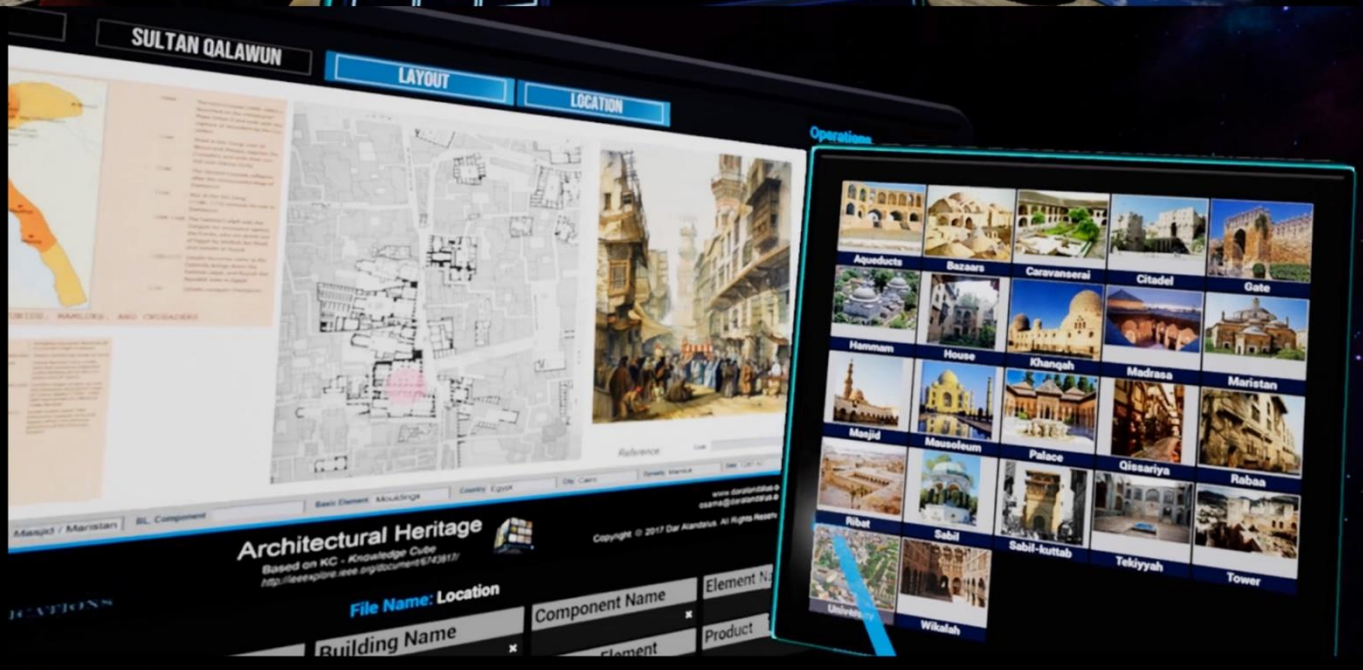
KNOWLEDGE CUBE

VIRTUAL HERITAGE APPLICATION



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KNOWLEDGE CUBE

BETA

Powered by UE5 engine ©

"History will never be lost."

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Singapore Patent App. No 10202201467Y – Malaysia Patent App. No. PI2023000757

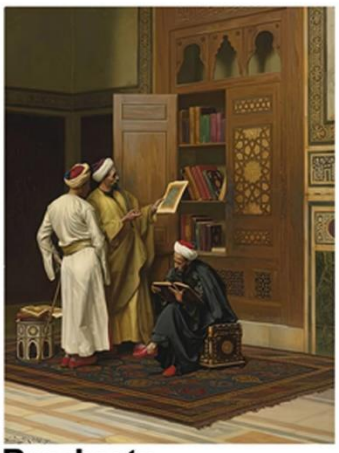
https://www.avraonline.com/wp-content/uploads/2024/08/KnowledgeCube_Teaser_2024.mp4

Application Description

- Knowledge Cube (KC) is an application software to serve as a Virtual Musepedia of Islamic Civilization –VMIC. A Virtual Musepedia that brings together the experience of museums and encyclopaedias in an integrated immersive virtual environment.
- KC is a complete comprehensively integrated virtual documentation for the development of Islamic urbanization, architecture and civilization through its various dynasties and locations.
- This endeavour is a direct response to UNESCO's prior actions, which show the various ways humanity has attempted to understand how culture may strengthen our sense of self.
- KC is founded on the belief that cultural heritage should be preserved by offering a dynamic platform for transmitting cultures as living legacies.
- KC combines traditional expertise in heritage management, museology, history, and archaeology with the potent new tools of digital information technology. KC aims to satisfy a broad spectrum of educational and cultural demands.
- KC is at the cutting edge of innovation in the study and creation of immersive heritage. The study will be the first to simulate both a thorough framework for Islamic Civilization sense perception and a direct method of transferring sensory information. For the first time, a new model for intangible sensory heritage will be developed and assessed.
- KC re-addresses the tangible and intangible values of Islamic Civilization by introducing a state-of-the-art multimodal sensory environment, which represents real advancements in obtaining the greatest knowledge possible.

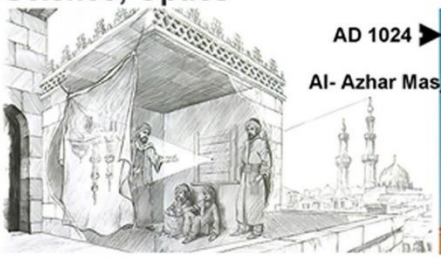
ISLAMIC CIVILIZATION

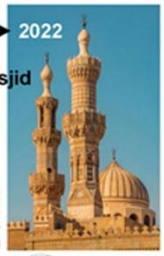
Urban Life
Building Types
Building Components
Building Elements



Products

Sociocultural Context:
Science; Optics





Scholar: Ibn Al-Haytham: Optics
Invention: The first pinhole camera
(known as the Camera Obscura)

BUILDING COMPONENT
(Minaret)

BUILDING ELEMENT
(Arch)

BUILDIND TYPE
(Masjid)

Locations
Country: Egypt
City: Cairo

Dynasty
Fatimid

Islamic Civilization

Islamic Civilization is an amalgam of a wide variety of cultures, made up of polities and countries from North Africa to the western periphery of the Pacific Ocean, and from Central Asia to sub-Saharan Africa. Islamic Civilization is a cultural, economic, and scientific flourishing in the history of Islam, traditionally dated from the 8th century to the 18th century.

At the event hosted by Wilton Park celebrating their 50th anniversary (1996), HRH The Prince of Wales, now His Majesty King Charles III, gave the opening speech at the dialogue, titled ‘A Sense of the Sacred: Building Bridges Between Islam and the West.’

The opening lines included:

‘I start from the belief that Islamic civilization at its best, like many of the religions of the East – Judaism, Hinduism, Jainism and Buddhism – has an important message for the West in the way it has retained a more integrated and integral view of the sanctity of the world around us. I feel that we in the West could be helped to rediscover those roots of our own understanding by an appreciation of the Islamic tradition’s deep respect for the timeless traditions of the natural order. I believe that process could help in the task of bringing our two faiths closer together. It could also help us in the West to rethink, and for the better, our practical stewardship of man and his environment — in fields like healthcare, the natural environment and agriculture, as well as in architecture and urban planning.’

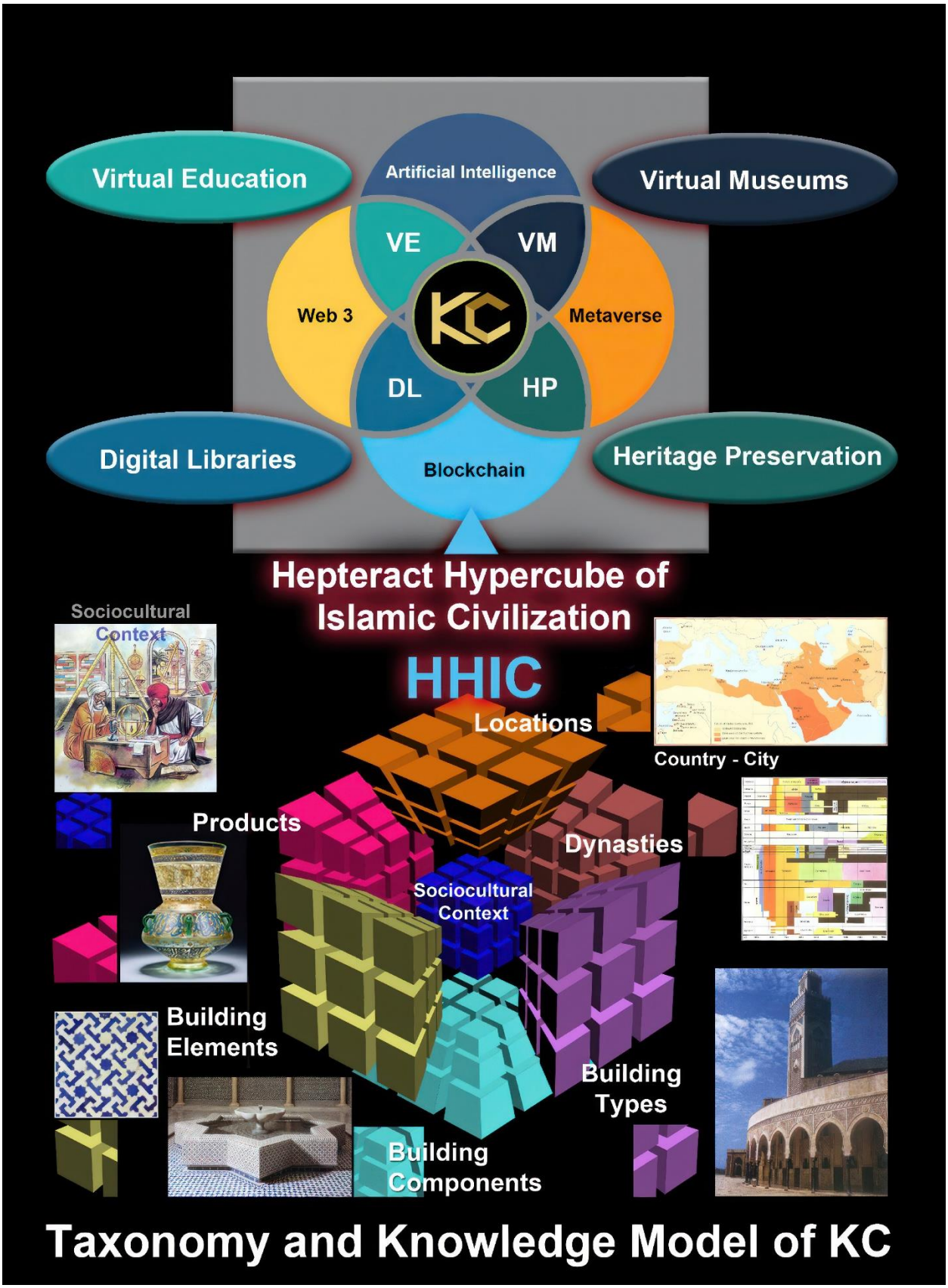
Cultural Heritage (CH) refers to the legacy of physical objects, environment, traditions, and knowledge of a society that are inherited from the past, maintained, and developed further in the present, and preserved (conserved) for the benefit of future generations.

Knowledge Cube Capabilities

Knowledge Cube (KC) provides special skills for managing knowledge, discovering new information about the history of Islamic civilization, and visualizing it in virtual reality. With the help of KC, academics may work together to create knowledge-based entities through a dynamic and adaptable search and research platform. Using contextual tools, KC users may visualize and analyze data, communicate, and share through the metaverse, gaining deeper insights into both tangible and intangible aspects of Islamic civilization. The contextual tools in KC have the capability of serving cultural tourism (museums), digital learning/education, and cultural heritage preservation at one time.

Cultural heritage management, which involves documentation, conservation, restoration, interpretation, and education. Cultural heritage is the embodiment of our shared human history, encompassing the tangible artifacts, intangible traditions, languages, rituals, and knowledge that have been passed down through generations. It reflects the essence of who we are, where we come from, and the collective experiences that have shaped our societies. Preserving and safeguarding this rich tapestry of cultural heritage has always been a critical mission, allowing us to connect with our roots, foster a sense of identity, and learn from the lessons of the past. In the digital era, safeguarding cultural heritage has become a vital concern. As technology advances and societies digitize vast repositories of historical artifacts, works of art and intangible traditions, the preservation of our diverse cultural heritage takes on new facets and challenges. Digital initiatives are opening considerable horizons for wider access, interactive experiences, and the dissemination of knowledge. The digital revolution offers unprecedented opportunities for cultural heritage preservation. By digitizing artifacts, artworks, historical documents, and traditional practices, we can ensure their wider accessibility to people around the world, regardless of geographic boundaries or physical limitations.

KC encourages a shift to digital methods, a transition that has been significantly accelerated by innovations in artificial intelligence, blockchain, Semantic Web (web3), ontology, metaverse, and virtual reality.

