

Indonesia's Mosque Architectural Heritage

Digital Documentation, Dissemination and Future VR Potential

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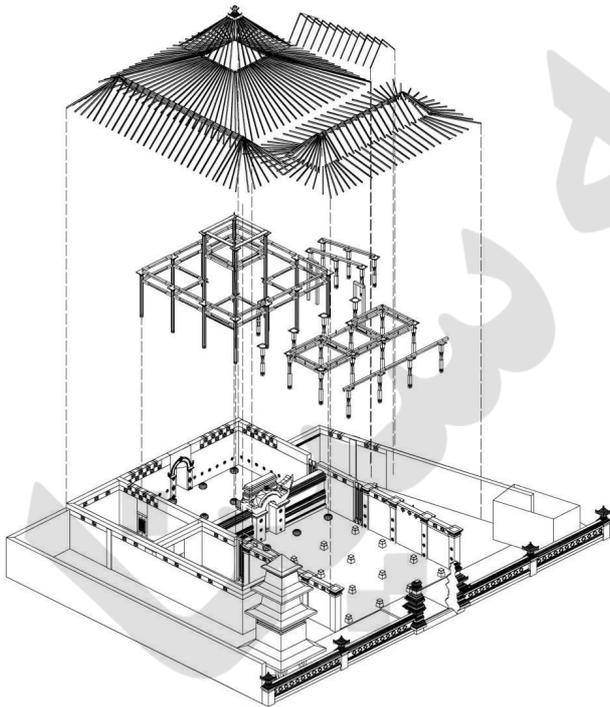


Fig 1: Cut-out model of 16th century Panjunan Mosque, Java.

ABSTRACT

The Project -- named **Masjid2000** (meaning Mosque2000) -- is an ongoing (1999 - to date) documentation and publication initiative to record the history, philosophy and technique of mosque building throughout the Indonesian Archipelago across more than six centuries, primarily intended for public education using easily-accessible digital interactive multimedia as the main dissemination platform. The result, now digitised in a CD (with a promotional website) is a searchable database of thousands of photographs, hundreds of drawings and text documents, as well as interactive animations from as many mosques.

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With mosques in Java thus far completed, and if further funding is available, this pioneering project will extend to mosques in other Indonesian island groups, other architectural forms and ethno-cultural heritage objects to promote greater inter-communal/regional understanding at a critical point in the country's recent history.

The project's recently established architectural network among tertiary educational institutions, it is hoped, will extend to cross-border collaboration on similar initiatives with like networks of architectural and heritage lovers in neighbouring Muslim communities initially, and worldwide eventually. We plan to adopt higher digital and internet technologies, such as 3D game engines and web3D collaborative communities, to develop our heritage database further and make heritage education more engaging and meaningful to an expanded audience.

Keywords: mosque architecture, Islamic architecture, Indonesia, digital multimedia, virtual walkthrough, 3D game engine, web3D, heritage tourism, public education, architectural network.

1. INTRODUCTION – MASJID2000

As the world's most populous Muslim country, mosques in Indonesia occupy a special position as the Muslim community's most important building no matter where they may be. Unfortunately, much of the information and research about mosque architecture are archived at various educational institutions and are not easily accessible to the public.

1.1 Digital Documentation

Masjid2000 is an ongoing architectural documentation project involving selected mosques from throughout the Indonesian Archipelago, begun since 1999 by a voluntary team of architecture students and teaching staff from the **Institut Teknologi Bandung (ITB)** and other Indonesian tertiary educational institutions. It involves meticulous on-site surveys, data collection and creation (photographs, pictures and architectural drawings) across the country's vast regional provinces. To-date the data collected includes thousands of photographs, hundreds of documents and pictures from as many mosques, and these will continue to accumulate.

In line with its primary public education objective, **Masjid2000** has published the results of this documentation exercise in various media formats, mainly digital (interactive CD-ROM series, and a bilingual website at www.masjid2000.org), as also conventional (books, posters and postcards too). Roving exhibitions staged publicly at strategic cultural and educational sites in five major

Indonesian cities also popularised its architectural education message in a focused way to its target audience.

In future, this documentation (and digital multimedia publishing) project is hoped will extend its scope to cover various other aspects of Indonesia's many ethnic cultures. This too will help bridge the wide information divide between Java and the other Indonesian islands by pioneering the creation of virtual communication networks among the Indonesian architectural community.

