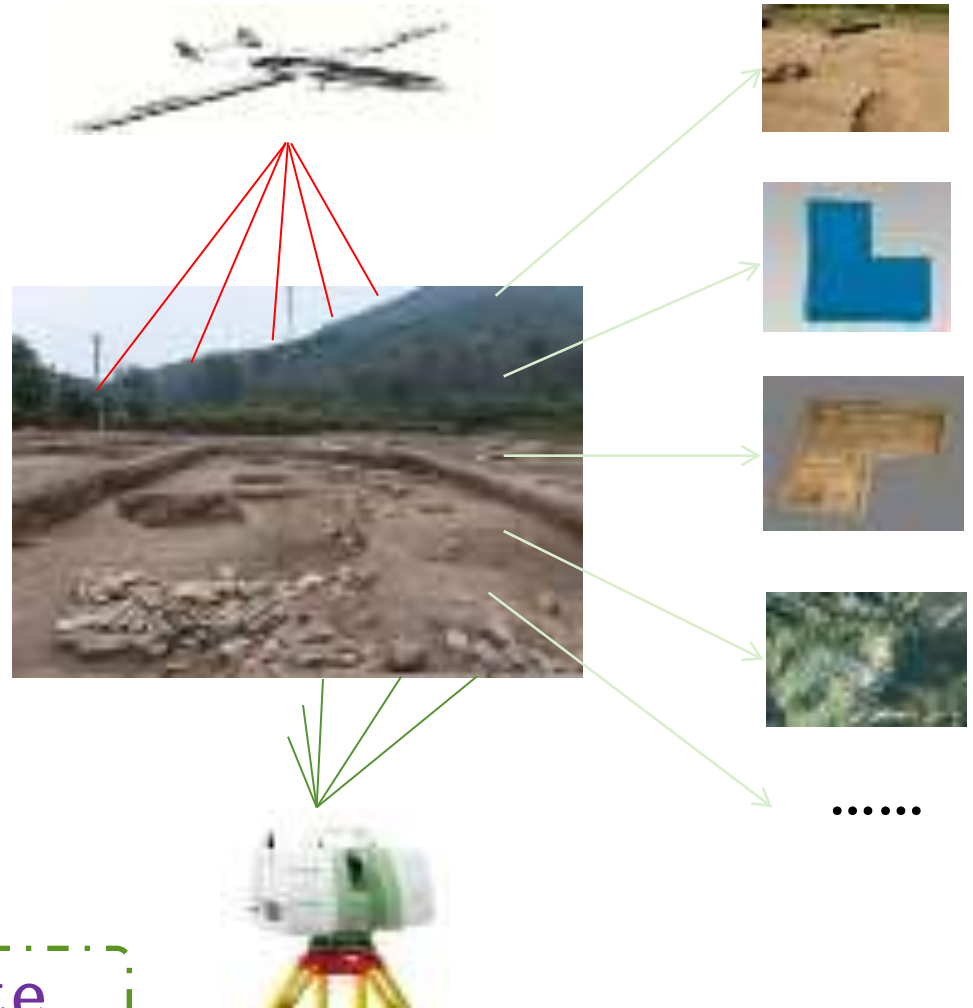
2001



Outline

- 1 Background
- 2 **Muti-resource data management**
- 3 Cultural heritage monitoring
- 4 Sustainable development indicator
- 4 Conclusion

2.1 Data collection



Muti - resource data

2.1 Data collection

The instruments we use :