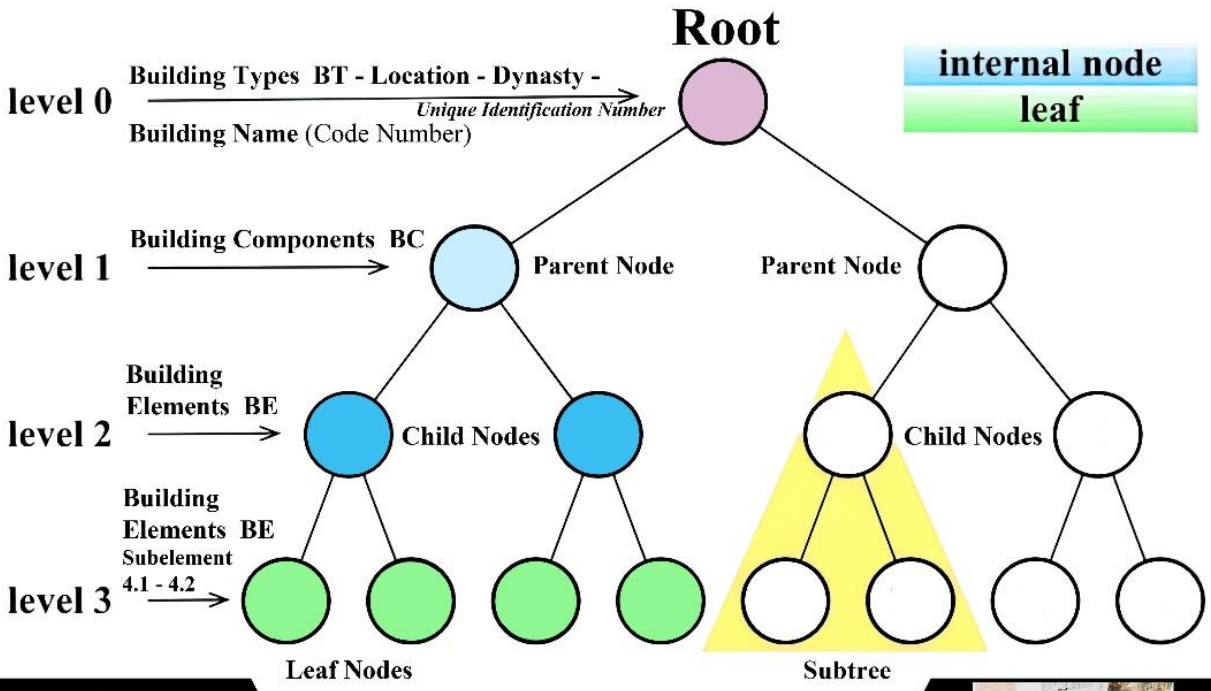

Virtual Education
Artificial Intelligence
Virtual Museums
VE
VM
Web 3
KC
Metaverse
DL
HP
Digital Libraries
Blockchain
Heritage Preservation
Hepteract Hypercube of Islamic Civilization
HHIC
Sociocultural Context
Locations
Country - City
Products
Dynasties
Sociocultural Context
Building Elements
Building Types
Building Components
Taxonomy and Knowledge Model of KC

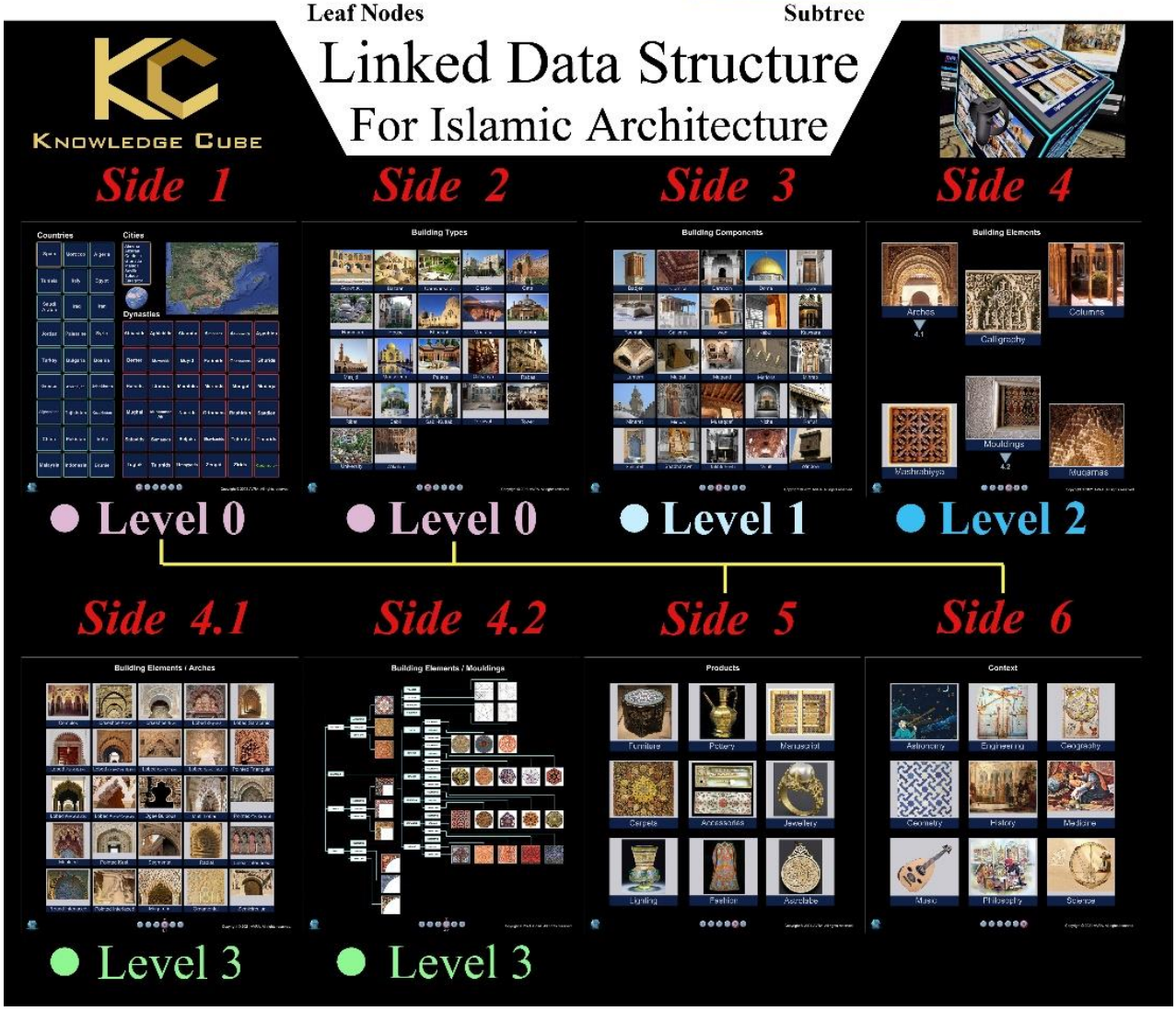
HHIC as a **Knowledge Model** (Taxonomy Framework)

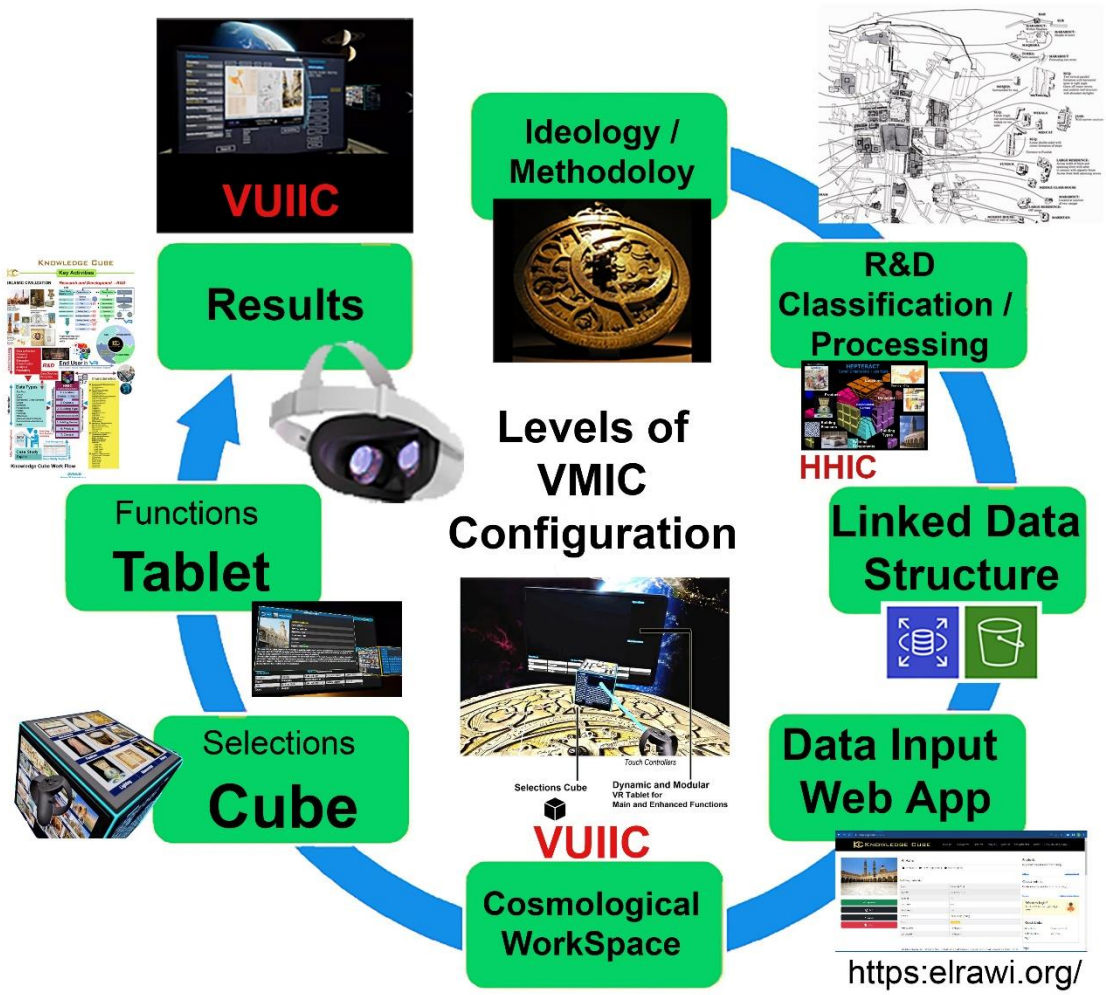
KC is an application built upon a **knowledge model** with seven dimensions we referred to as the Hepteract Hypercube of Islamic Civilization (HHIC). HHIC is equipped with a classification system that uniquely identifies the meaning of each entry and ensures that it is proposed for the required classification of all entries. Uniqueness is ensured, on the one hand, through integration (linking) with relevant data and controlled vocabularies, and on the other, by the user's own annotation, evidenced by links to online virtual Models and artefacts.

The HHIC– the core of this platform – is a **knowledge model** containing *modules* of self-contained components of information that are interchangeable and has a well-defined interface to other components. Architecture, products (elements of daily use), and the socio-cultural context, of Islamic Civilization are all integrated in one comprehensive immersive entity to tell the untold story of this cultural heritage.The Hepteract Hypercube of Islamic Civilization – HHIC is a knowledge based information system invented to put the multi-layered data structure into a descriptive model seeking collecting linking and sharing information and events, in a global dimension, taking into account the different approaches that scientific, humanistic and artistic culture have to the digital age, with meta-data for reality-based and model-based models. The HHIC is linked with visualization system to manage and create a useful tool for overcoming the segregated divisions of this Islamic civilization, getting it into one integrated entity. The Hepteract Hypercube of Islamic Civilization – HHIC is also an open repository of 3D cultural heritage models, providing standard mechanisms for preservation, updating, and dissemination, and urban development construction planning, to promote the historical cities, cultural heritage conservation planning scientific and technological such as data acquisition and data deep processing.

The HHIC is built upon classification hierarchies organizing knowledge; it can facilitate comparison, highlight difference, limit generalization, expose gaps in knowledge, assist theory development and provide comparability within a ***linked data structure***.


Root
internal node
leaf
level 0
Building Types BT - Location - Dynasty -
Unique Identification Number
Building Name (Code Number)
level 1
Building Components BC
Parent Node
Parent Node
level 2
Building Elements BE
Child Nodes
Child Nodes
level 3
Building Elements BE
Subelement 4.1 - 4.2
Leaf Nodes
Subtree

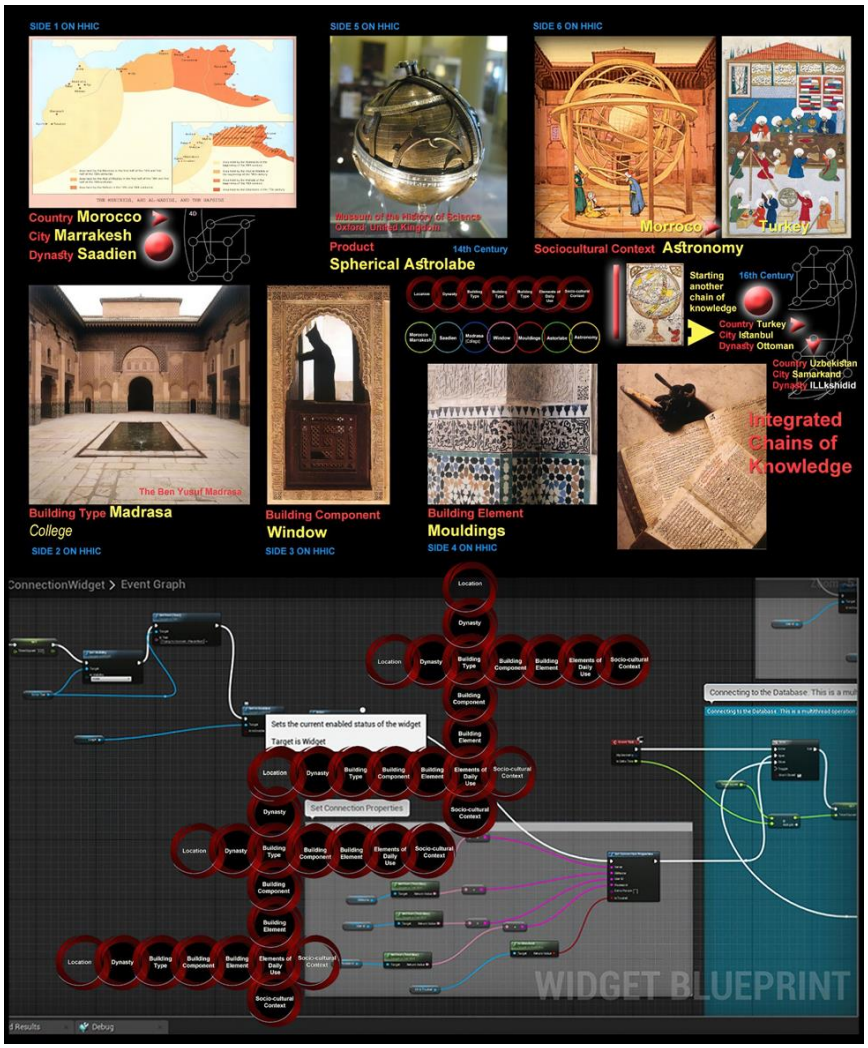

KNOWLEDGE CUBE
Linked Data Structure
For Islamic Architecture
Side 1
Side 2
Side 3
Side 4
Countries
Cities
Dynasties
Building Types
Building Components
Building Elements
Arches
Calligraphy
Columns
Mouldings
Mashrabiyya
Muqarnas
Level 0
Level 0
Level 1
Level 2
Side 4.1
Side 4.2
Side 5
Side 6
Building Elements / Arches
Building Elements / Mouldings
Products
Context
Furniture
Pottery
Manuscript
Carpets
Accessories
Jewellery
Lighting
Fashion
Astrolabe
Astronomy
Engineering
Geography
Geometry
History
Medicine
Music
Philosophy
Science
Level 3
Level 3



*The HHIC– the core of this platform – is a **knowledge model** containing modules of self-contained components of information that are interchangeable and has a well-defined interface to other components.*

The knowledge graph application for digital cultural heritage management

The heart of the knowledge graph is a knowledge model: a collection of interlinked descriptions of concepts, entities, relationships, and events. Knowledge graphs put data in context via linking and semantic metadata and this way provide a framework for data integration, unification, analytics and sharing. The application of knowledge graph has many benefits, including enhanced search and discovery, improved interpretation, and storytelling, facilitated collaboration and data integration, increased accessibility and inclusivity, and better preservation and conservation as follows:



KC can link and integrate collections and distinct chains of heritage information.