1.2 CD-ROM Dissemination

The CD has been *Masjid2000*'s chosen media format mainly because of financial considerations. Traditional media, such as books, necessitate high initial funding. Besides, a CD can store large amounts of graphical and other data which are presentable in a manner not replicable by traditional media: for example, animation. A book illustrated with 1,200 photographs, and a massive pictorial quantity equivalent to *Masjid2000*'s CD-contents would have clearly cost beyond a student's affordability, as also a large portion of Indonesian society's.

The biggest challenge lies in the sieving through of a warehouseful of data. To present the data in multiple formats – text, photographs, video, pictures, as well as 3D models – and at the same time in an informative and appealing manner to a mainly non-architectural audience (the publication's primary target market) is not a simple task. Other than the quantitative and product pricing aspects, basically, the choice of interactive media SHOULD be able to present these two advantages:

- **A data structure which is clear and accessible in a variety of ways.** This means that the mosque data collected should be accessible by chronology (when built), location, and keyword, other than the mosque's alphabetically arranged name.
- **Level of detail to suit the user's needs.** A novice user would merely need to access the overview information in the CD's introductory section without risking his overall comprehension, while a more advanced user can access the more detailed sections.

To fit them into the CD, the above data still requires to be sorted, digitised, and attractively presented. Almost two years (September 1999 – March 2001) were required to complete the first Volume (Mosques in Java) in this CD series, with a team comprising a total of 25 undergraduates and 2 teaching staff working in alternate rotation.

2. MULTIMEDIA PRESENTATION

A sample demo accompanying this paper can be downloaded from this URL: <http://www.masjid2000.org/demo/download.htm>. It exhibits the main features of the digital multimedia presentation available in the actual CD-ROM, as well as a sample realtime-3D model of a mosque, more fully explained in "Section 3.1 -- VR technical Upgrade" below.

2.1 Information Content Overview

The CD is filled with exhaustive descriptions of more than 180 mosques; each mosque's description is packed with information about its historical background and physical development. It contains data amounting to more than 1,200 photographs,

hundreds of plan/elevation/cross-section drawings detailing its construction system, hundreds of pages of textual information, 15 computer-rendered structural models, 15 articles from specialist architectural writers, as well as 15 two-minute video footages and walkthrough animation.

The user can find interesting articles in the reference section surveying various aspects of mosques in the Indonesian Archipelago. He may also study interactively the structure of several unique mosques, or detailed expositions of various functional features commonly found in the mosque, complete with numerous photographs: *mimbar* (pulpit), *mihrab* (prayer-leader's central niche), minaret, *pendopo* (front hall), *pawestren* (ladies' corner), and others.

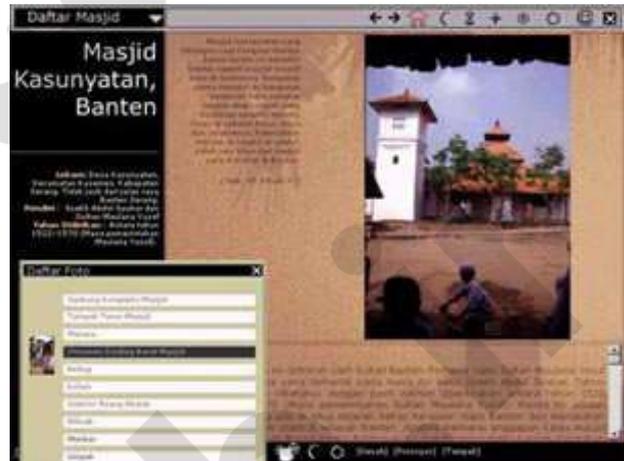


Fig 2: Sample screenshot – typical detailed data about historic Kasunyatan Mosque in Banten, Java.

Detailed information about individual mosques included in the CD can be searched based on construction date, location, or keyword. Mosque-related terms are explained in the glossary. Each mosque is illustrated with an average of 20 photographs of the exterior, interior, sections/parts and important details -- every single photo is accompanied with a detailed commentary.

All told, it is a substantive user-friendly architectural and historical database of a representative sampling of Java's mosques (and the other Indonesian islands subsequently) which any level of user can interactively access according to his scope of research and information needs.