Airborne laser mapping



UAV aerial photography



Photogrammetry



3D Scanning



Heritage



Surveying



Scanning

Some work photos



✓ ROMER



✓ FARO



✓ CIMCORE



At work



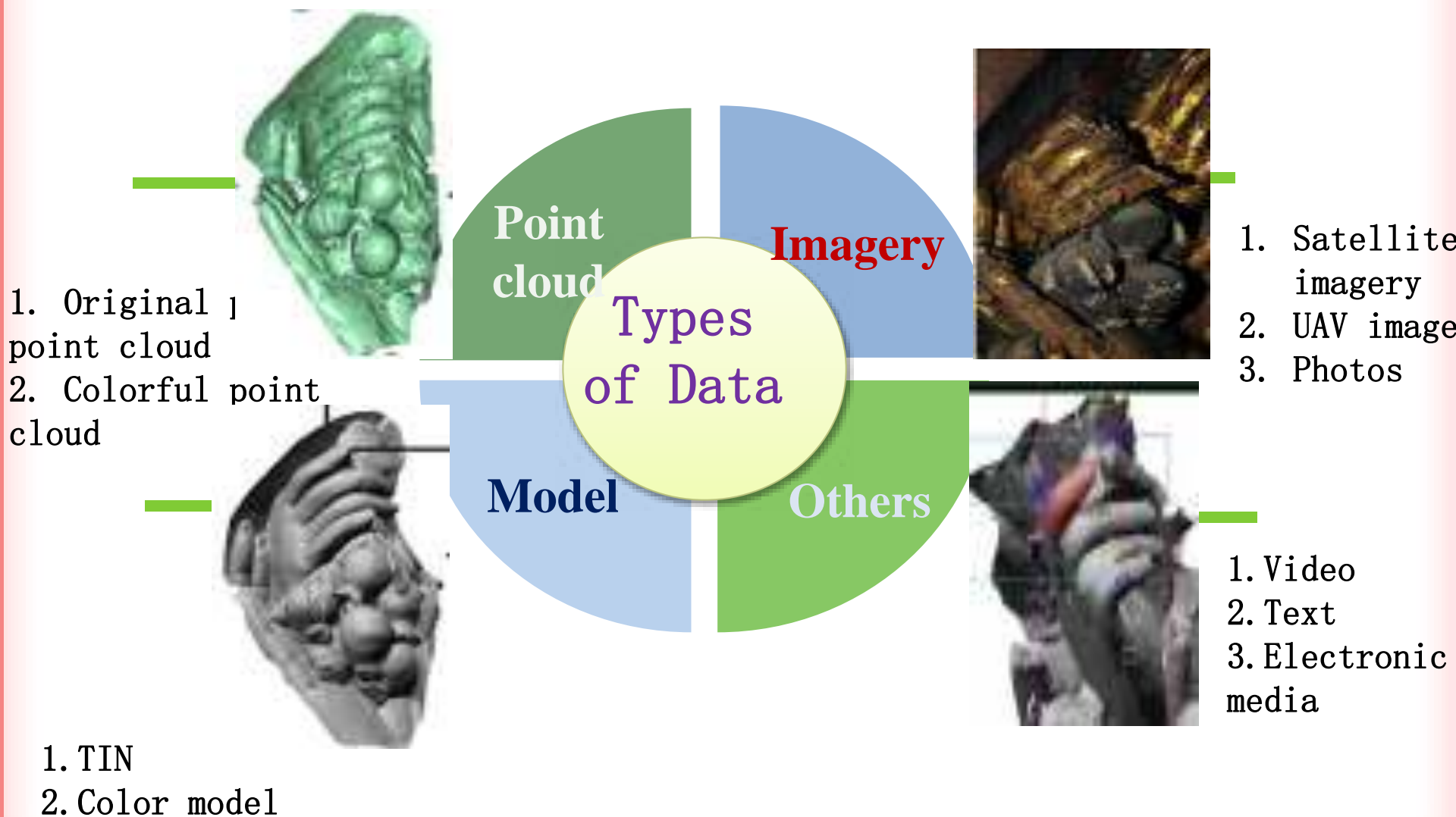
Faro



CimeCore



2.2 Types of multi-resource data about culture heritage

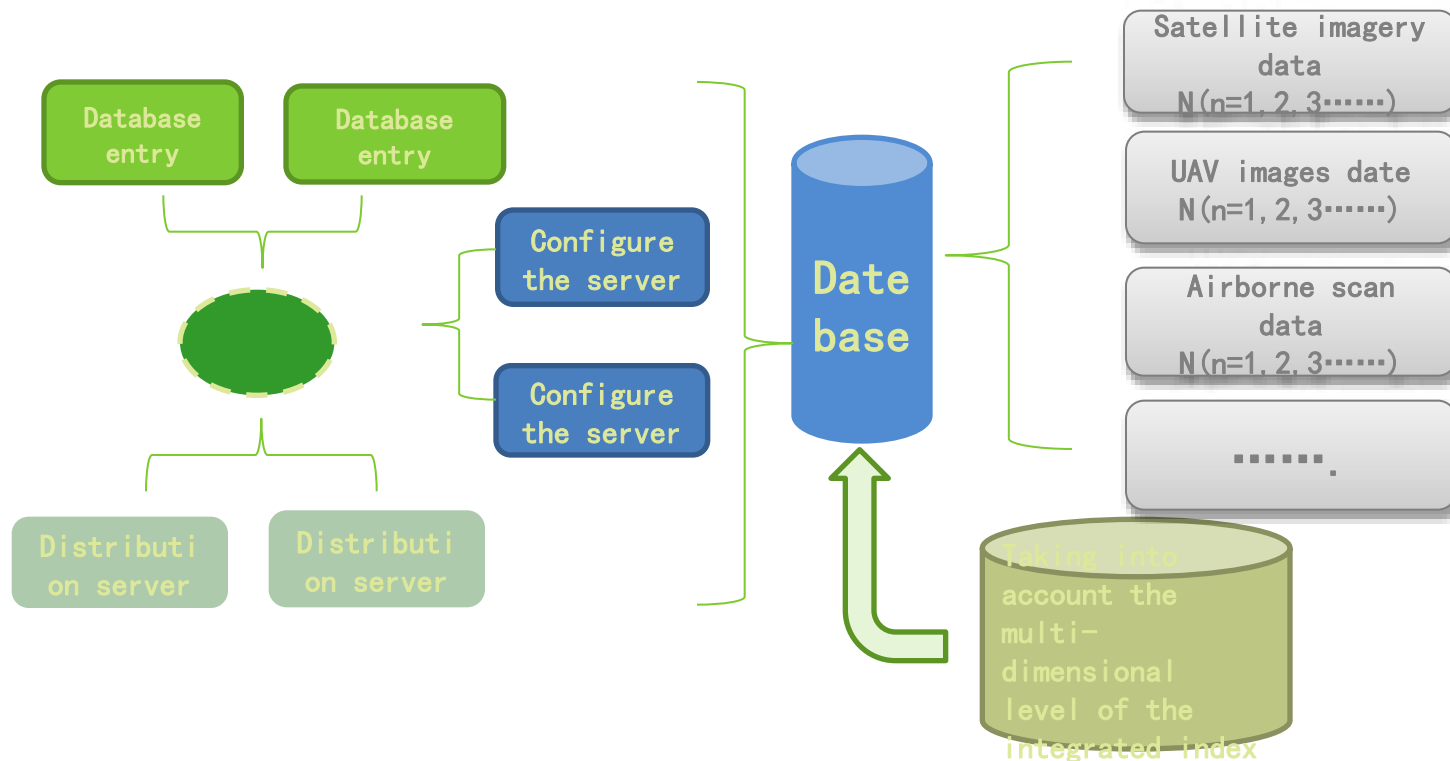




3D cloud model (4500 million points)

2.3 Multi - source data organization and management

Based on the distributed non-relational database of multi-source data storage and organization program to “heritage data” as the center, the formation of two-dimensional, three-dimensional multi-level storage structure, to solve the mass multi-source data integration storage problem.

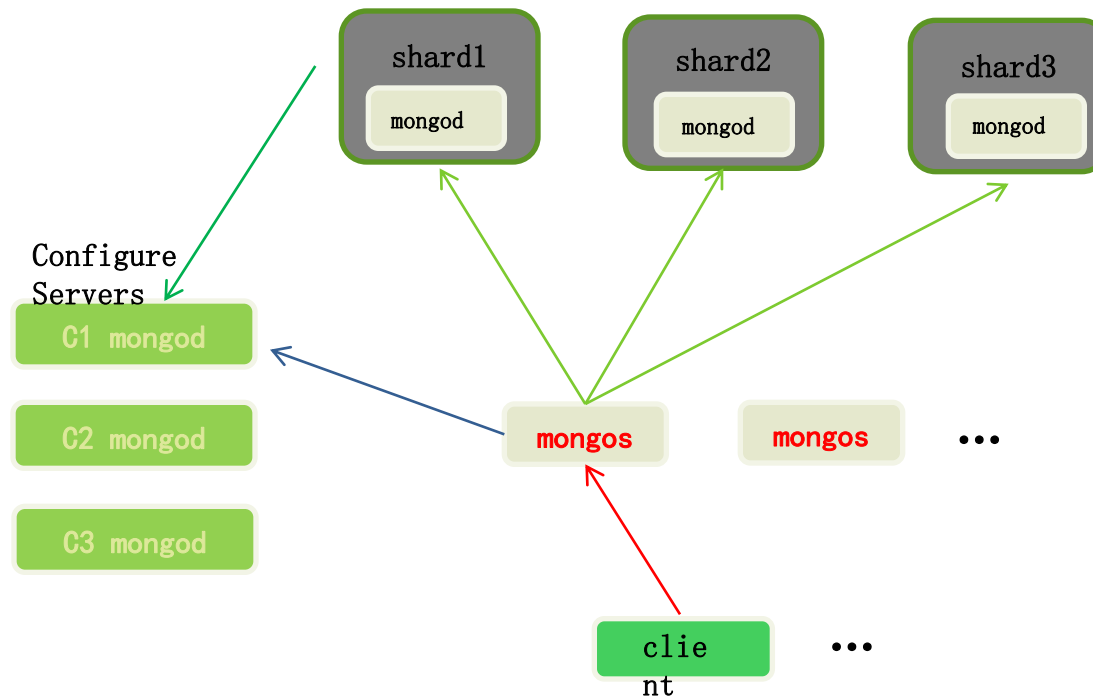


Multi - source Data Storage and Organization Based on Distributed Non - relational Database