(1) Enhanced search and discovery: The knowledge graph application enables museums to provide more accurate and personalized search results, improving the overall user experience. For example, museums have implemented a knowledge graph-based search engine that allows users to search for artefacts by different criteria, such as materials, periods, and regions, and obtain a visual representation of the search results. Additionally, the knowledge graph application plays a significant role in managing cultural heritage data by organizing and categorizing vast amounts of information, aiding in efficient data retrieval and exploration.

(2) Improved ***interpretation*** and ***storytelling***: The knowledge graph application helps museums present their collections more engagingly by connecting different artefacts and their contexts. For example, museums use a knowledge graph to create digital stories that illustrate the life and work of Vincent van Gogh. By incorporating cultural heritage data into knowledge graphs, museums can effectively showcase the historical significance and narratives associated with each artefact, enhancing the interpretive experience for visitors.

(3) Facilitated collaboration and data integration: The knowledge graph application enables museums to share and integrate their data more efficiently internally and with external partners. This capability is particularly beneficial in managing cultural heritage data, as it allows for the seamless integration of diverse information sources related to art history, including archives, catalogues, and bibliographies.

(4) Increase accessibility and inclusivity: The knowledge graph application can help museums to provide more inclusive and accessible experiences for visitors with different backgrounds and interests.

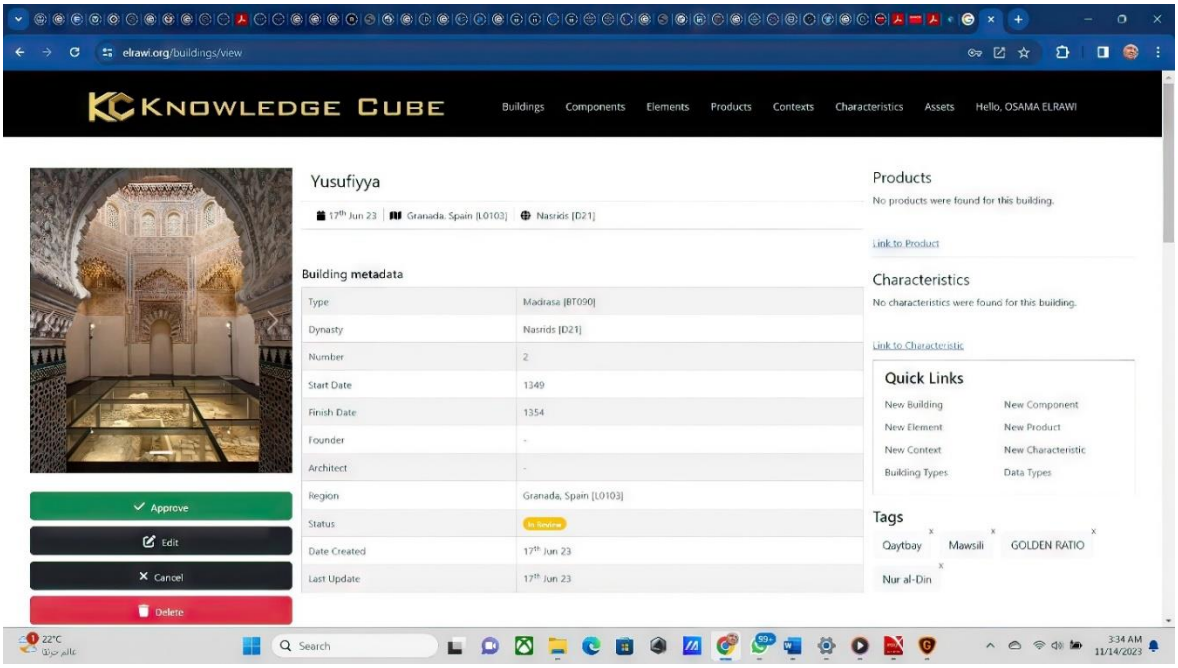
For example, museums create a knowledge graph that allows users to explore their collections through different keywords, such as color, glaze, and shape. By incorporating knowledge graphs in the management of cultural heritage data, museums can foster collaboration between different stakeholders and ensure comprehensive access to valuable information.

(5) Better preservation and conservation: The knowledge graph application can help museums manage their collections more efficiently and effectively

by providing a more comprehensive and interconnected view of the objects and their metadata. For example, museums develop a knowledge graph that incorporates information about the physical and chemical properties of their artworks and their historical and cultural contexts to support preservation and conservation efforts.

The knowledge graph application assists in the organization and management of cultural heritage data, enabling museums to better understand the relationships between artefacts, make informed decisions regarding conservation methods, and ensure the long-term preservation of cultural heritage for future generations.

The proposed knowledge graph-driven cultural heritage management framework allows for acquiring interconnected and visualized cultural heritage information. This model automatically identifies entities and relations defined by experts, enabling efficient data integration. Additionally, the knowledge completion model is presented to deal with the issue of missing information in cultural heritage data. The knowledge completion model enables the completion of missing information, further enhancing the quality of the knowledge graph. Finally, a cultural heritage knowledge graph is constructed to satisfy cultural heritage management requirements.



KC Data entry website
https://www.avraonline.com/index.php/knowledge-cube/

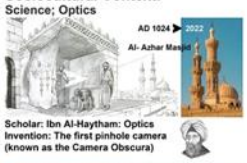
ISLAMIC CIVILIZATION

Research and Development R&D

Urban Life
Building Types
Building Components
Building Elements

Products

Sociocultural Context:
Science; Optics



Scholar: Ibn Al-Haytham: Optics
Invention: The first pinhole camera
(known as the Camera Obscura)

Locations
Country: Egypt
City: Cairo

Dynasty
Fatimid

ASK

Case Study:
Topics:

Operations

Functions

Results

Select

Drawings of	Country	Information
Proportions of	City	S1 Association
History of	Dynasty	Comparison
Demolished Fountain of ..	Building Type	S2 Inventions
Inventions of	Building Component	S3 Scholars
	Building Element	S4 (4.1 - 4.2)
	Product	S5
	Context	S6

Output

Deployment

END

ADD

ANSWER

VR

A case study may have unlimited number of topics

End User in VR

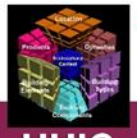
Case Study / Topics / Operations / Functions / Results

Data Processing

Data collection
Cleaning
Revision
Extraction
Classification
Analysis
Formatting

R&D

Data Sources
Bibliography



Characteristics

Information

Data Types

Site Plan
Layout
Plans
Elevations& Cross-Sections
Details
Isometric
Perspectives
Photos
Paintings
3D Models
Articles/Research Papers
Documentaries/Animations
Audio

HHIC
7 Dimensional Cube

1. Location
   - Country
   - City
2. Dynasty
3. Building Type
4. Building Component
5. Building Element
6. Product
7. Context

Hepteract Hypercube of Islamic Civilization

Hepteract Hypercube of Islamic Civilization

- **Environmental Characteristics**
  - CE1 Ventilation
  - CE2 Thermodynamics
  - CE3 Lighting
- **Formal Characteristics**
  - **CF1 Proportions**
    - CF1001 The Golden Section
    - CF1002 Arch Proportions
  - **CF2 Organization of Form and Space**
    - CF2001 Centralized Organization
    - CF2002 Linear Organization
    - CF2003 Radial Organization
    - CF2004 Cluster Organization
    - CF2005 Grid Organization
    - CF20M1 Prophet
    - CF20M2 Transept
    - CF20M3 Piers
    - CF20M4 Iwans
    - CF20M5 Estrades
    - CF20M6 Elevated
    - CF20M7 Dominated Space
  - **CF3 Patterns**
    - CF3001 Sixfold
    - CF3002 Pattern-Hexagon
  - **CF4 Shape**
    - CF4001 Multi-foil Plan
  - **CF5 Formation**
- **Ideological Characteristics**
  - CD1 Character / Identity
  - CD2 Geometrical Principles
  - CD3 Cosmology
  - CD4 Quadrivium
  - CD5 Light
- **Technical Characteristics**
  - **CT1 Assembly Systems**
  - **CT2 Construction Systems**
  - **CT2001 Key Stone**
  - **CT3 Building Materials**
  - **CT4 Finish Materials**
  - **CT5 Crafts**
    - CT5001 Brass
    - CT5002 Steel
    - CT5003 Wood
    - CT5004 Ceramics
    - CT5005 Gypsum
    - CT5006 Stone
    - CT5007 Glass
- **Physical Characteristics**
  - CP1 Geographic Coordinates
  - CP2 Site Area
  - CP3 Foot Print
  - CP4 Landscape
  - CP4 Courtyard
  - CP6 Capacity
  - CP7 Founder
  - CP8 Architect

The Knowledge Cube

First Entry
Final Revision
Uploading

DATA ENTRY

Task Management

Case Study
Topics

Case Study/Topics/Operations

Knowledge Cube Work Flow

KC and Technological Advancements

New technologies create new opportunities.

KC has rich datasets of cultural artefacts that could be made accessible to a larger audience. Due to technological advancements, some disruptive technologies are being replaced by newer ones. KC has uniform databases with suitable classification schemes and multimedia metadata that would enable researchers to make connections between different cultural heritage objects, and thus increase the knowledge about and understanding of the cultural heritage.

1. KC and Blockchain

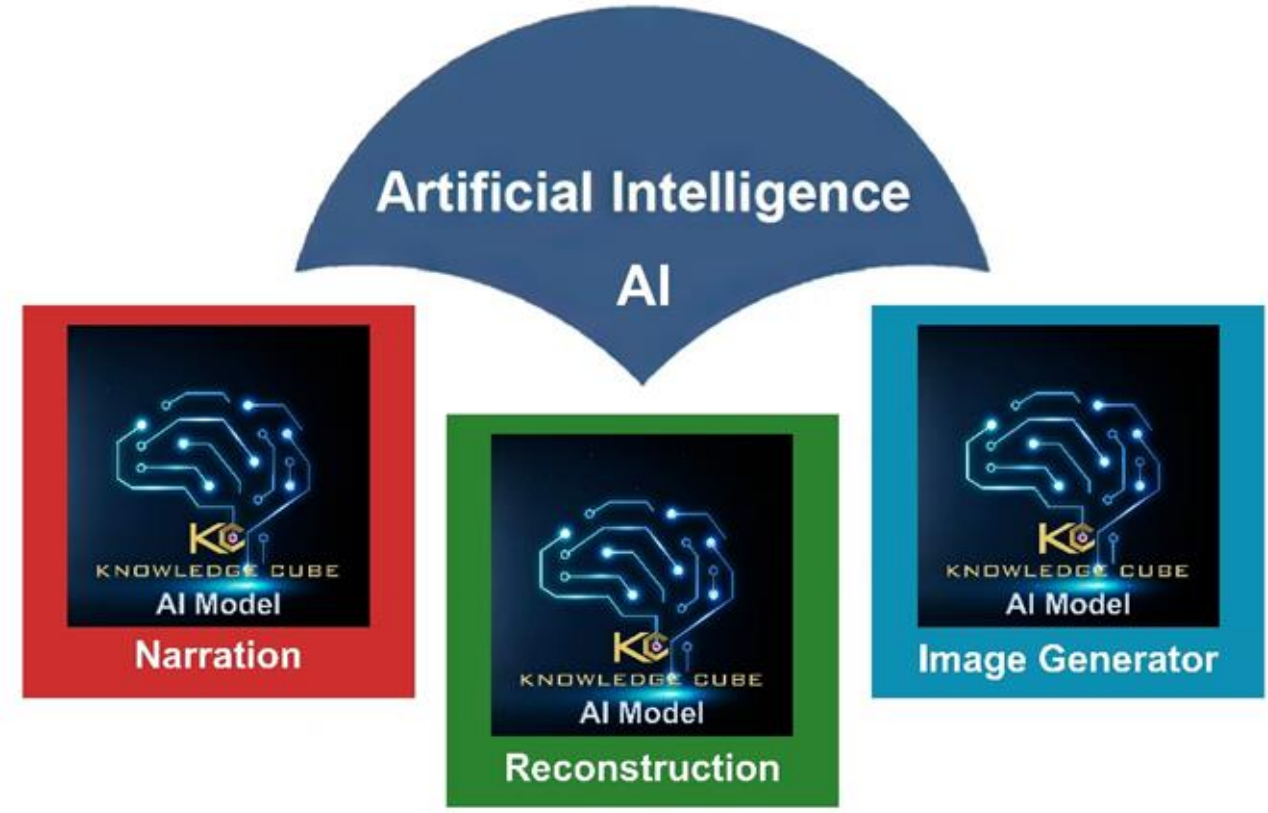
A new approach is presented that considers deployment scenarios by linking heritage science to tourism. Such an approach is necessary because neither technology nor society views can be treated separately to obtain deployable solutions of a wider social, and even national importance. Clearly, while the traditional approaches to cultural heritage preservation will remain a gold standard, they will be increasingly complemented by digital preservation techniques.

Blockchain can provide assurances about historical data and accuracy by establishing unalterable records. Although blockchain does have great potential, it is important to be realistic about its applications in the fight to save endangered historic places. The rhetoric of blockchain “saving” heritage obfuscates the truth—that blockchain is just the latest in a long series of technologies contributing to the documentation, conservation, and restoration of our world’s historic places. Digital representation of artifacts has served no other purpose than internal archives and the odd marketing endeavor. This notion is being challenged by the emergence of technology that captures and creates a digital twin of any artifact in stunning detail. High-fidelity images and photorealistic 3D models of objects present great potential for institutions looking to make cultural heritage accessible to the public. Blended with the providence of blockchain, museums can create original and otherwise impossible exhibitions.

2. KC and Artificial Intelligence AI

Cultural legacy presents itself in both tangible and intangible forms. All of them are related to the results of people's interactions, both with one another and with the environment in which they live. Cultural heritage values conflated the notions of tangible and intangible "heritage" with tangible and intangible "values" because all values are intangible concepts that are projected on tangible (and intangible) goods of a community, the concept of "tangible value" is an oxymoron.