2.2 Interactive Features

Highlights of interactive features in this CD are as follows:

2.2.1 Virtual Walkthrough

A number of important mosques had, at one time or another, undergone a total reconstruction. To help the user visualise a mosque's physical condition at a particular time, we have prepared a Virtual Tour feature, in the form of a computer simulated 'walkthrough animation'; the user may click his way along particular pre-set paths to explore various parts of the mosque. With this computer simulation capability, the user will be able to explore particular corners of the building not possibly traversable by the ordinary visitor or researcher -- e.g. ascending the minarets of Banten and Kudus Mosques, orbiting over Salman Mosque to

examine its original roof-form, or exploring Bondan Mosque on a mist-shrouded morning.

2.2.2 Structural Analysis

Mosque construction techniques are analysed section by section. To witness the development of construction techniques applied by mosques at a particular historical period, in a particular area, we provide a Structural Analysis feature using interactive graphics that will help the user understand the structural relationships which are usually difficult to be illustrated with ordinary orthogonal drawings (plan, elevation and cross-section). The accompanying substantive description will enable the user to understand not only the construction technique used, but also the symbolic meanings attributed to each part.

2.2.3 Architectural Elements

All mosques share similarities with regard to the main architectural elements, e.g. they equally have the *mihrab* (prayer-leader's central niche), *mimbar* (pulpit), *beduk* (leatherised wooden drum), and others. Each such element is scrutinised in detail (text averaging 1-3 folio pages), ranging from its history to the development of its design-form. The text is also supported by a collection of similar thematic photographs, so that the user may be able to view the numerous variations to each element.

2.2.4 Quick Search

This will facilitate easy searching of the user desired mosque, from an estimated list of 400 mosques in this CD series. Arranged by alphabet within each geographic region, this will help those who already know the mosque's name, to quickly retrieve its detailed data.



Fig 3: Sample screenshot – animated history of the 14th century Hindu Majapahit Kingdom and its transition to Islamic Java.

2.2.5 Animated History

This offers a simple way to learn about the history of Islam's spread in the Indonesian Archipelago and its relationship to the evolution of regional kingdoms there. Much as in a 'game', significant events from the 14th to 20th centuries are presented in animated form. The user will discover for example, where Islam was first introduced in Java, the relationship between Islam and Majapahit (Java's last great 14th century Hindu Kingdom), Sultan

Agung's (17th century Mataram Sultan who almost unified Java) strategy in attacking Batavia (Dutch colonial capital, now Jakarta), as also the unfolding of Fatahillah's similar attempt.

2.2.6 Timeline

On a comprehensive Timeline map, each mosque is sequenced according to its construction date and location. Each thumbnail picture size signifies the corresponding mosque's status: the bigger its picture, the more important is the mosque. For more detail, a click on the picture will immediately bring the user to the Photos Section which describes in detail its history, background, and physical condition, complete with photographs, plan/elevation/cross-section, as well as videos. Besides displaying the mosques' built dates, this Timeline is also complemented with various important historic events occurring in the Indonesian Archipelago. Consequently, the user can understand the background and relationship between some historic mosques and significant events transpiring then.

Other non-interactive features are:

2.2.7 Further Reference

To assist readers in further research, we provide a reference and further-reading list.

2.2.8 Glossary

This consists of architectural terminology used frequently in this CD, arranged in alphabetic order.

2.3 Technical Data

- Operating System: Windows 95/98/NT 4.0/2000/XP. Flash player and Cinepac Codec plug-in required for animation.
- Screen Size: 800x600. Recommended Display resolution: 1024x768 pixel at high-colour. No AGP card required.
- Total Data Size: 702 MB, including video and animation footages
- Software used: Macromedia Director for final programming and authoring, 3Dstudio MAX for animation and rendering, AutoDesk's AutoCAD for modelling, Adobe Premier for footage editing, Adobe Photoshop for image editing.

3. FUTURE DEVELOPMENT

3.1 VR Technical Upgrade

3.1.1 Realtime 3D Game Engine

The use of a VR technique in presenting the mosque architecture of any particular century is indeed the most attractive feature of this CD. This very moderate technique – the pre-rendered walkthrough – was chosen to enable its use across almost all Windows-based computers, without requiring any plug-ins whatsoever. Unfortunately this technique allows only restricted perspectives (albeit in very great detail) along a fixed camera-path through the mosque building/complex.