2.3 Multi - source data organization and management

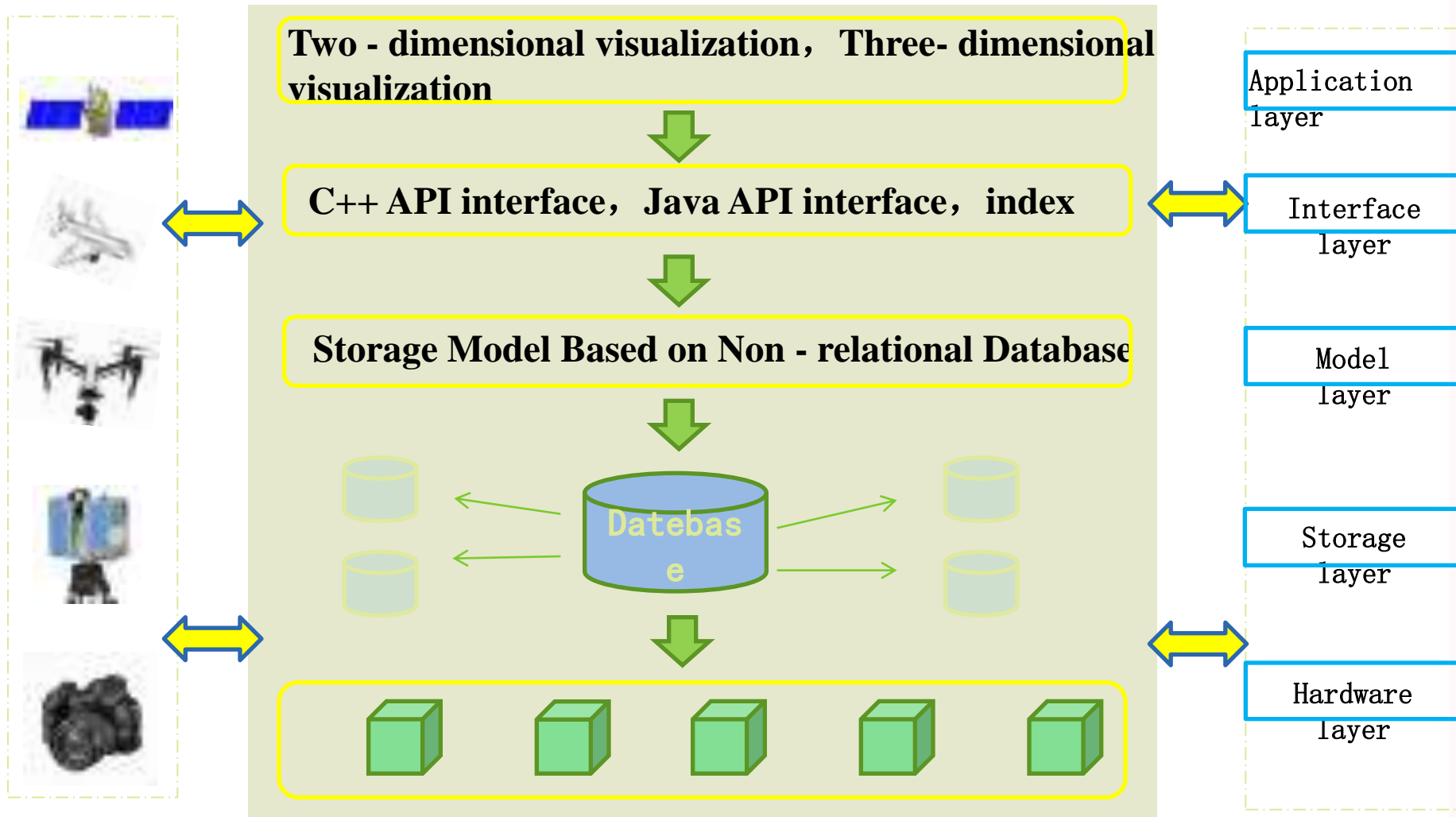
Database management system —— multi - source data storage program

The multi-source data storage scheme based on non-relational database (MongoDB) mainly supports raster (image, terrain), vector, 3D model, sensor data and time series, and can support other types of data.



Database illustration

2.4 Multi - source data platform construction



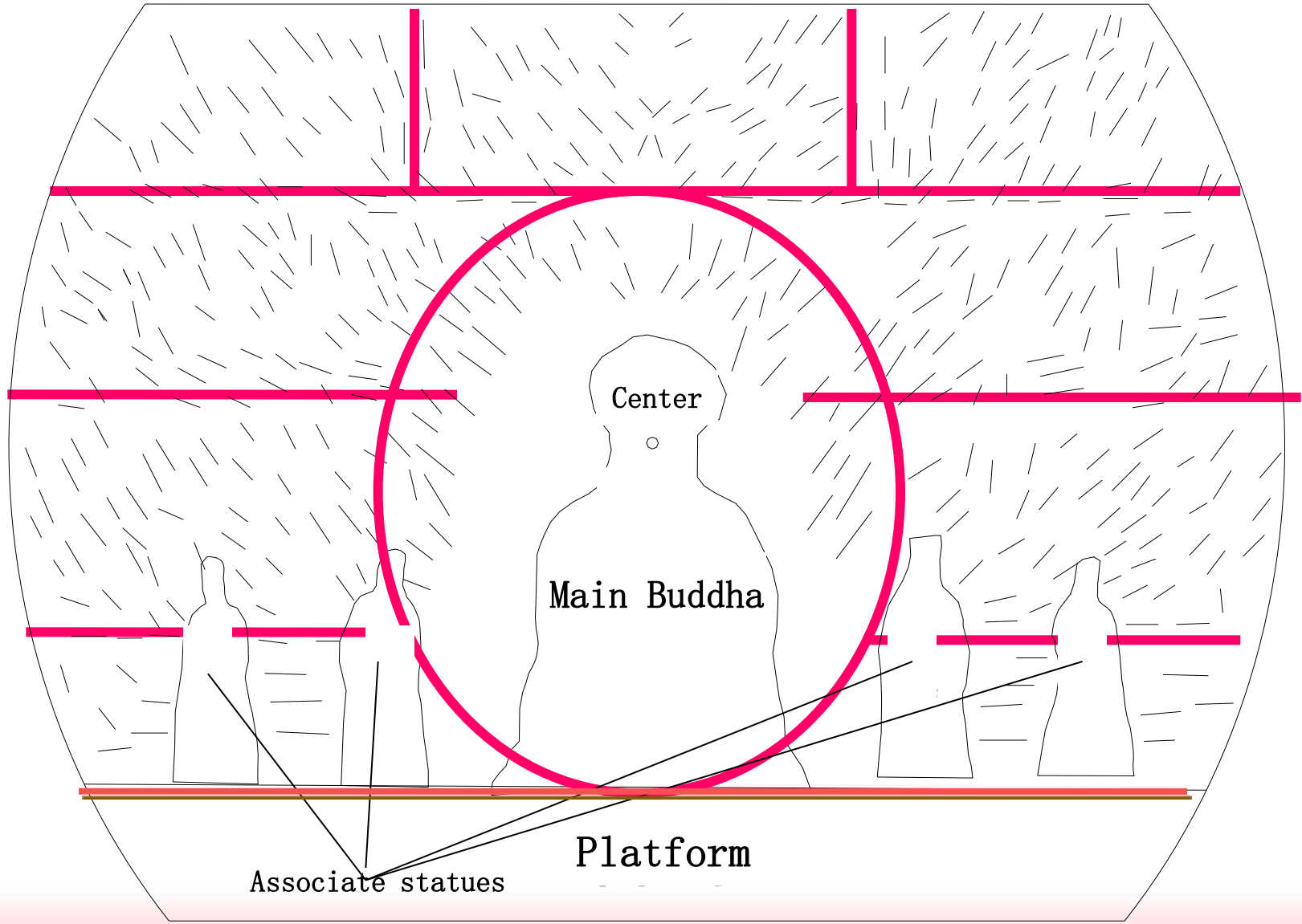
2.4 Multi - source data management system