These values can be classified into seven categories: "tangible and intangible values”; "historical and social values" ; "aesthetic and artistic values" ; "symbolic and spiritual values" ; "environmental and sustainable values" ; "economic and tourism values" ; or "community and identity values." Each of these included a descriptive sentence or two followed by a statement outlining what would be required to assess the corresponding value (e.g., "Evaluating these values requires an understanding of the historical context and societal dynamics that shape the heritage's significance"). An AI language model could be highly beneficial in the process of interpreting cultural heritage values.



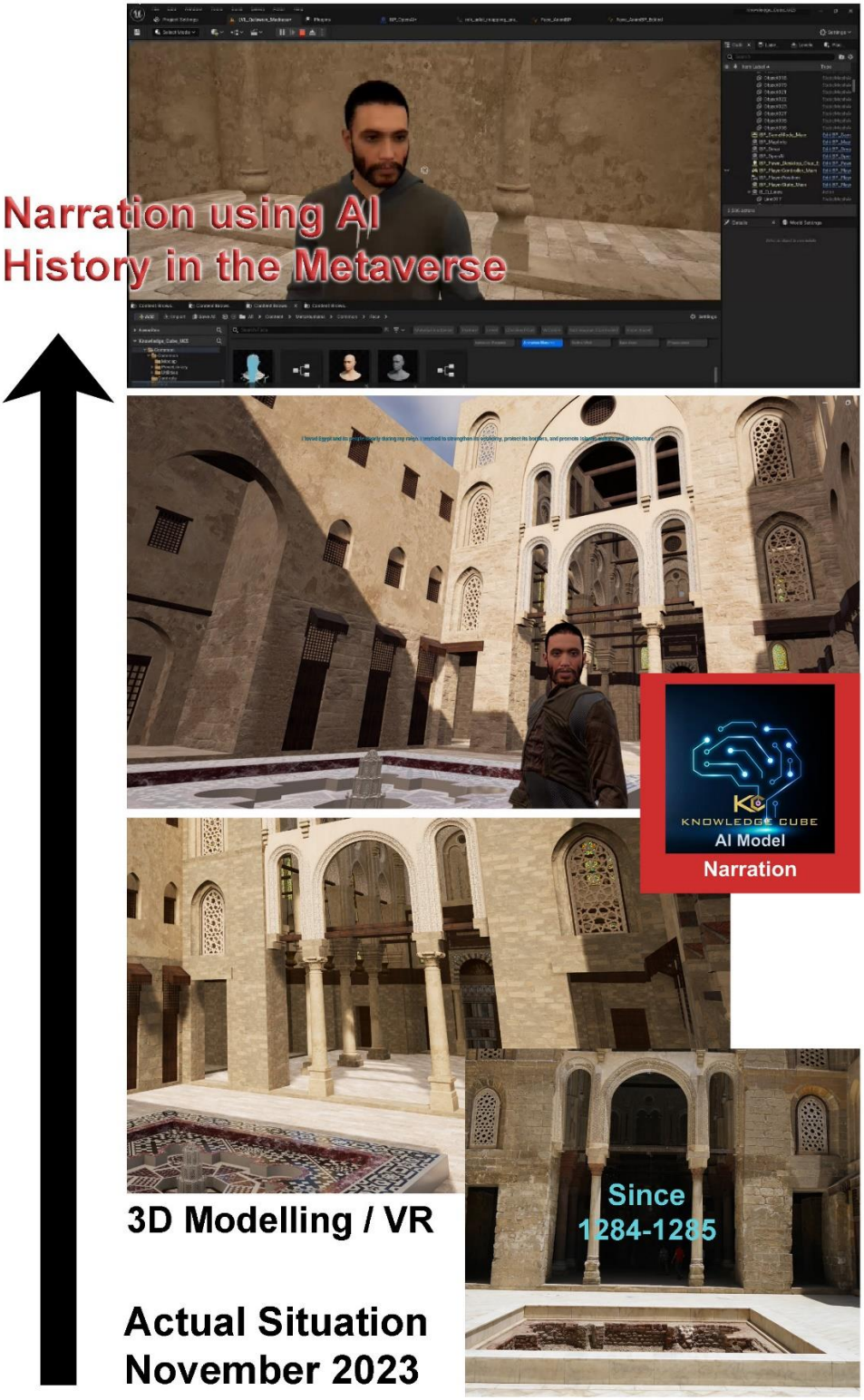
Generative AI language models in KC

2.1 AI in cultural heritage Story Telling – ***Narration***- *The Heritage Spokesman*

The Heritage Spokesman, an AI-powered assistant gadget that acts as an interactive exhibit guide, where historical figures and scholars answer visitors' queries about historical locations. AI-powered translation software can make historical documents, inscriptions, and other materials more accessible to those who speak other languages. AI could also be used to develop solutions that allow those with visual impairments to appreciate art and cultural sites through sound and touch.

The Heritage Spokesman

Sultan Qalawun in Egypt



https://www.youtube.com/watch?v=TiDp7YtFWBQ

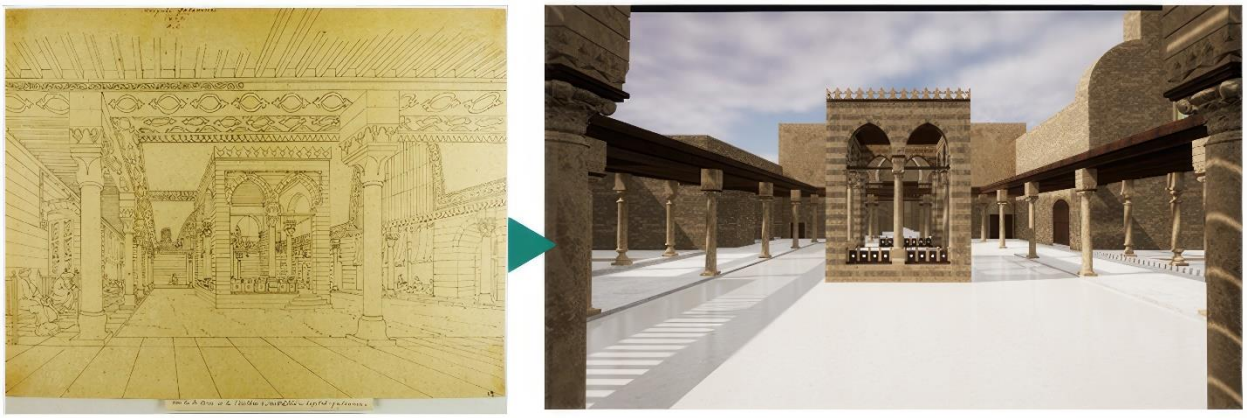
2.2 AI in cultural heritage reconstruction

The power of machine learning in uncovering lost details

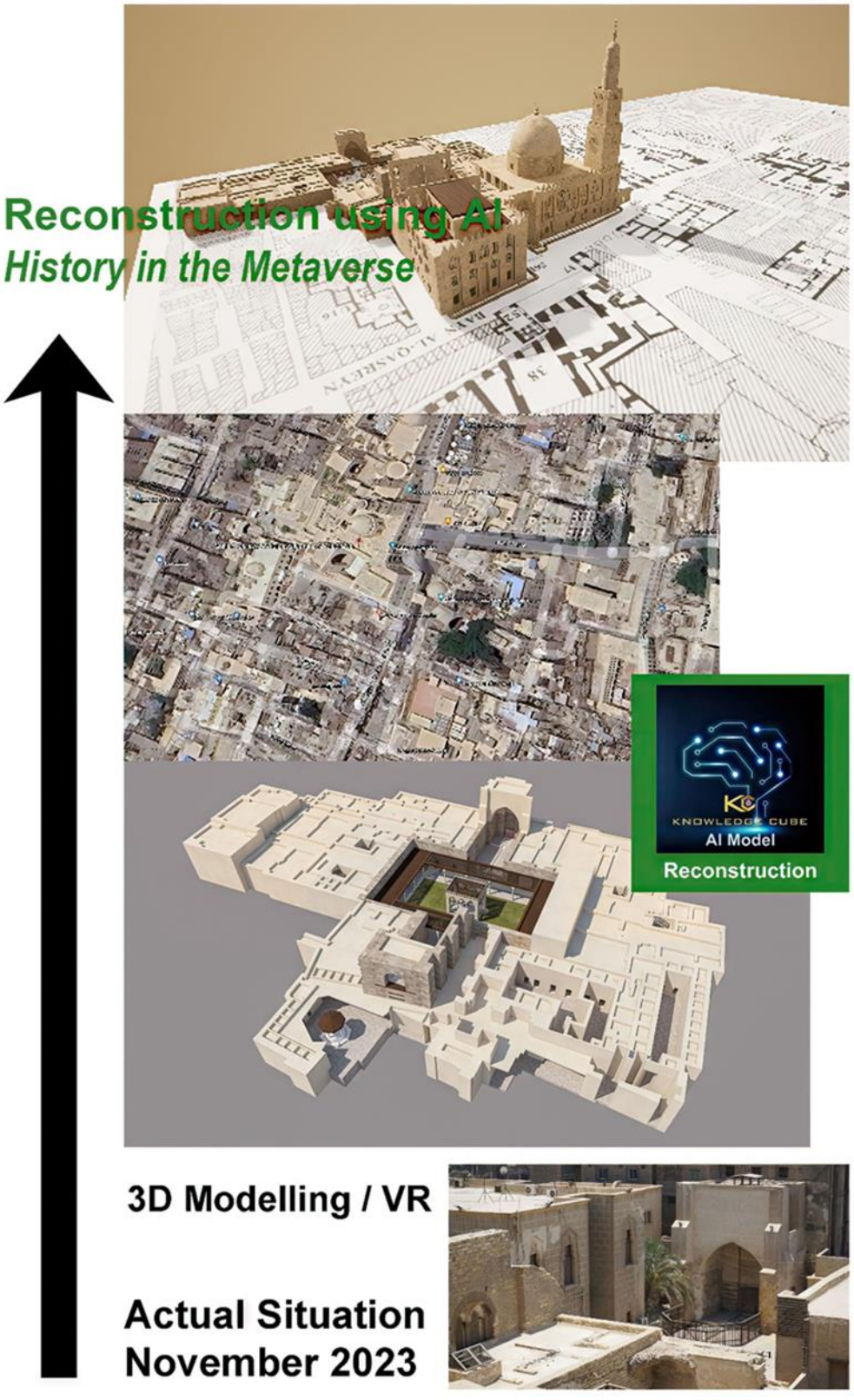
A subset of AI known as machine learning involves training algorithms on massive volumes of data to make predictions or judgments without being explicitly programmed. Machine Learning models can be trained on architectural styles, themes, and designs from specific times or civilizations in the context of historical preservation. These algorithms can accurately guess what the original structure would have looked like when presented with a ruined or partially destroyed landmark. The resulting digital reconstructions are not only speculative renderings but are based on considerable historical and architectural data.

With AI-powered 3D modeling and scanning technology, archaeologists and conservationists can create detailed, accurate digital replicas of artifacts and ancient ruins. This not only helps to preserve the original objects but also allows researchers and the public to explore and interact with them in new ways. By using machine learning algorithms, researchers can analyze large datasets of cultural artifacts and historical documents to uncover patterns and insights that might otherwise have gone unnoticed. This can help us gain a deeper understanding of our cultural heritage and promote cross-cultural exchange and understanding.

The Complex of Sultan Qalawun and Restoring the Demolished Hospital:



An antique sketch by Xavier Pascal Coste- ***(26 November 1787 - 8 February 1879),*** *a French architect- has been converted to a Virtual 4D Model for the historical Maristan (hospital) of Sultan Qalawun in Egypt.*



The historical Maristan (hospital) of Sultan Qalawun in Egypt.

2.3 AI as an Image Generator

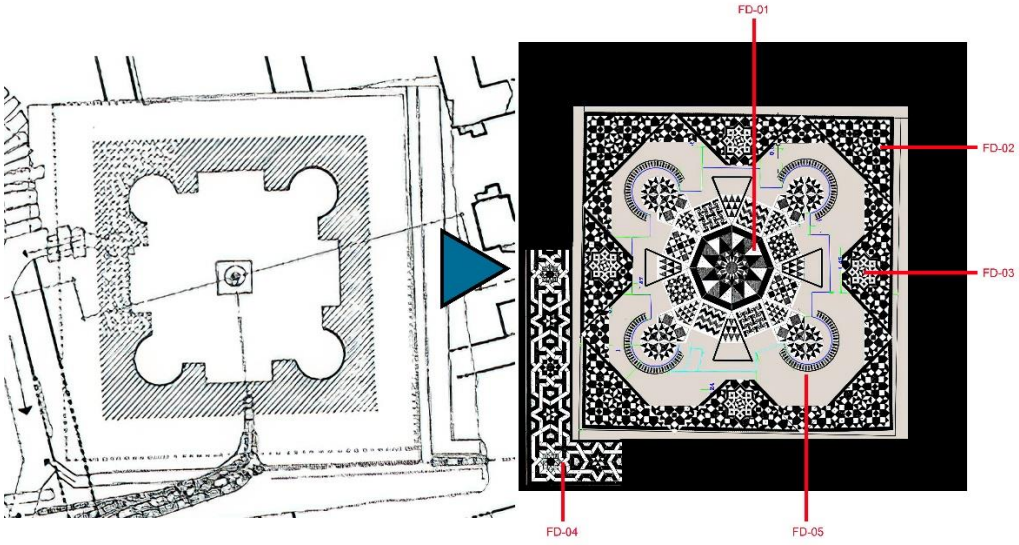
The term "AI image generator" refers to a sort of artificial intelligence technology that creates or generates new images by using patterns detected in existing data. Other technical terminology for this type of generator includes artificial intelligence-powered image creation tools. AI image generators offer various benefits to designers:

• **Increasing Creativity:** AI image generators can act as inspiration for designers, encouraging them to try out new ideas and approaches to their work.

• **Experimenting with Styles:** The opportunity to experiment with a wide range of artistic and aesthetic styles expands the creative possibilities available to design experts.

• **Idea Generation:** Designers can swiftly produce a wide range of design concepts and variations by examining unique ideas and viewpoints.