In the near future, a 3D game engine will be used (as in games like Quake, Doom, Unreal Tournament, Half-Life and others) to create real-time architectural 3D walkthroughs. The user is then

free to choose the walkthrough's camera-path without any restriction, manipulate particular objects such as doors and windows, in fact, even having a virtual personal guide to show him around (see the sample demo referred to in "Section 2 – Multimedia Presentation" above). This is an engaging tool for architectural and heritage education, particularly in attracting younger audiences to connect with historical mosques and other buildings, monuments, landmarks and tourist attractions which abound in Indonesia's extensive and varied cultural landscape.

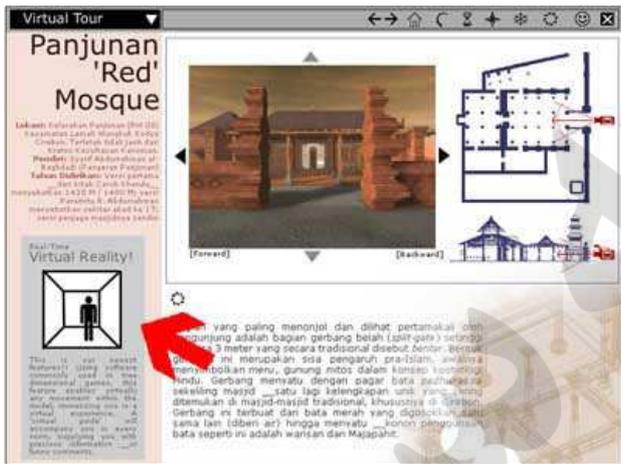


Fig 4: From fixed-path walkthrough to realtime-3D

3.1.2 Sample Model – Panjunan Mosque

In the sample demo, we present a simple realtime 3D model of the historic Panjunan Mosque, located in the north-coast Javanese city of Cirebon. Now still in use only for special occasions to ensure it's sustainability (the two annual Muslim commemorative days of the 'Id), it was first built in the turbulent early 16th Century during the pre-colonial period of the burgeoning seafaring Muslim Port Sultanates dotting Java's Northern Coasts in which Chinese-Muslim trading and religious communities had exercised great influence then.

Contributed by our cross-border collaborators from **Singapore**, **Immersphera**, a private initiative set up by a group of concerned professionals wishing to promote greater local public awareness and appreciation of the Muslim world's mosque architectural heritage, this graphical medium of the future will also be incorporated into **Masjid2000's** future productions (if there is sufficient funding) to enhance user interactivity in its public architectural visualization, presentation and educational programmes, particularly to the younger generation who have already come to expect such features as standard fare in the entertainment sector. Thus, for example, structural elements and analysis of notable buildings and monuments can be made more graphically instructive, immersively interactive and educationally compelling.

Prior to this, in late 2001, using a locally-developed 3rd party game engine, **Immersphera** had pioneered a similar realtime 3D model of Singapore's architectural-award-winning **Darul Aman Mosque** (Singapore Institute of Architects Award, 1987, and a semi-finalist in the Aga Khan Award for Architecture, 1989). The Mosque is built in the traditional Malay architectural vocabulary akin to Indonesia's historic Grand Mosques of Demak and

Banten. Coupled with a comprehensive mock-up website additionally featuring, among other educational material, a related historical recollection of the great pre-colonial Muslim Port Sultanates of the Spice Trade Era (eg Banten, Demak, Aceh and Makasar), the model formed part of a pioneering project proposal presented to the Singapore Muslim Religious Council (MUIS) to develop, using interactive digital multimedia, an architectural and historical appreciation of ten of Singapore's

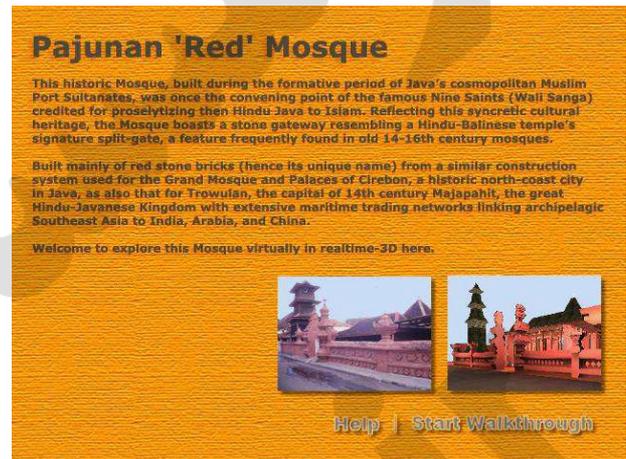


Fig 5: Realtime-3D walkthrough -- Introductory page

most significant mosques, five of which have been officially designated as among the country's National Monuments. While MUIS would be willing to assist in providing resources and information, funding had to be sought elsewhere from other sources.