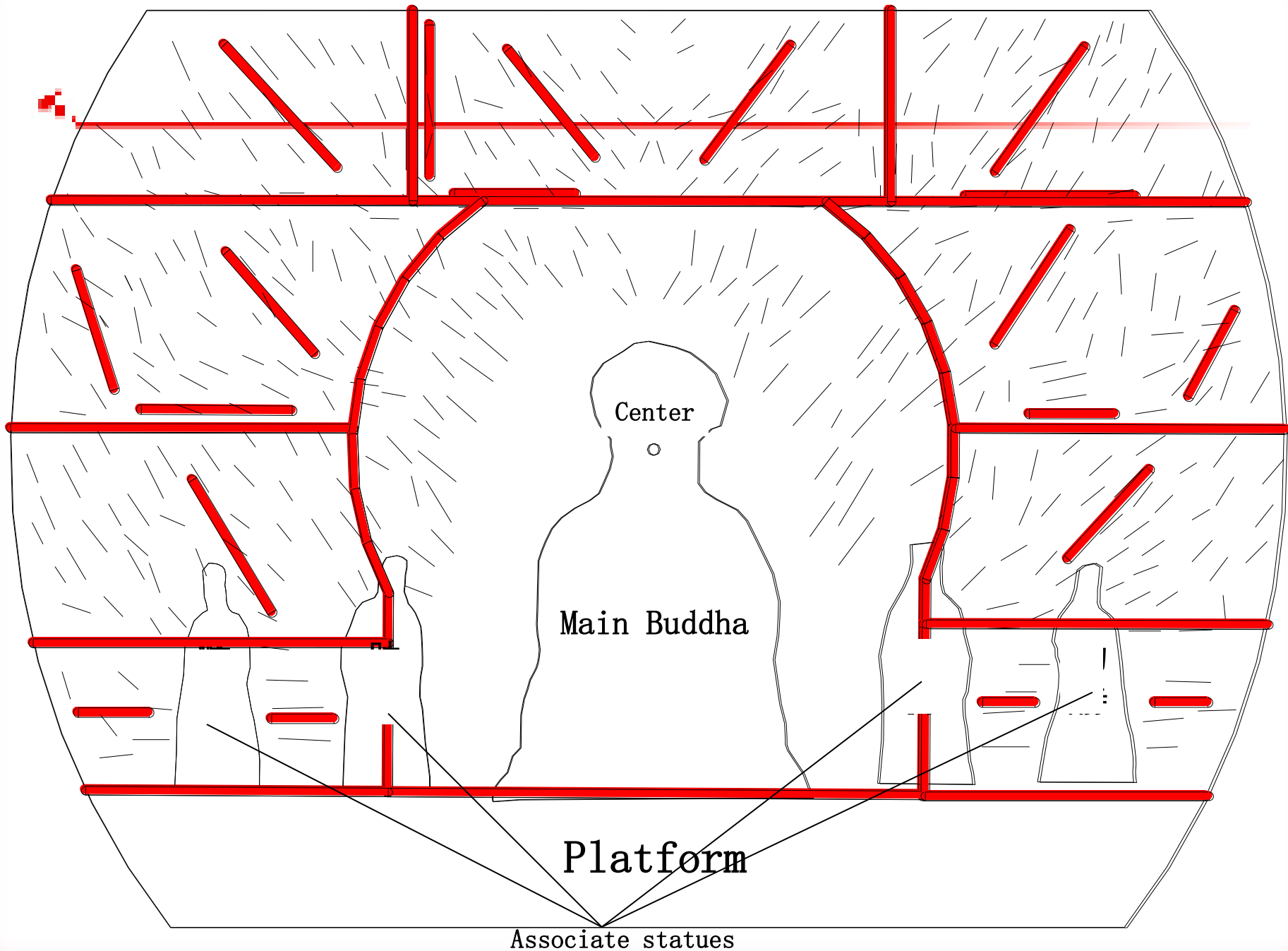


Outline

- 1 Background
- 2 Muti-resource data management
- 3 Cultural heritage monitoring
- 4 Sustainable development indicator
- 4 Conclusion and Future works

Regional division based on the direction of the hand



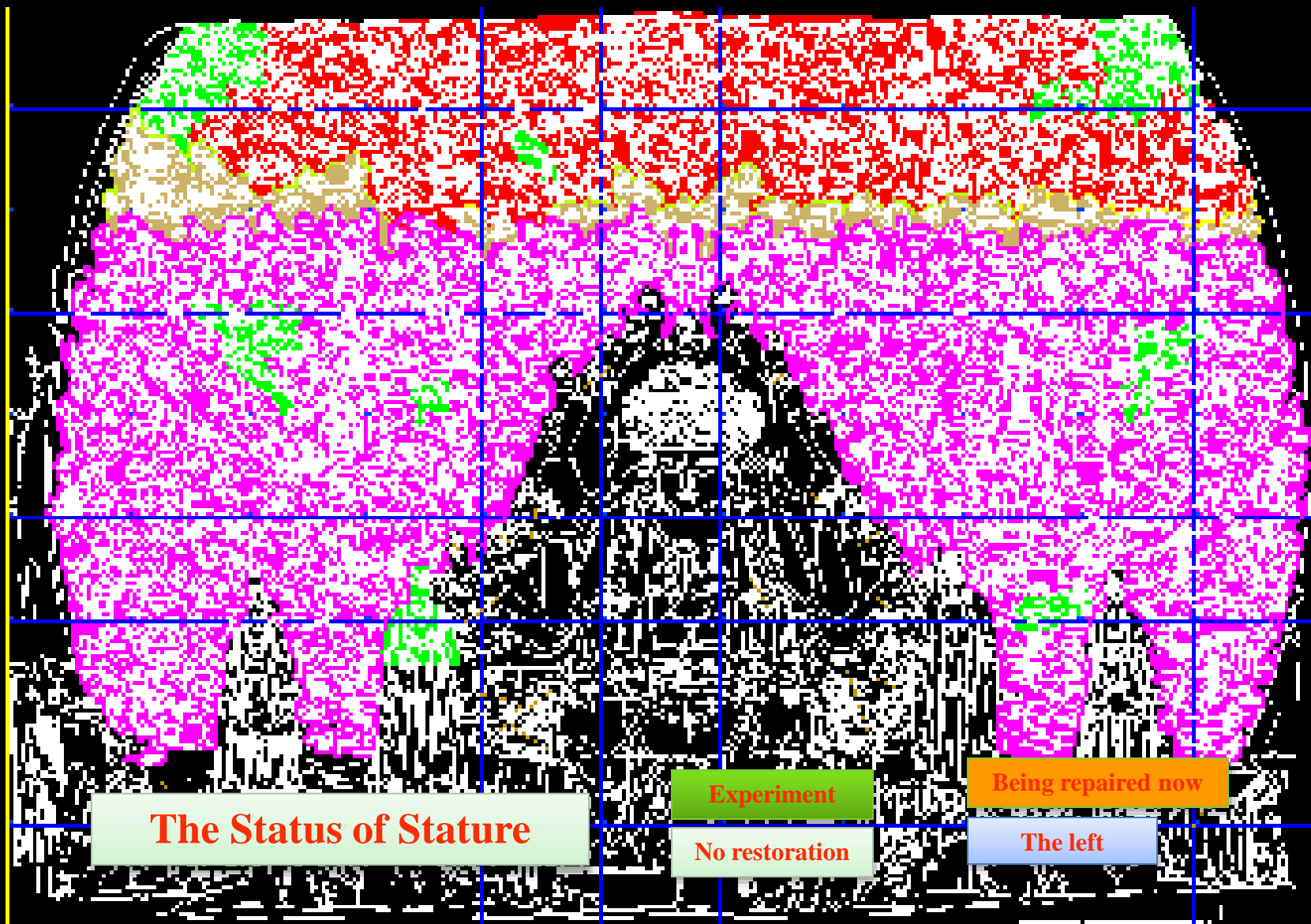


Center

Main Buddha

Platform

Associate statues



工艺试验及保护修复位置图

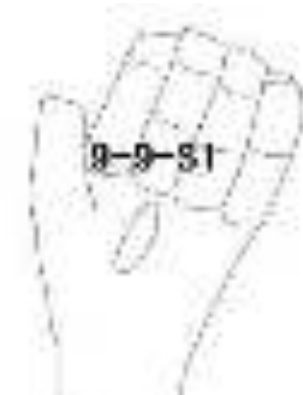
- | | |
|--|---|
| 前测、中期试验位置 | 2011年保护修复位置 |
| 实际修复除外增加位置 | 剩余区域位置 |