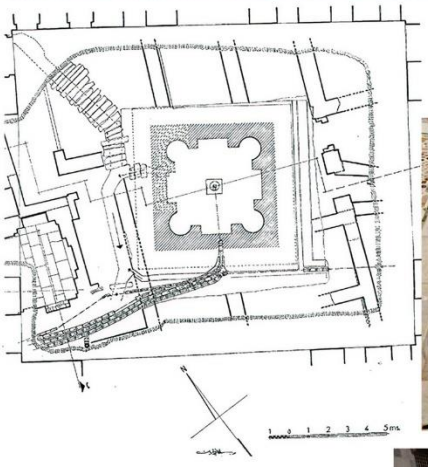
• **Time Efficiency:** By automating repetitive processes, AI generators can greatly speed up the design process, allowing designers to focus on more creative and strategic elements.

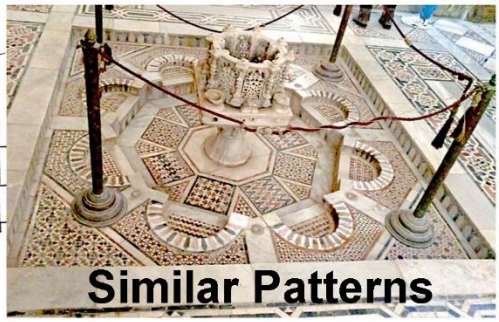


Using AI as an image generator linking collections and distinct types of pattern information.

Image Generation using AI
History in the Metaverse

3D Modelling / VR





Actual Situation
November 2023

3. KC and Metaverse "*Blockchain and AI Meet in the Metaverse"*

"*A metaverse is an online service giving access to shared and persistent simulations of real-time 3D spaces, in which we can live immersive experiences together*".

By enabling people to travel back in time and experience historical events, locations, and artifacts as they were in the past, the metaverse can act as an archive of human history. Several methods exist for us to experience history through the metaverse: emulating historical events, digital relics, and virtual recreations of historical locations. Feel as though you're going back in time thanks to the multisensory realism, responsive characters, and improved interactivity. Through engaging virtual worlds, the metaverse has arisen as a possible tool and medium to teach tourists, locals, and students about the rich past. Here are a few ways the metaverse allows us to experience history:

Reenacting historical events: See yourself standing by during the building of Granada's Alhambra or the conflicts between ancient civilizations. These memories can be vividly recreated online in three dimensions. Users can watch and engage with historical events through AI-driven simulations, developing a deeper comprehension of the background and importance of each occasion.

Virtual replication of historical sites: Throughout history, numerous historical sites have experienced damage because of conflict, natural calamities, or aging. The digital preservation of these sites is made possible by the metaverse, providing a solution. They used aerial photography, 360º mapping, and millions of images to recreate renowned panoramas to enhance the immersive experience. With the use of interactive hotspots, audio narration, and sound effects, users can virtually navigate the pathways.

Digital artifacts:

Priceless physical relics are often housed in museums and are not publicly accessible. These relics can be replicated in the metaverse, enabling users to study them closely and engage with them without causing harm to the original. This digital depiction of priceless antiquities democratizes access and offers individuals everywhere a learning tool.

Engaging with historical events:
Students can study historical events and have a firsthand look at them through the metaverse. By taking the roles of historical individuals and engaging with the surrounding environment, students can actively participate in historical events using avatars. For example, by immersing themselves in a virtual depiction of the historical Maristan (hospital) of Sultan Qalawun in Egypt, students could learn about its significance. With the help of this teaching approach, students would be able to develop greater empathy and understanding, making historical education a more interesting and intimate experience. By immersing students, locals, and visitors in captivating virtual landscapes, the metaverse has emerged as a possible tool and medium for educating people about the rich past.

Learning through virtual museums and exhibitions:
It is possible to establish virtual museums with historical documents, artwork, and objects on the 3D internet. Interactive exhibits are available at several museums, allowing visitors and students to visually engage, examine, and even enter historical items. has the ideal chance to use the metaverse to tell these stories in an immersive, dynamic, and captivating way because of its rich tapestry of history, culture, and civilizations. The following are some applications of 3D online storytelling for historical and cultural evolution.

Audio-guided virtual tours: Providing tourists with virtual tours of 3D locations within historical monuments or cultural venues can captivate them, especially when combined with educational materials and audio guides to help them better understand the narrative.

Interactive virtual scenarios: Users can participate actively in historical events rather than just view them through virtual encounters in digital spatial settings. Thanks to advances in metaverse experiences such as real-time animation via facial tracking, computer-generated pictures, and motion capture, avatars can fully immerse themselves in 3D virtual surroundings. Users would don virtual reality goggles to embark on an immersive trip. They might explore different areas of the route, experience a bit of their culture, view artifacts, and interact with virtual representations of historical figures. This metaverse experience would offer global accessibility and a singular chance for people to engage with other explorers, cultures, and historical events.

Storytelling through augmented reality (AR): Users using AR can create virtual visual overlays in real-world environments and transition with ease between the actual and virtual worlds. By providing users with access to augmented reality (AR) through a smartphone or head-mounted display, a museum may communicate the story of its historic sites or artifacts while also providing additional information and a deeper historical context.
The metaverse's spatial computing revolution, which is redefining human-computer interaction, is predominantly driven by artificial intelligence. Essentially, this means that virtual content interactions should seem just as natural as those with real-world objects. The future development of the Metaverse may depend significantly on AI (Artificial Intelligence). Similar to blockchain, 5G, and extended reality technologies, artificial intelligence is essential to building dynamic virtual worlds and scenarios that seem more real than before. A shared digital twin (the cyber and the physical) would guarantee an obvious connection between virtual and actual CH (Cultural Heritage). People could perform on the artefacts while working together, even if they were remote. These purposes could range from simple recreational activities to collaborative academic research in CH.

Effective metaverse design could provide affordable options for the preservation and safeguarding of cultural assets. Interactions between tourists and cultural heritage may improve user experience and create enduring interest. Stories from cultural heritages serve as a means of illustrating facts about history and values that change throughout time. giving the impression that people are living in a reality that is distinct from their own. With the help of interactive virtual and augmented reality tools, visitors can improve their experience once a cultural heritage metaverse is built. With the help of interactive virtual and augmented reality tools, visitors can improve their experience once a cultural heritage metaverse is built.

The creation of the metaverse can provide new opportunities for cultural heritage protection, site upkeep, heritage object conservation, monitoring, and other related activities, in addition to improving the visitor experience. It will support the transmission, upkeep, and promotion of traditional cultural legacies. Additionally helpful for research and growth in the fields of archaeology and museology is the culture heritage metaverse. Creating metaverse environments calls for enormous computer power and extraordinary expertise. For those that adopted Metaverse early on, the

release of new AI solutions has already ushered in a new period of development and innovation.

Blockchain technology for the metaverse makes it possible for users to travel freely between virtual worlds and take their belongings with them. Virtual reality technology is applied in the tourism and archeological fields to create virtual reconstructions that surpass the conventional 3D architectural model depiction. By creating these virtual worlds, this is accomplished. With this strategy, the user experience is expanded to new heights and gamification is practically instantaneous. In fact, a relatively new study subjunctivizes tourists' experiences at cultural heritage sites to address this component. A process of source collection, analysis, and creative replication of an imaginary (or extinct) entity results in a computer-supported, scientifically grounded 3D reconstruction model. The original digitally generated model should be considered the born-digital counterpart of the cultural legacy it imitates, and it is a unique source for research. Among other things, virtual reconstructions let us experience heritage that is sometimes unavailable or nonexistent. We are employing Metaverse as a virtual version of a data-driven, regenerated historical city in virtual restoration.

4. KC and Web3 *(Semantic web)*

Web3 aims to be fully decentralized, putting content creation in the hands of creators and not platform owners. Web3 consists of five components: semantic web, AI, 3D graphics and spatial web, Blockchain and cryptocurrency, ubiquitous connectivity (5G). Web 3.0 will place a strong emphasis on decentralized applications and probably make extensive use of blockchain-based technologies. It will also use machine learning and AI to empower a more intelligent and adaptive web.

KC will provide a decentralized architecture that eliminates data silos, demonopolizes platforms, and ensures data sovereignty for Cultural Heritage Institutions and citizens who participate. Web 3.0 is particularly crucial as the infrastructure for the projected metaverse, a 3D virtual world in which digital representations of people, known as avatars, communicate and perform activities. Whatever name you give it, the Semantic Web, Web 3.0, Linked Data Web, or Web of Data is the next big evolution in connecting and representing information. It allows data to be linked from one source to another and comprehended by computers, enabling them to conduct increasingly complex activities on our behalf.

Semantic web (Web3) technologies facilitate the structured and semantically enriched recording of cultural contents, enable their publication as linked open data, improve distributed information interoperability, and provide mechanisms for data reuse for new knowledge and value generation. In the case of KC, it incorporates both tangible and intangible components of creation in Islamic urbanization into a user-friendly immersive 3D user interface (VUIIC) for Islamic civilization. Users engage with the visible content while visualizing integrated information in an immersive environment that shifts human sensation from the level of seeking data to the level of vision—subjectively and objectively—in real-time operations. Users organize study and research operations on VR interaction and visualization, in particular developing, to build diverse exploitation experiences.

KC Workspace [**VUIIC**]: The working space had been designed within the solar system having a plateau (astrolabe) where users are virtually located and immersed by a cosmological working environment. It is a new display system interface with 4D overlay in which we can jump from one function to another directly in VR mood.

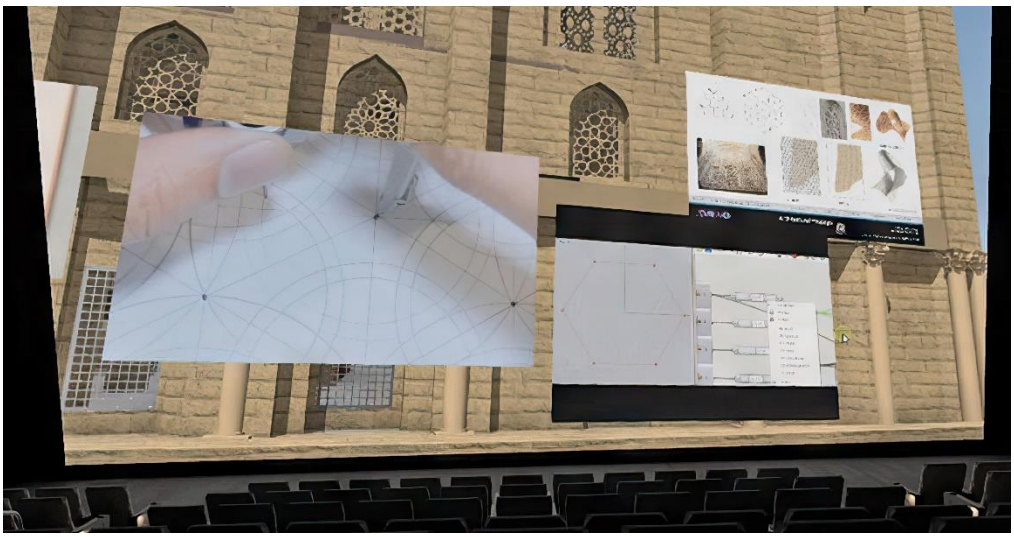
Objectives

- Preserving the memory of history, as each community, passing through its history and its collective memories, has the duty to conserve, identify, and properly manage its own heritage, which unfortunately is often susceptible to transformations due to time, anthropogenic factors, or damages. By telling the untold story of Islamic civilization in virtual reality, this history ***will never be lost***.
- Collecting and sharing information and events in a global dimension, considering the different approaches that scientific, humanistic, and artistic cultures have to the digital age.
- Managing to create a useful tool for overcoming the segregated divisions of this civilization to get it into one integrated entity.
- Interactively experience, select cultural objects, and observe their digital representations in the context of real artifacts with an extreme interest in visualizing and interacting with four-dimensional (4D) information in a VR environment.
- Connecting and integrating collections and various types of heritage information to aid in the long-term management of vulnerable heritage sites (GIS Data Support), as well as engaging local communities as active participants rather than passive audiences in the creation of historical narratives and exhibitions.
- Creating a methodological, coordinated, and integrated platform for digitization involving academies, research centres, and national and local institutions.
- Creating a useful tool for retrieving missing and demolished parts of historical urban structures and telling untold stories regarding their social, intellectual, and political backgrounds within an interactive and immersive experience.
- Creating more inclusive, sustainable, and meaningful methods of preserving and commenting on the past by effectively integrating research topics, heritage objectives, and emerging technologies.

Target Users / *Fields of Application*

1. VR Education / Research

- ❑ Knowledge Cube is equipped with tools that helps in educating specialists about artefacts and their history and develop 3D multimedia tools to record, reconstruct, encode, and visualize archaeological ruins in virtual reality. These tools could be applied to buildings, building parts, pottery, terrain geometry, textures, and texture materials.
- ❑ The designed virtual reality system in KC (Knowledge Cube) provides the users with advanced tools of knowledge and understanding. The navigation system in KC is based upon three-dimensional aperiodic spatial tiling which is an important contribution in the direction towards more topological relationships to achieve a coherent and historically meaningful comprehensive virtual experience.



Within the VR environment users can display educational movies to describe the process and theory behind selected elements. This feature is extremely useful for self-learning.

2. Heritage Preservation, Renovation, Conservation, Restoration and, Rehabilitation.

Architectural heritage is a carrier of history and culture, a medium for historical transmission, and a foundation for future development. Digital technologies can fight destruction and can ensure integrity by monitoring, managing, and protecting architectural heritage from disasters.

In 2003, the United Nations Educational, Scientific and Cultural Organization (UNESCO) issued the Charter on the Preservation of

Digital Heritage, which defines digital preservation as the process of using digital technologies to record, preserve and access the cultural and historical values of historic buildings and sites. Digital preservation involves methods of recording, analyzing, displaying, and disseminating information about architectural heritage in a comprehensive, accurate and efficient manner using digital technologies such as three-dimensional (3D) scanning, modeling, visualization and virtual reality (VR).

The preservation of architectural heritage is a crucial task that will help to carry on human civilization's history, serving as a vital bridge connecting the past, present, and future.

3. Cultural Heritage Tourism

- Individuals from diverse backgrounds shall be able to communicate through a visual language through a list of heritage sites that shall be virtually accessible.
- Knowledge Cube can serve as a ***Virtual Museum*** through its collection of digitally recorded images, sound files, text documents, three models, and other data of historical, scientific, or cultural interest that are accessed through electronic media. Though the concept of KC (Knowledge Cube) user shall take full advantage of the easy access, flexible structure, hyperlinking capacity, interactivity, and multimedia capabilities.
- Cultural heritage and tourism can be considered organic twins, since tourism is highly dependent on culture, current and past.

Within the VR environment you have access to knowledge of the know-how about your selected elements. This includes displaying documentaries and element's properties.