With realtime 3D character animation included into such educational products at a later stage, the Panjunan Mosque's history can be more immersively relayed to make heritage learning and socialisation no longer a staid experience, as is commonly perceived.

Masjid2000's existing architectural database (as also other similar archival databases generally) will then have another new and compelling medium of public dissemination to reach out to the next generation especially.

In addition, it can be used as a medium to encourage more youth to acquire new IT skills and expertise as they learn to interact with and even design the digital models and virtual environments of particular heritage sites just as if they are creating their own game-levels and character animations, something they are already quite adept at, as amateur programmers and hobbyist game-designers.

3.2 Mosques in Indonesia and Worldwide

3.2.1 Indonesian Mosques

For the short term, we plan to publish the follow-up 3-volume CD series which will feature mosques from other Indonesia islands. At this moment, we are actively compiling the initial data – besides, of course, seeking more funding. About 300 mosques will be included, containing a total of almost 6,000 photographs, 60 animations, 60 video footages, as well as hundreds of document-pages. This undertaking is projected to be completed in the year 2004, in 3 phases:

Phase 1: Sumatra

Phase 2: Kalimantan (Borneo) dan Sulawesi (Celebes)

Phase 3: Bali, Maluku (the Moluccas), and Nusa Tenggara.

3.2.2 Cross-border Collaboration Worldwide

In the long run, this project can expand to include collaborative efforts with like-minded architectural enthusiasts across the other Muslim communities in Southeast Asia initially (for example, Malaysia, where a very similar architectural documentation programme is already underway for some time now, and the **Islamic Arts Museum Malaysia**, where physical scale-models of about a dozen of the world's most significant mosques are already on display), and later to other parts of the wider Muslim world (eg China, Central Asia, the Middle East, Turkey, and the Muslim immigrant diaspora in Europe and the Americas).

Such a vision may, for example, be crystallised in the idea of a **Muslim Architectural Heritage Virtual Park** where virtual 3D models of significant historical and cultural landmarks from all across the Muslim world are clustered together for a virtual heritage tourism experience, much as a similar real-life visit to the popular **Indonesia's** (and **Malaysia's** too) **Taman Mini** (Miniature Park), where a representative sample of the country's varied architectural traditions are physically showcased in a theme-park setting. Another example is the **Window of the World Park in Shenzhen, China**, just north of Hong Kong, where almost all the world's most famous landmarks are similarly re-modelled for a "one-stop" world-tour experience. Several other such miniature parks can be found in France, Holland, and Japan, for example.

In like measure, UNESCO's own distinguished list of **World Heritage Sites** (such as Indonesia's **Borobudur** and **Prambanan** temple-complexes) can be similarly virtually modeled to popularise them to an ill-informed public, thereby generating increased visitor statistics and tourist dollars, part of which may in turn be funnelled into self-sustaining heritage conservation programmes to improve the sites even more in a snowballing virtuous cycle.

An easily portable CD-ROM of such a virtual theme park, if made widely accessible to a worldwide audience, for a "heritage tourism preview experience", can be a powerful advertising and publicity tool for the real monuments themselves. In **China** itself, many architecturally outstanding historic mosques can be better publicised throughout other parts of the Muslim world to attract the heritage lover – for example, the **Great Mosque in Xian**, built in 1392 AD and Beijing's own **Niu Jie Mosque**, built in 1362 AD, to name just two of the many others found throughout the country [Frishman and Khan 1994].

3.2.3 CDs Enclosed in Architecture Publications

To make the study of architecture more instructive, the realtime 3D models can be enclosed on a CD-ROM packaged into the back-covers of architectural books, magazines and other print publications, as for example, in the case of [Novitski and Mitchell 1999], where the models are of buildings of which some no longer exist or are purely imaginary.

3.3 Architectural Network – Indonesia and Worldwide

3.3.1 New Network Being Established

The data compilation method used in the 1999 survey phase – that is, by coordinating with local universities on-site — has indeed opened the opportunity for the emergence of a virtual communications network among Indonesia's institutions of higher learning, one of which, **The Nusantara Architectural Documentation and Publication Foundation**, is currently in the process of being established.