We can use multi-resource data to express the damaged hand



9-9-S1 gesture

9-9-S1 gesture



photo

3D model



3D colour model

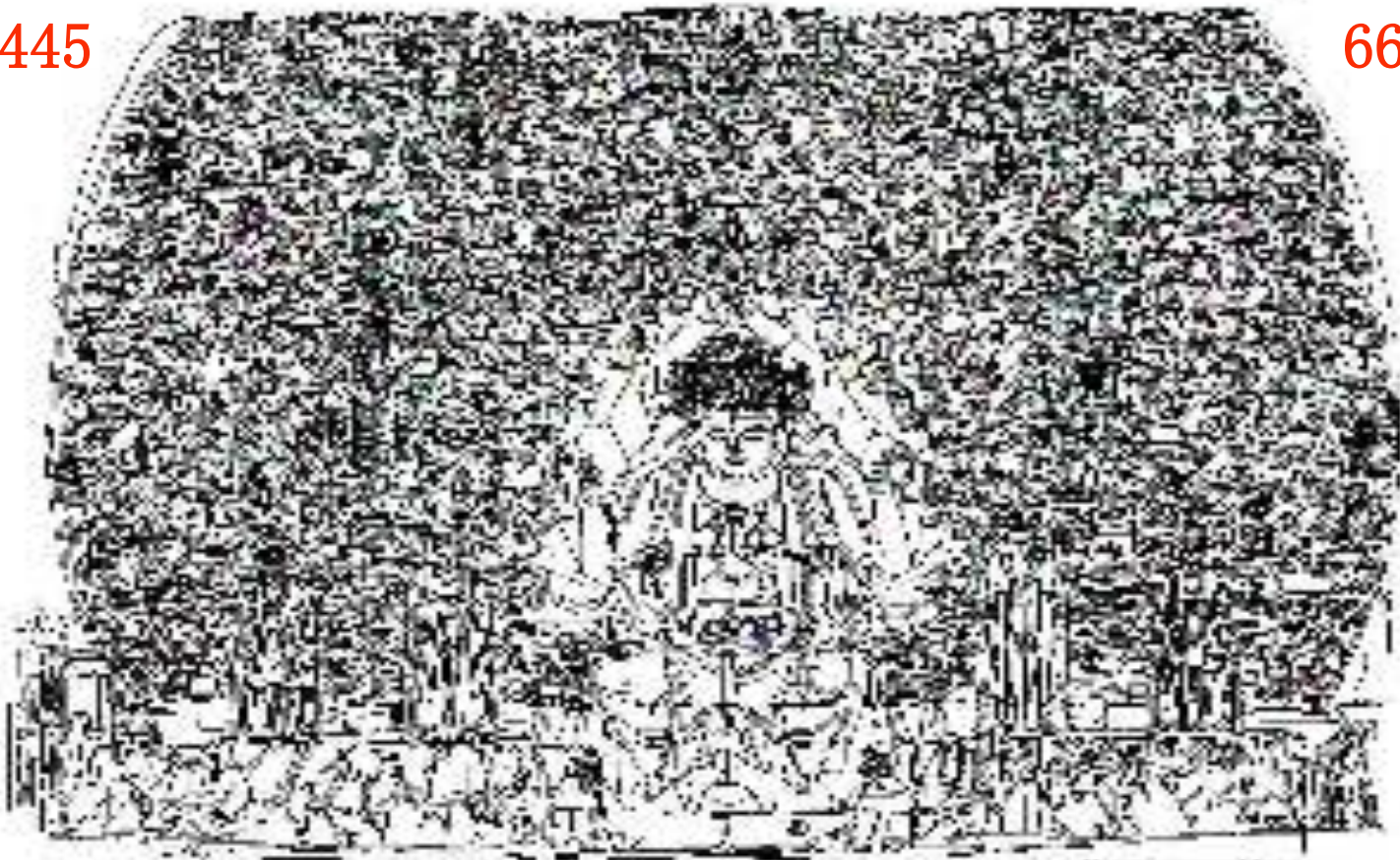
Virtual restoration



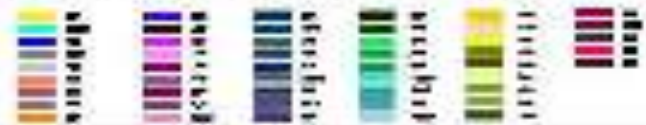
Gesture distribution of Dazu Thousand-hand Bodhisattva Statue

445

66



Gesture distribution



damage situation express

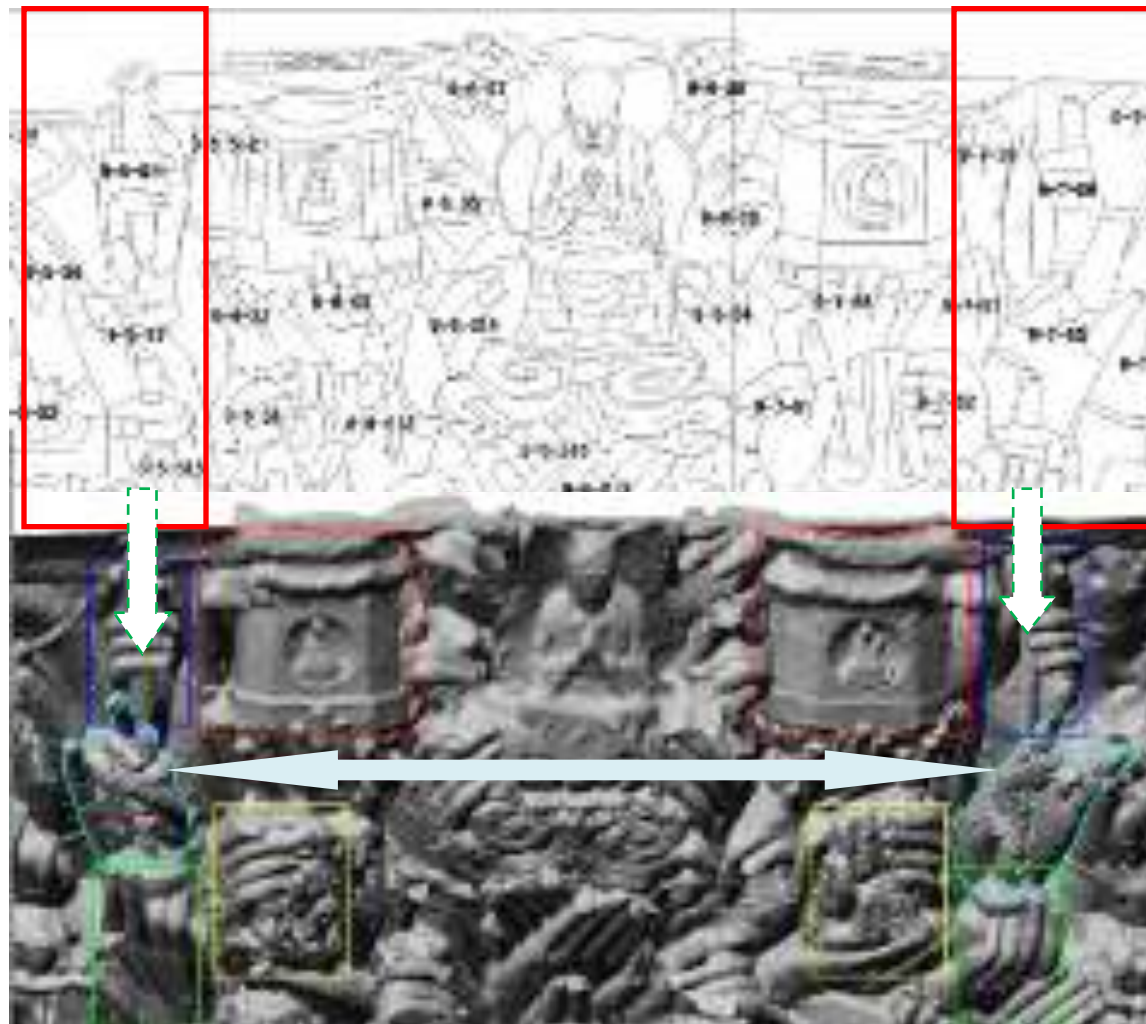


9-7-S3

Different aspects of 3D model (9-7-S3)