Virtual Musepedia of Islamic Civilization (VMIC)

VMIC is an underdevelopment application software to serve as a Virtual Musepedia of Islamic Civilization -VMIC- that brings together the experience of museums and encyclopedias in an integrated immersive virtual environment. With Musepedia, users visualize integrated information and interact simultaneously with the seen content in an immersive environment that moves human sensation from the level of seeking data to the level of vision - subjectively and objectively-in one real time operation. It is a complete virtual addressing for the development of Islamic Architecture and Civilization through its different dynasties and locations within interactive virtual reconstructions. Knowledge Cube forms a VR visualization and a VR content visualization and management system.

VMIC is an extended umbrella that covers all the various technologies that enhance our knowledge together with our senses, whether they're providing additional information about the actual world or creating totally unreal, simulated worlds for us to experience. Musepedia brings together the experience of museums and encyclopedias in an integrated immersive virtual environment.

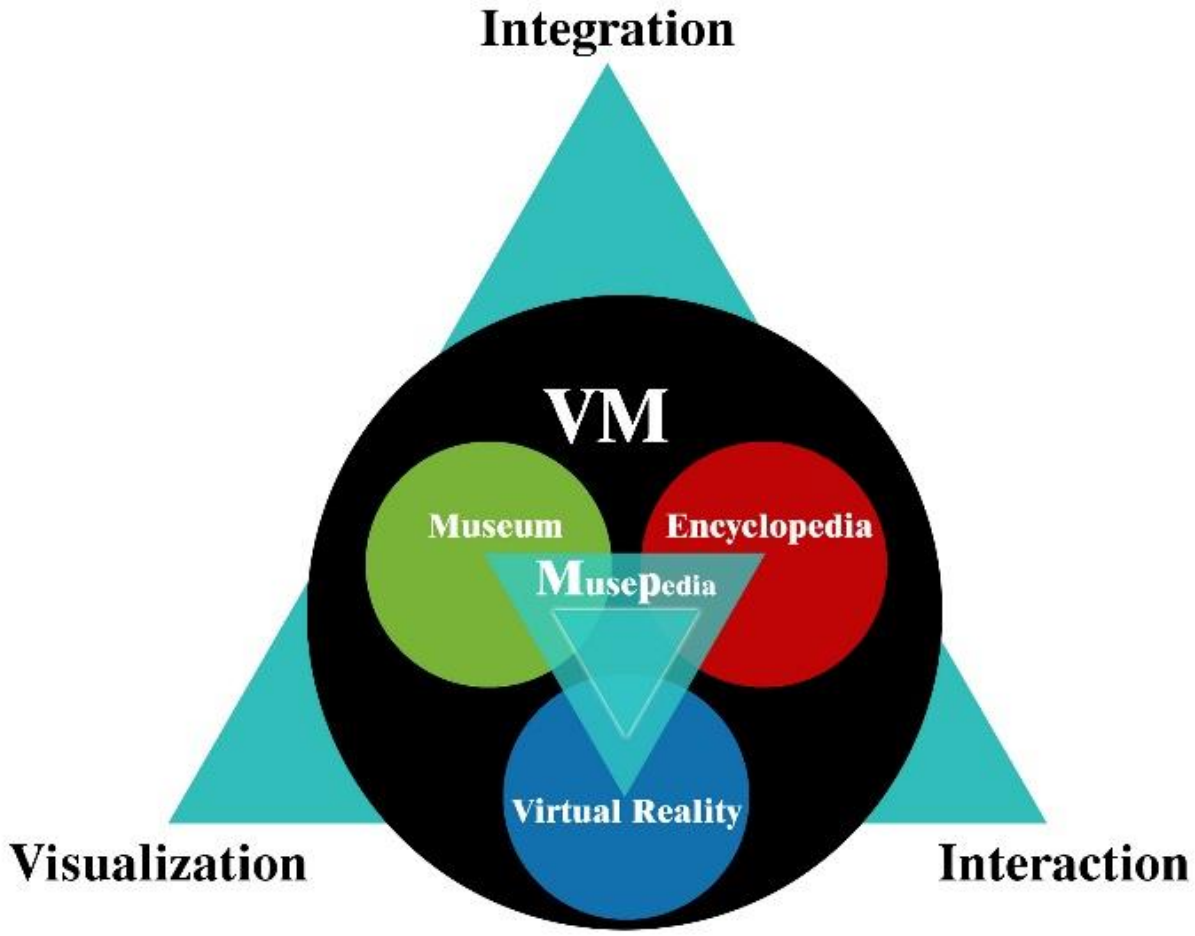
The triple-combination of Virtual Musepedia is managed to boost, accelerate, or create new horizons in knowledge discovery. For that structure of Musepedia is based on a developed model for an encyclopedia. With Musepedia, users visualize integrated information and interact simultaneously with the seen content in an immersive environment that moves human sensation from the level of seeking data to the level of vision - subjectively and objectively-in one real time operations (see Figure 1).

VMIC is putting together past, present and future in a virtual horizon in which viewers can enter, walk through, handle virtual objects, obtain information, discover knowledge and experience selected historical environments through ages of Islamic Civilization.

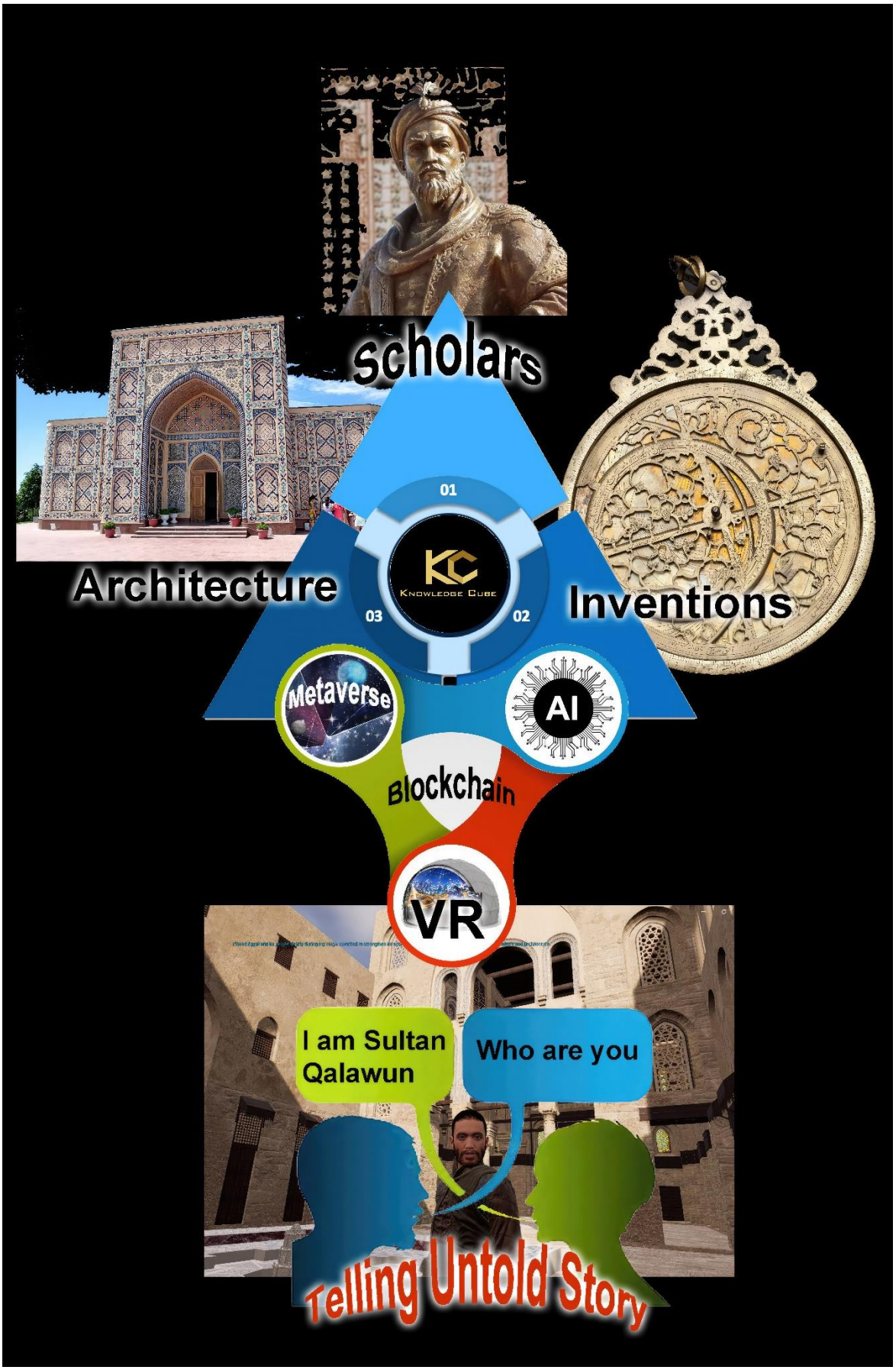
VMIC can link collections and distinct types of heritage information and contributions together to be integrated within a common virtual interactive environment and thereby involve local communities in the creation of historical narratives and exhibitions as an active participant rather than as a passive audience. The watchwords for the future of heritage are place, network, memory, identity, and communication.

The VMIC can provide the context and tools for these new approaches to cultural heritage not merely by recording, data processing and visualization, but by helping to shape the meaning and direction of the entire enterprise.

The novelty of the technologies employed is that they not only allow users to switch between different types of visualization environments but include and interact with multidimensional virtual realities. Additionally, several different interface techniques can be employed to make exploration of the VMIC through its User Interface (Virtual User Interface of Islamic Civilization-VUIIC) for seminars, presentations and online lectures containing visualization environments in the virtual world.



The triple-combination of Virtual Musepedia.


scholars
Architecture
Inventions
01
02
03
KC
Knowledge Cube
Metaverse
AI
Blockchain
VR
I am Sultan Qalawun
Who are you
Telling Untold Story

Visualization systems

KC could be displayed on a full range of immersive workspace solutions. These Include Media Players, Cubes, Cylinders, Domes and Many More.

Low immersive desktop environment

High immersive HMD VR environment

Interactive Archives & Emergent Narratives

Speculative, applied, and theoretical research focused on new modes of knowledge creation from digital cultural archives through immersive visualization and interactive narrative. Themes include visual analytics, computer vision, deep mapping, data-aesthetics and pan-aesthetics, audification, data and interaction design, networking, open linked data, crowd-sourcing and participatory media.

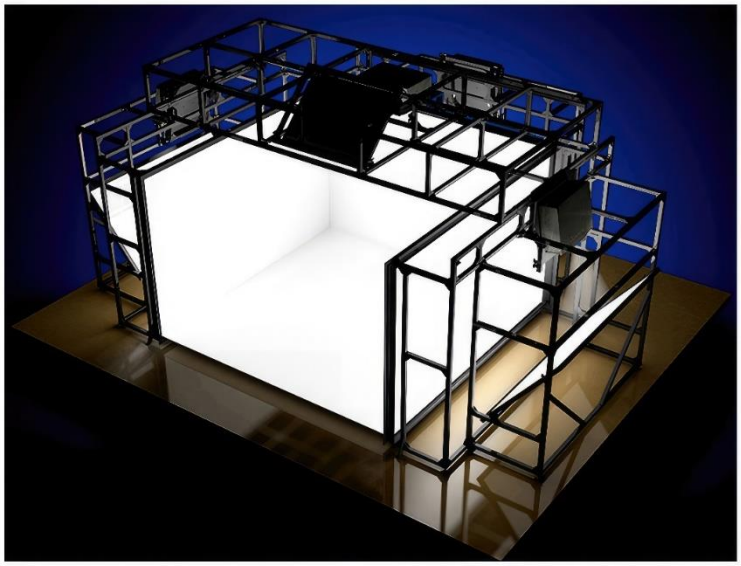
Immersive Visualization

Applied design frameworks for interactive omnidirectional and omni spatial data visualization for small and big data from the arts and sciences. Themes include VR, AR, MR, data sonification, networking (e.g., ‘internet of big machines’), gamification and advanced computer graphics. Image Science, Visual Computing & Data Curation

The application of new documentation technologies to objects, places and people, pioneering solutions for the acquisition of high resolution and high-fidelity data. This research theme includes data curation models (ontologies, LOD, annotation), data fusion, data science and image science.