3.3.2 Aga Khan's ArchNet Example

As is commonly known, the information divide and educational facilities between Java and the other islands are very wide indeed. This network, it is hoped, can narrow this divide, by way of providing information, resources and facilities possessed by educational institutions in Java to the other institutions outside Java, such as by operating distance-learning virtual lectures, virtual libraries and databases, as with the fine example of the **Aga Khan Trust for Culture's** (AKTC) digital database, **ArchNet** (www.archnet.org), based at Boston's **Massachusetts Institute of Technology** (MIT), which holds a varied collection of the Muslim world's architectural documentation and image resources made globally accessible to a virtual community of architecture-related professionals, heritage activists/enthusiasts and interested laymen.

3.3.3 Web3D Realtime Collaborative Networks

Although the much-hyped online 3D chat worlds such as *Worlds.com*, *ActiveWorlds.com* and *CyberTown.com* have thus far not measured up to their initial expectations of building expansive cyber-communities across the globe, the concept can still hold great promise for developing specialised communications networks with focused memberships of common-interest groups, such as architects, urban planners and museum professionals and lovers.

Adobe's Atmosphere software (see www.adobe.com), albeit now still in beta stage, can be just such a user-friendly tool for these kinds of collaborative networks spanning large geographical distances, as in Indonesia's case. Web3D online chat functionality can enable communities of architectural and museum enthusiasts to collaborate in realtime with one another in an intuitive 3D world setting so very suited to the "spatial" nature of their everyday work and/or pastime. They can design and build their own online 3D chat worlds in the image of whatever suits their particular individual or group fancy, and having so personalized them, they can then virtually congregate in cyber communes of any chosen size and entry restrictions to pursue collaborative design projects for example, or just purely to socialize.

3.4 Heritage Tourism and Other Architectural Forms

3.4.1 Heritage Tourism and Cultural Objects

Objects which can be documented and published in this manner are not only restricted to architecture. As mentioned in the introductory section, similar projects are also planned to be executed on various artifacts and other cultural objects, such as palaces, temples, or traditional dances, traditional languages, even including children's games. With this, it is hoped that a

community awareness and pride towards its cultural uniqueness would grow – something which often is undermined due to exploitation by an unbridled tourism industry and lack of foresight. It is hoped that the mushrooming of this community pride will be an early step towards a cultural sustainability which is very important in maintaining such tourism industry itself.

The architectural documentation project will thus not be an isolated stand-alone endeavour restricted to only one sphere of human activity, but rather part of a wider spectrum of a total cultural civilisation represented by the particular tourism destination/object.

3.4.2 Banten Lama “Open Museum”

For example, the still-active **Banten Grand Mosque** (fully documented in Masjid2000’s CD, including a virtual 3D walkthrough animation, and other structural analysis features) located about 80 km west of Jakarta is part of a significant archaeological excavation site that has been dubbed an “**Open Museum**” (including the royal palace/tombs/square, artifacts museum, the Dutch’s Fort Speelwijk, Chinese temple, water purification reservoir, other mosques, a religious centre, and others) which, if judiciously restored and conserved, could showcase the total heritage of the **Sultanate of Banten**, once the largest and most important spice trading entrepot in all of Southeast Asia during the 16th and early 17th centuries – rivaling even Amsterdam in size and importance in its heyday [Guillot and Ambary 1990].

A virtual reconstruction based on historical sources, of the old city’s environs within its fortress-wall enclosure, using a realtime 3D game engine, similar to what is sampled/proposed in this paper, complete with an interactive virtual talking tour-guide, would make this tourism destination an even more enriching experience for the local and foreign visitor who would then be better able to appreciate the organic link between the living Banten Grand Mosque and the whole historical legacy of “**Banten Lama**” (**Old Banten**), not just its disjointed parts.

This indeed is our long term hope and aspiration for this and similar future projects.

4. CONCLUSIONS

This project has been single-mindedly motivated with a keen desire to create, using some of the new technologies of the digital age, new heritage “products” and make them easily available to the general public to help cultivate a greater regard for and appreciation of the country’s rich architectural and cultural endowments. The volunteer students and teaching staff who had pioneered the creation of this previously non-existent heritage

“product” and disseminated it to both specialist and ordinary “consumer”, had done so with very limited resources available on hand, and all this done in a youthful country beset with many recent difficulties.

We hope our project experience fits the theme of this Conference and would like to present it as a case study here so that our mutual sharing with this worldwide community of heritage lovers, by way of access to funding resources and new technologies, may enable us to improve what we can continue to offer to our public back home and elsewhere.

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