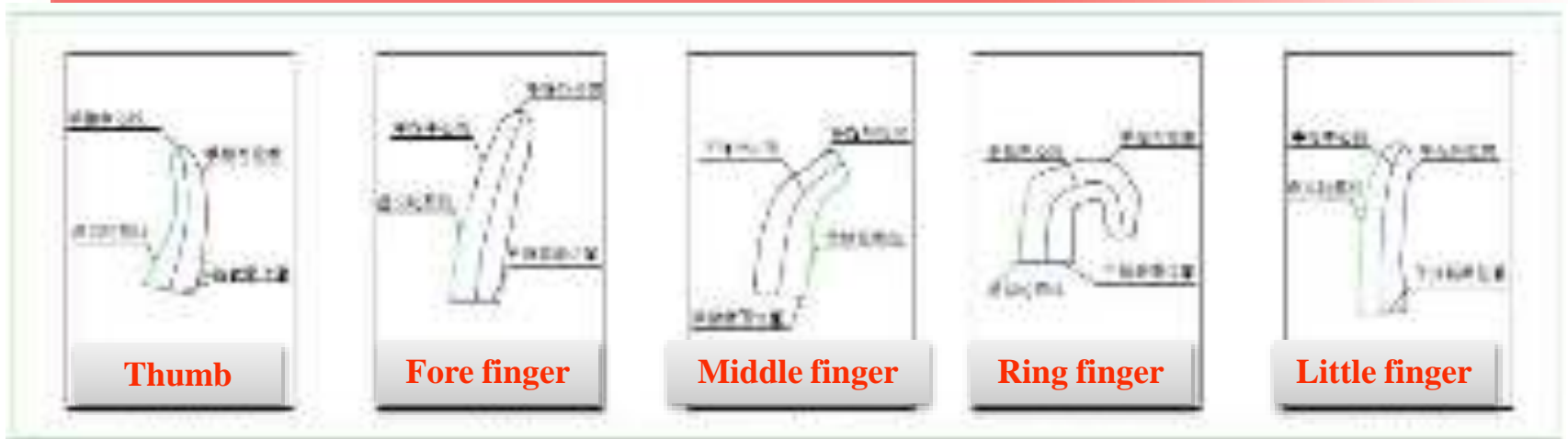


First step: identifying the symmetric area

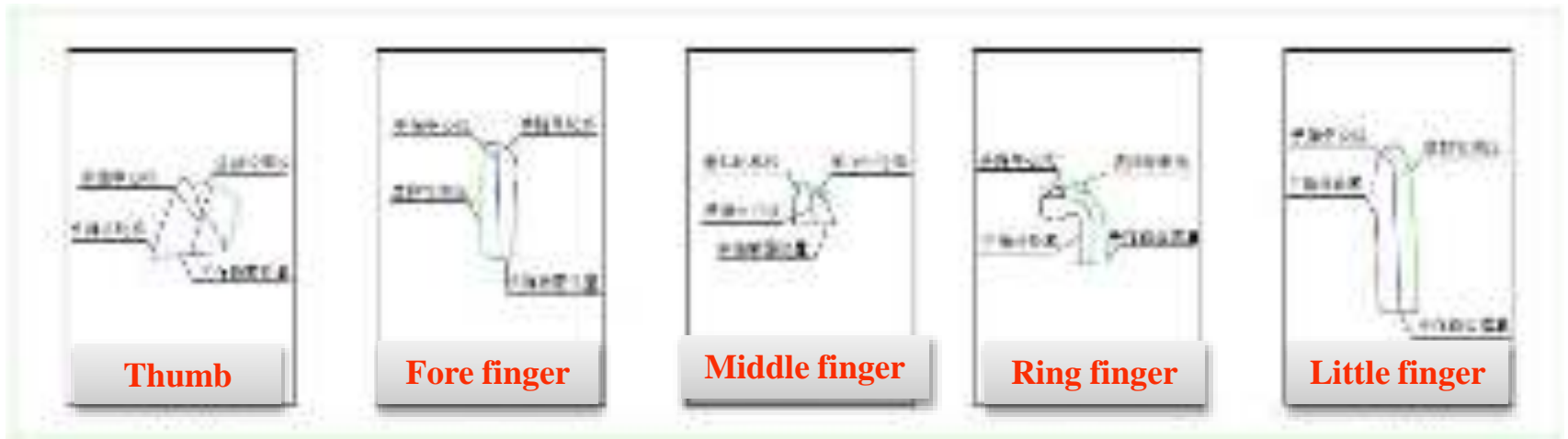


Spatial Analysis

Second step: comparing figure contour

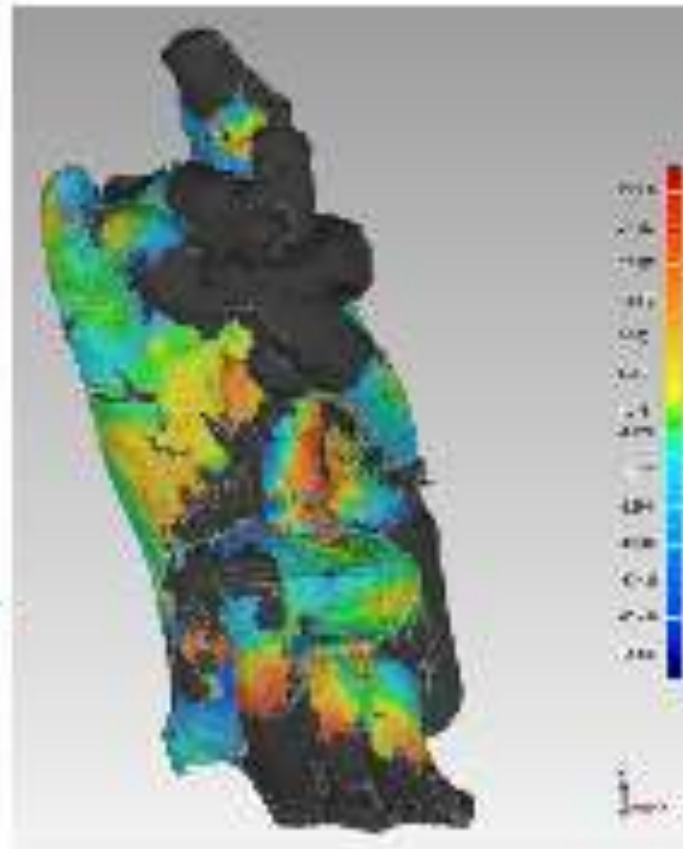


9-5-S7 finger contour



9-7-S3 finger contour

Third step: comparing 3D shapes



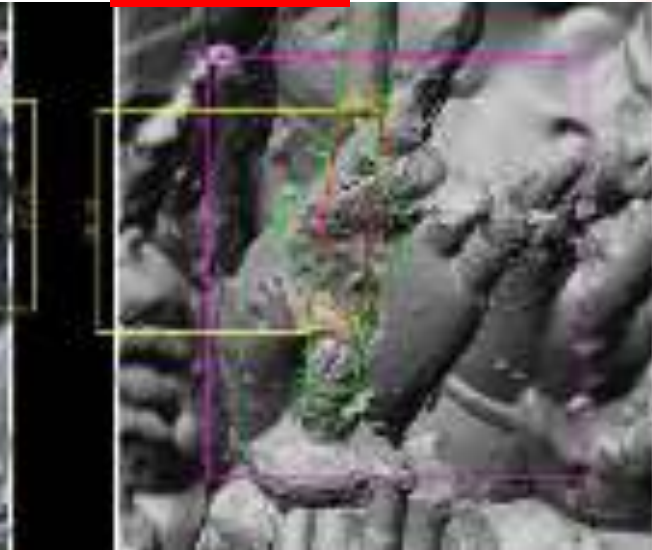
Comparing hand instrument



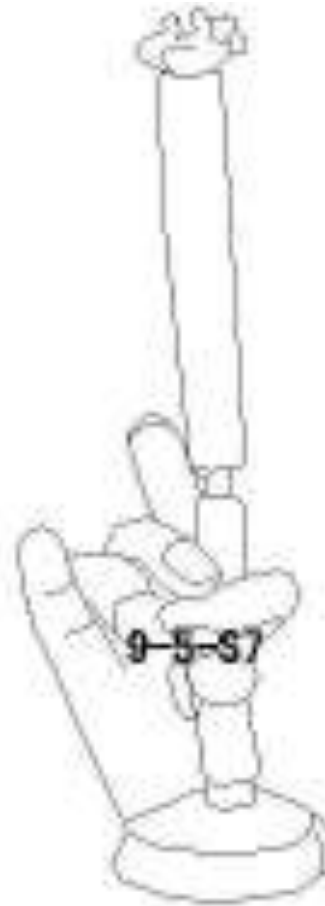
9-5-S7



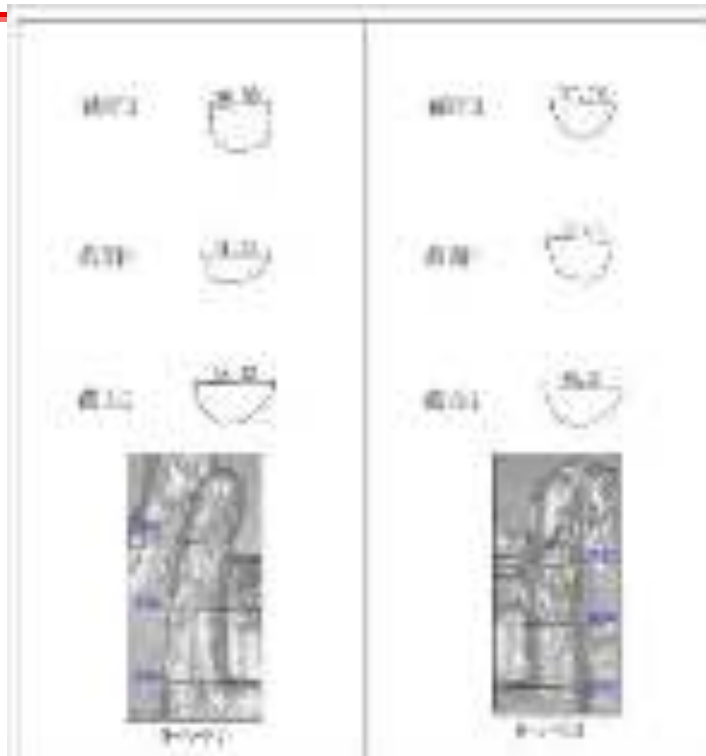
9-7-S3



9-7-S3 is symmetric and similar to 9-5-S7



Fourth step: generating the thematic map



transversal surface
Between 9-7-S3 and 9-5-S7

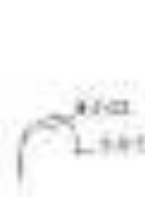
Thumb

Fore finger

Middle finger

Ring finger

Little finger



Center line comparison
between 9-7-S3 and 9-5-S7

Preliminary compensation effect of 9-7-S3



Fifth step: detecting the difference



Before

After



Comparison of 3D models

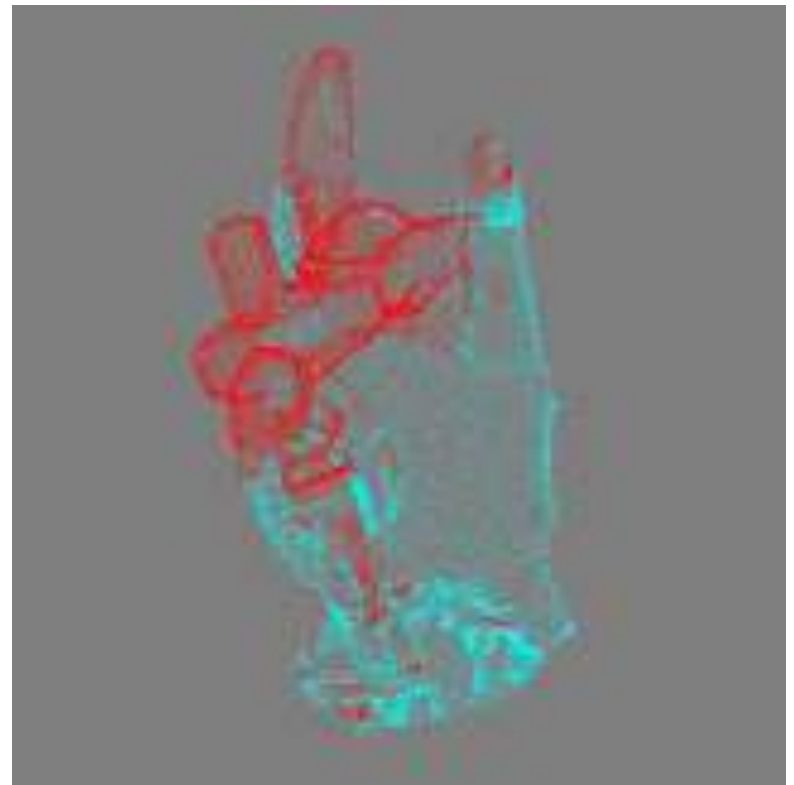
before



after



Change



Outline

1 Background

2 Muti-resource data management

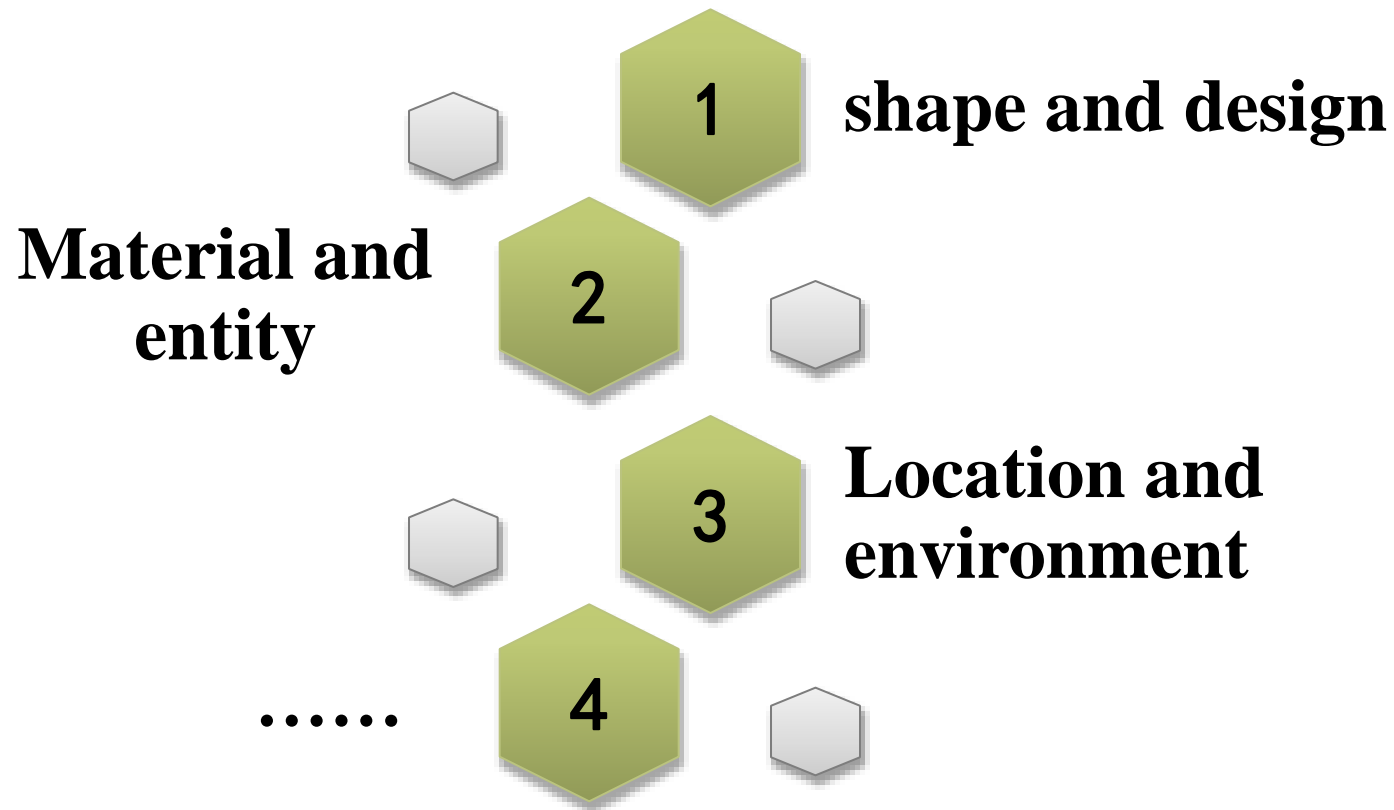
3 Cultural heritage monitoring

4 Sustainable development indicator

4 Conclusion

4.1 Classification of cultural heritage monitoring indicators

◆ **Monitoring content:**



4.1 Classification of cultural heritage monitoring indicators

Monitoring content: shape and design

Monitoring factors	Monitoring factor	Monitoring Indicators - Ancient Architecture (G)	Monitoring indicators - Ancient tombs
Overall pattern	The pattern / size / quantity of	The overall size of the an	ion and the ancient
Monomer form	The cha / element	Component Size / Materi	me / plat, cation / structure
Subsidiary heritage	Number heritage elements / form / size / location / characteristics	potential / number of r relics, level, preservat abduction, damage, loss)	status quo

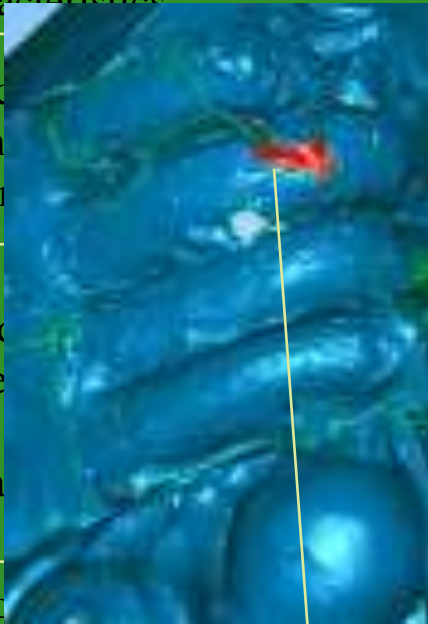


Geometric features

Geometric features, position, Facade

4.3 Classification of cultural heritage monitoring indicators

Monitoring content	Material and entity	
Monitoring factors	Structural style /Structural characteristics	Material