360 Full dome projections

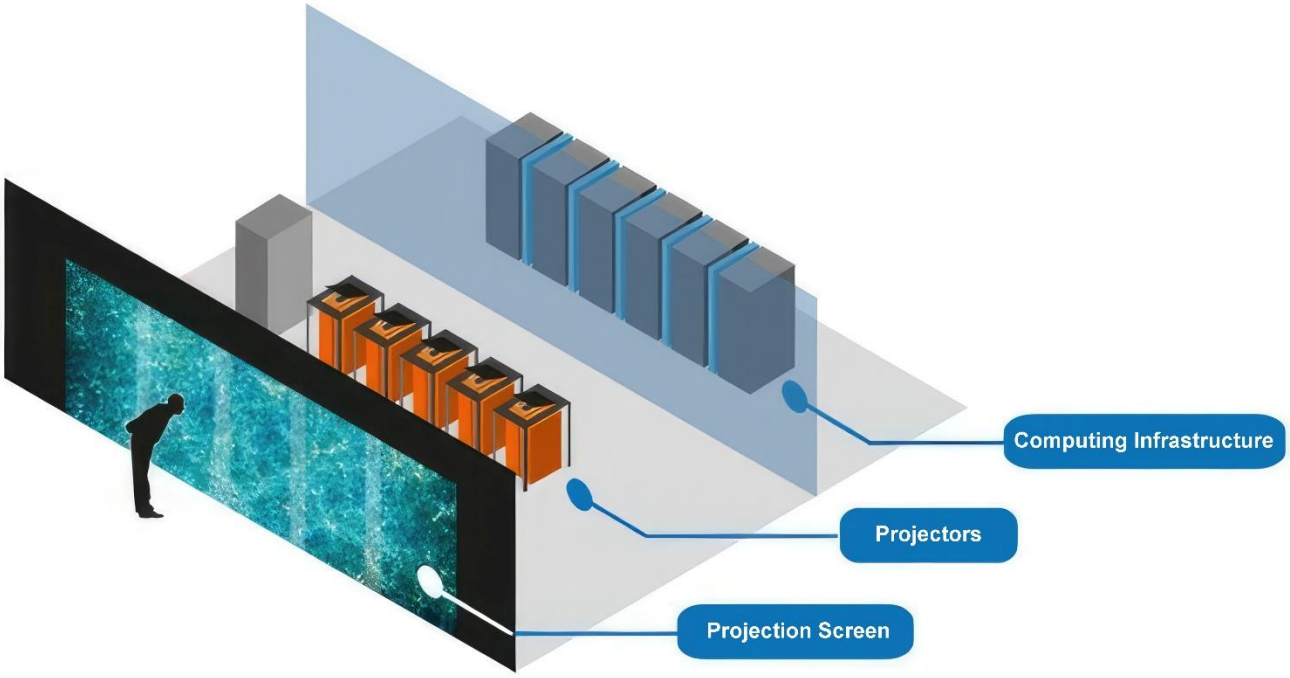
CAVE Immersive 3D Display



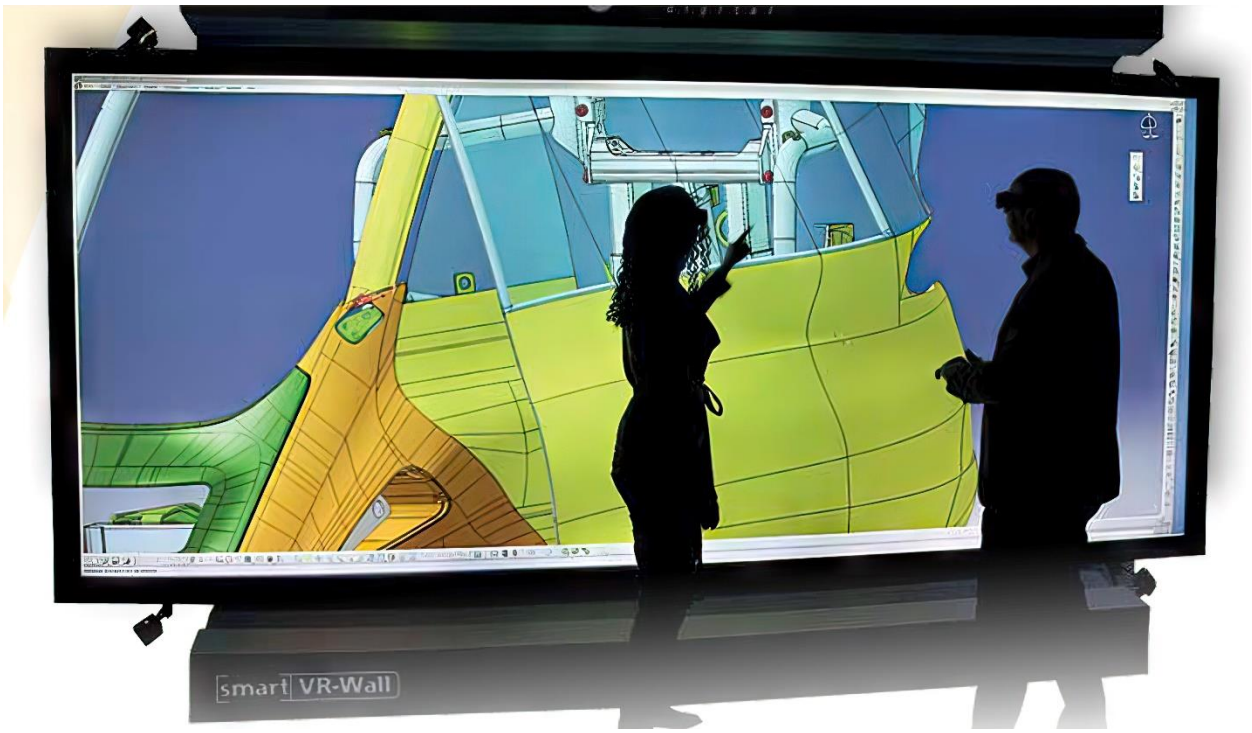
The panorama screen.

Powerwalls

Powerwalls allow to display both 2D and 3D images on the wall simultaneously, from many different sources.



LASER smart VR-Wall



Head-mounted displays

Why funding this project

1. Creating a knowledge-based information system for Islamic Civilization

The aim is to use virtual, augmented, and mixed reality technologies to push the boundaries of traditional information analysis functions and explore new areas such as deep mapping, immersive visualization, documentation, and knowledge creation.

Islamic architectural legacy will be provided in an application context through the establishment of a knowledge-based information system (KBIS) by KC. This method allows us to comprehend Islamic architecture and civilization within a thorough, integrated classification framework by defining and approaching knowledge acquired from an analytical comparative strategy.

2. Authenticity and Authentication of Cultural Heritage

If authenticity is a concept related to sincerity and honesty, it is relevant to heritage because it is through the past that we build a collective version both of society and of the individual self. If confidence in this construction is lost, there are consequences—a loss both of a sense of self and of the cultural and social environment which provides individual and shared stability and security. Authenticity is a component of the function of heritage which helps to build a sense of the collective nature of society and of the individual self. It is part of defining and recognizing concepts of identity and belonging. If society is building the present from the past, it is clearly of fundamental importance that this past, the material with which identity is constructed, is accepted as authentic. In an environment where the identifiers of a sense of personal or social authenticity are unclear, heritage may be thought to offer a context where authenticity is fixed and stable.

3. Creating Embodied Knowledge Systems.

Travelling in Time (metaverse), interacting with historical scholars and figures getting information directly from main sources within the actual built environment at that time.

In the Metaverse, people appear by scanning themselves in 3D or transforming them into avatar characters. Characters in the Metaverse are recognized as beings like clones in real life, not just game characters. In the Metaverse, besides their own avatars, they create things that can express their uniqueness. And to prove this, technology of the blockchain is used. Artists and creators are the key to a **massive exploitation of the metaverse**. We all witnessed the proliferation of virtual museums and exhibitions in the past two years. Next step is to bond the creative industry with biggest innovation players. The Metaverse could be the "*leverage to promote the development of sovereign technology solutions*".
The combination of blockchain and artificial intelligence can help enable trusted digital analysis and decision-making on vast amounts of data. And it can be used to create secure data sharing and make artificial intelligence explainable, as well as regulating trust between devices that cannot trust each other. Metaverse uses artificial intelligence and blockchain technology to create a digital virtual world where you can safely and freely engage in social and economic activities that transcend the limits of the real world, and the application of these latest technologies will be accelerated. Artificial intelligence and blockchain technology are expected to play an essential role in the ever-expanding world of the Metaverse.

4. Creating Immersive Pedagogy

Improving data and content visualization for teaching and research with Shared VR. Integrating immersive modes of learning into higher education is a fundamental strategy for next-generation learners. Interactive systems have been shown to facilitate reflection, interrogation, and interaction with hypothetical simulated worlds, enabling students to develop high-level skills in cognitive association, creative thinking, problem solving and innovation.

Research into the analysis of features based on the form and style of archetypes and products in 3D space. Creating archival, analytic, and

representational frameworks for intangible heritage and embodied knowledge systems (from ritual and tradition through to performance and sport). Themes include automated annotation, motion overtime analysis, computer vision and preservation protocols including metadata (sociocultural context).

5. Cultural heritage preservation

Decay caused by natural phenomena had gone behind in the hierarchy of factors affecting the deterioration of tangible cultural heritage. For these facts we need a comprehensive multiple documented knowledge structure for the history of Islamic architectural and cultural heritage, otherwise it will be impossible to either preserve or retrieve- respectively- the decayed or lost cultural heritage. We are facing a three-dimensional problem in this concern, first, a demolishing urban and architectural heritage, second, scattered cultural heritage, non-integrative cultural heritage. This project shall be retrieving missing and demolished parts of the historical urban structures, telling the untold story regarding their social, intellectual, and political backgrounds within an interactive and immersive experience. This implementation shall explore the capabilities of the KC, and address its benefits in heritage preservation, VR education. and cultural tourism.

6. Decentralizing Cultural Heritage

Blockchain is best described as a digital record-keeping technology that forms a decentralized network and is run by a set of protocols ensuring authenticity, as it is almost impossible to alter digital records inscribed in the blockchain. It holds a great potential to change and revolutionize many aspects of our daily lives. A new and advanced use of blockchain technology has already been implemented within the archival sector that deals with the issues of digital-born documents and the need to provide their security and authenticity. Artificial intelligence can provide customized services to individuals without violating personal information. Artificial intelligence can perform analysis on the user’s local device and not perform analysis that is not permitted in advance. Artificial intelligence can realize decentralization so that real individuals have control over personal information.

At what phase are we?

The following already achieved:

IP Intellectual Property Protection, POC: Proof of Concept, POV: Proof Of Value *and* Beta Version

https://www.youtube.com/watch?v=TiDp7YtFWBQ

ADVANCED VR APPLICATIONS PTE. LTD.

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Intellectual Property Rights
Software Patent

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KNOWLEDGE CUBE

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PT ID TM ©
" Today's Asset, Tomorrow's Value "

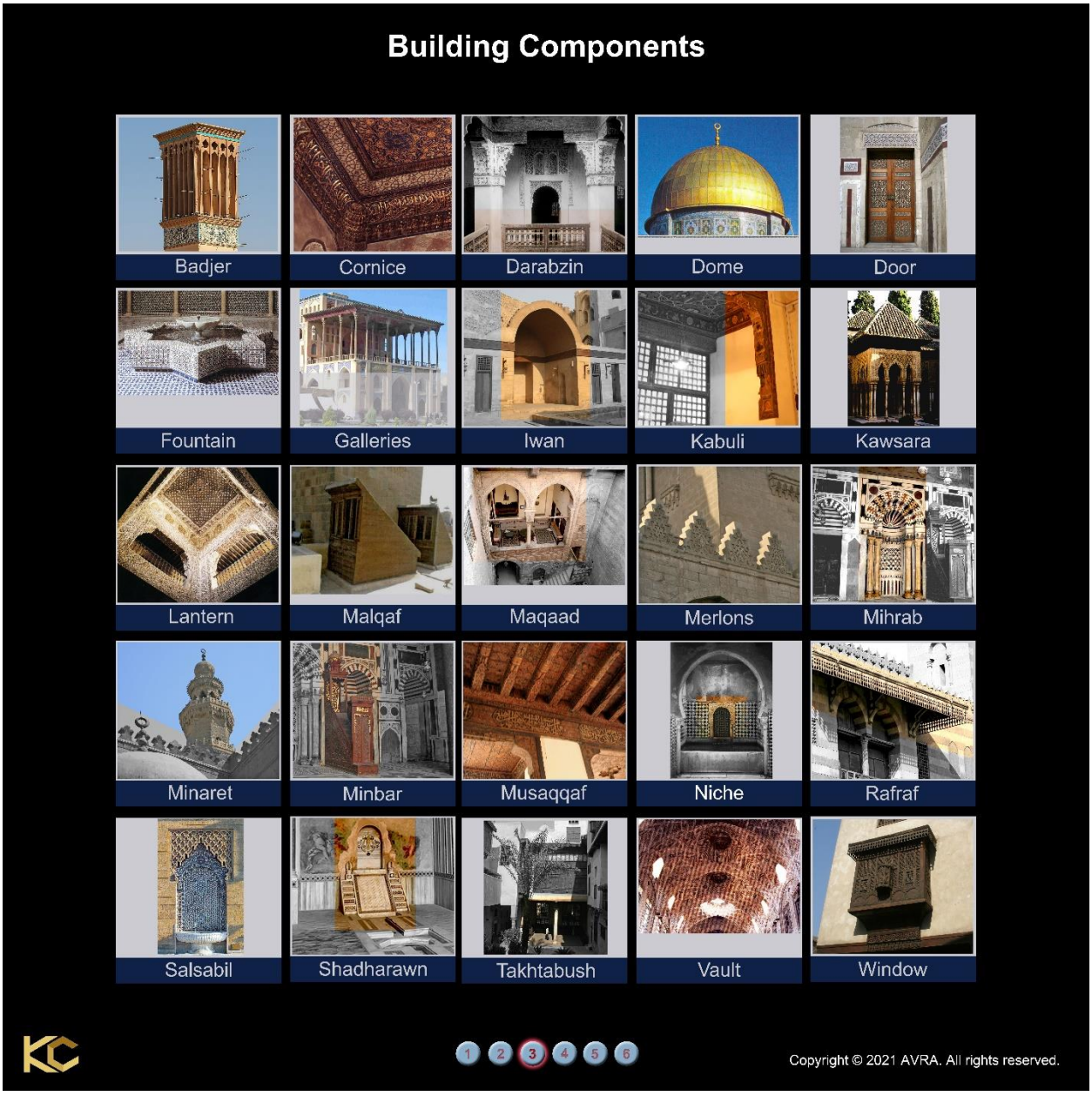
Singapore Patent App. No 10202201467Y – Malaysia Patent App. No. PI2023000757