Monitoring factor	Structural elements /Structural deformation	The structure and material of heritage elements /Bonds /Material
Monitoring Indicators - Ancient Architecture (Group)	Buildings /Structural deformation /The collapse	Main position /Material composition /Construction
Monitoring indicators - ancient ruins ancient tombs	Major structural elements /Collapse, settlement, settlement	Proportion of main soil and stone /The pigment, color, composition and painting process of fresco



Gold foil from the Alice parts



Artifact surface painted off

4.1 Classification of cultural heritage monitoring indicators

Monitoring content

Location and environment

Monitoring factors

Geographical position

Surrounding environment

Monitoring factors

Monitoring Indicators
- Ancient Architecture
(Group)

Monitoring indicators
- ancient ruins and
tombs



Spatial location

4.1 Classification of cultural heritage monitoring indicators

Besides, the cultural heritage indicators of the monitoring content in terms of **spirit and feelings** remain blank and require further development of the definition and monitoring of stress, as well as the development of reliable and measurable indicators related to political and perceptual aspects.

Methods / strategies: Analyze through questionnaires

4.1 Classification of cultural heritage monitoring indicators

Indicators are also used to measure and compare urban management performance and urban competitiveness.

Item	Source	Indicator	Related category	Relevant	Sustainability dimension
Urban competitiveness	Priswatulhasan & Ompusri (2014)	1. No. of World Heritage sites	Quality of living	Direct	Social, economic
	Economic Intelligence Unit (2012)	3. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