Appendix

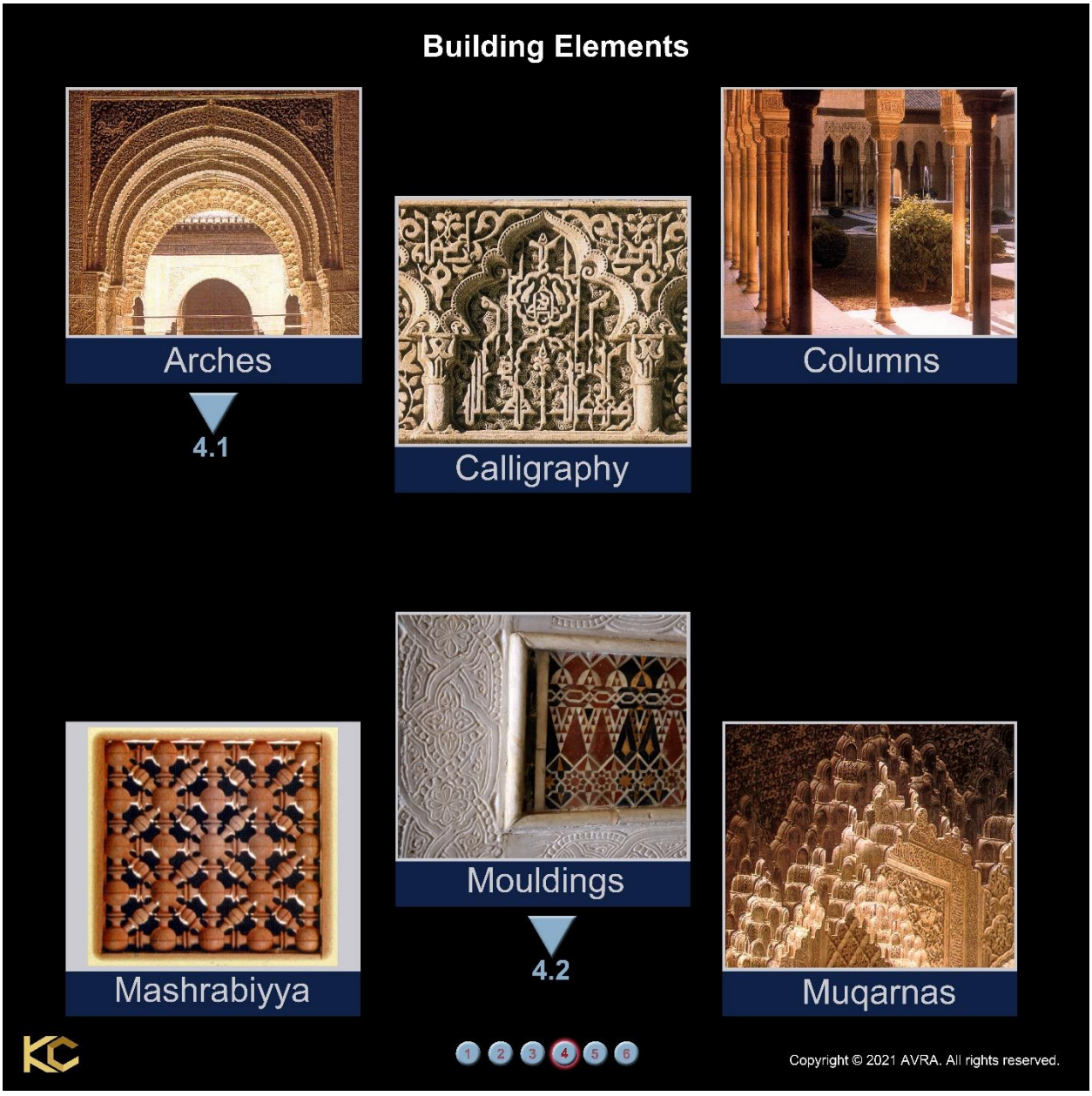
Knowledge Cube Contents

Locations / Dynasties

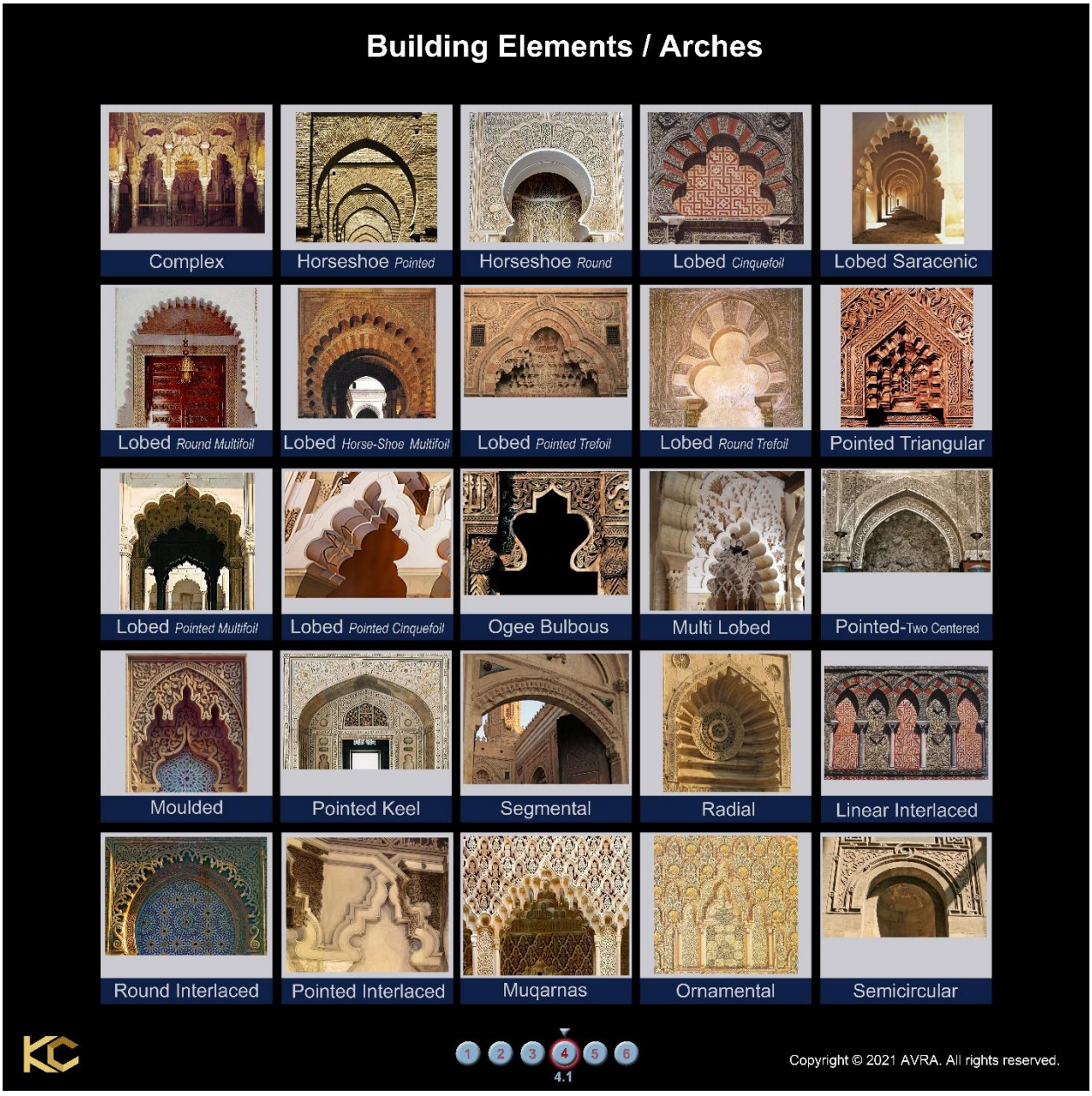
Building Types



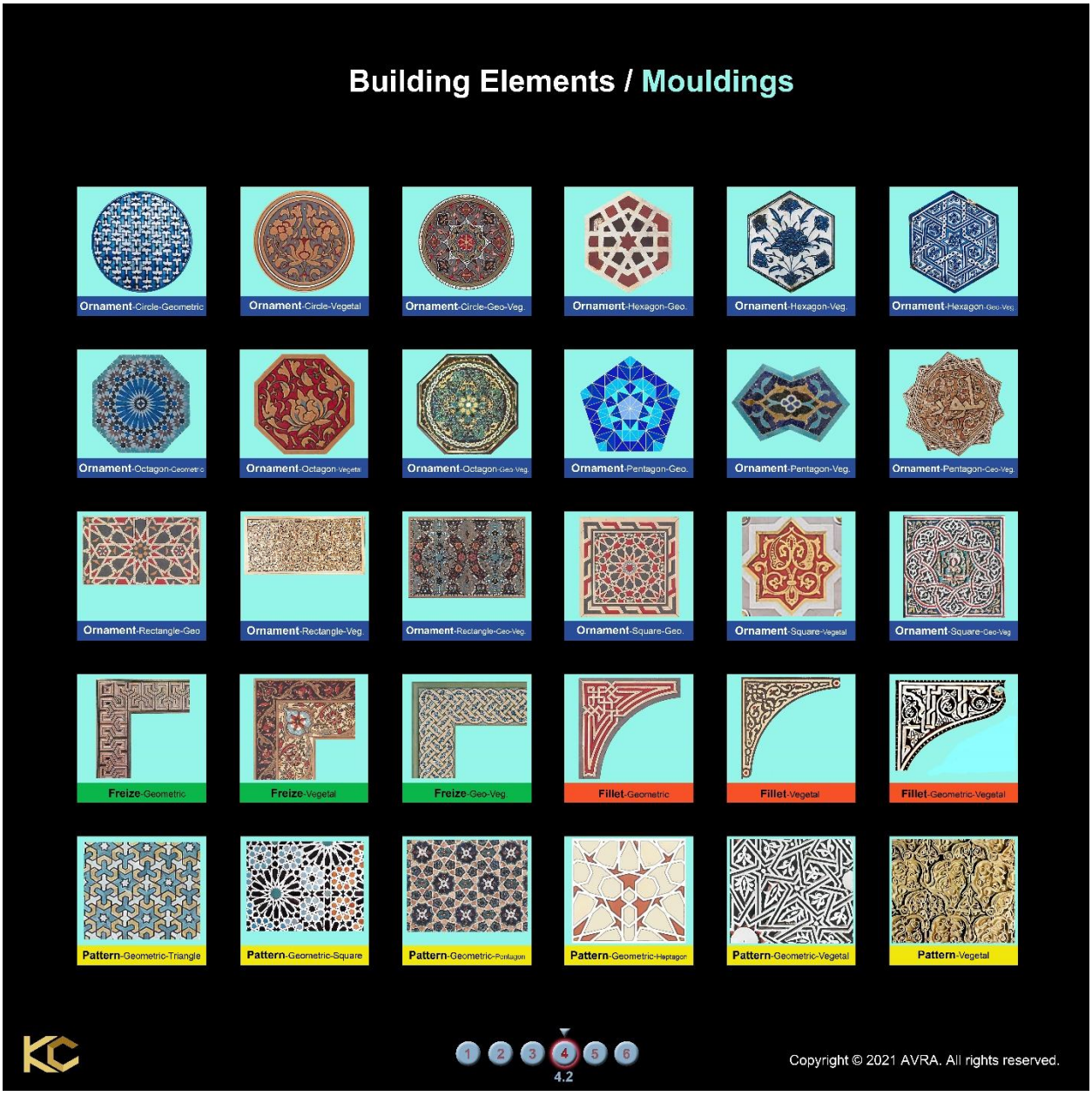
Building Components



Building Elements



Building Elements / Arches



Building Elements / Moldings


Products
Furniture
Pottery
Manuscript
Carpets
Accessories
Jewellery
Lighting
Fashion
Astrolabe
1 2 3 4 5 6
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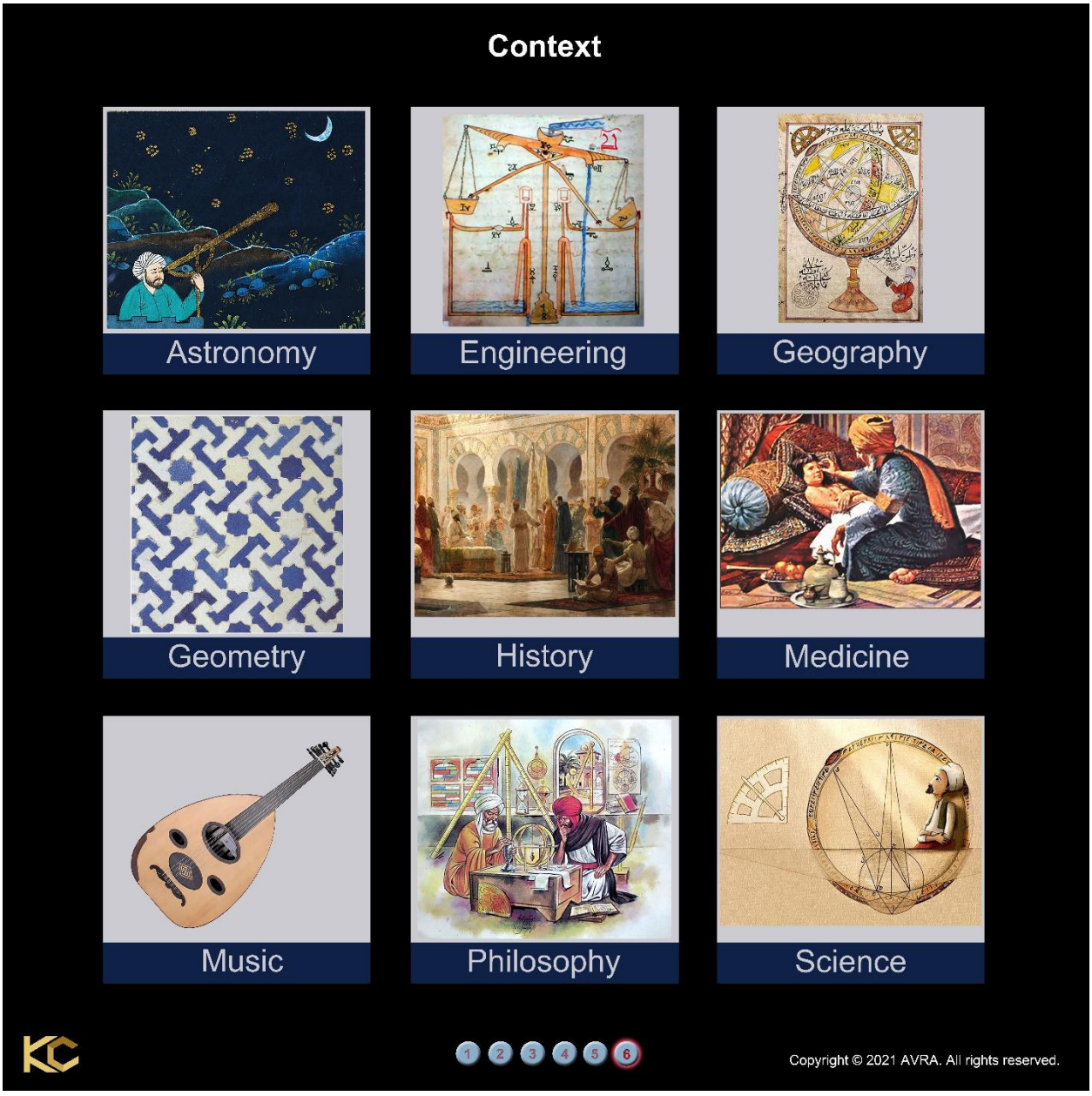
Products


Context
Astronomy
Engineering
Geography
Geometry
History
Medicine
Music
Philosophy
Science
1 2 3 4 5 6
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Context

Acknowledgement:

Great thanks to for our partner Mostafa Nabil Bakry for his great efforts and innovations in VR Development and Programming.

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Architectural Engineering Department, Faculty of Engineering
Al-Azhar University.

Founder and Director of AVRA Singapore
Advanced VR Applications PTE. LTD.

January 2024

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https://www.avraonline.com/wp-content/uploads/2024/08/KnowledgeCube_Teaser_2024.mp4

Knowledge Cube (KC) is powered by UE5 engine. Unreal Engine (UE) is a series of 3D computer graphics game engines developed by Epic Games.
© 2024, Epic Games, Inc. Available: https://www.unrealengine.com/en-US