Urban management performance	UNEP (2012)	1. No. of World Heritage sites	Cultural heritage	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	2. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	3. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	4. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	5. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	6. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	7. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	8. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	9. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	10. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	11. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	12. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	13. No. of World Heritage sites	Social and cultural character	Direct	Social, economic
	Priswatulhasan & Ompusri (2014)	14. No. of World Heritage sites	Social and cultural character	Direct	Social, economic

These indicators not only create stronger linkages with the **economic, social, and environmental dimensions** but also include a **fourth cultural dimension** by correlating to economic investment, benefiting the living conditions and life quality of local communities through the conservation of both natural and cultural heritage resources.

4.2 Reconstruction after cultural heritage monitoring



Before repair



Virtual repair



After actual repair

4.2 Reconstruction after cultural heritage monitoring

Local area repair image



Fix the results
before scanning



Repair
medium



Repair is
complete

4.2 Application of Sustainable Development Indicators

DaZu Thousand-Hand Bodhisattva Statue before and after the comparison map



Outline

- 1 Background
- 2 Muti-resource data management
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- 4 Conclusion

5 Conclusion

- 3D scanning are extremely necessary to express the situation of culture heritage after disaster.**
- Muti-resource data management is the key part for the culture heritage risk reduction.**
- Virtual Restoration is useful for the culture heritage after disaster.**

A vibrant, sunlit forest scene. A dirt path winds through a dense forest of tall, thin trees. The ground is covered in lush green ferns and other undergrowth. The lighting is bright, creating a warm and inviting atmosphere.

>Welcome !

Thanks !