Abstract – Aging had been a serious problem to centuries old artifacts where they become very vulnerable from damage caused by intensive interaction during studies and research. As the growth of technology in computing, virtual reality concepts were being sought to be an alternative way to preserve ancient manuscripts. Virtual reality is an environment simulated by a computer, in which we graphically make the environment and condition to be the same as the real one. It is constructed as a set of components that can be used either independently or simultaneously to develop applications [1]. For 3D Virtual reality programming, we use Java Language and OpenGL platform. OpenGL (Open Graphics Library) is a standard specification defining a cross-language cross-platform API for writing applications that produce 3D and 2D computer graphics. The interface consists of over 250 different function calls which can be used to draw complex three-dimensional scenes from simple primitives. It is very popular in the video games industry where it competes with Direct3D on Microsoft Windows platforms. OpenGL is widely used in CAD, virtual reality, scientific visualization, information visualization, and video game development [2] In this work we review studies about virtual museum and user experience in virtual environment, and how the interaction with the virtual manuscripts can be made almost exactly as real as opening their virtual copies. With the copies, more people can be brought closer to the manuscripts even to touch and turn pages. In collaboration with a similar project from the University of Sheffield, United Kingdom, we try to use this technology for Indonesian manuscripts while defining a system which can share the virtual copies from both countries in interactive and collaborative way, using grid computing environment.

This paper reviews such issues to be implemented in Indonesian historical artifacts focusing to Javanese manuscripts.

Key words – virtual reality, virtual environment, grid computing, distributed museum, haptics tools, and avatar.

I. INTRODUCTION

Indonesia has been recognized as one of the source or center of the ancient culture and civilization in the world. An example of this fact is Borobudur Temple in Central Java. Presently, there are many valuable ancient manuscripts which teach wisdom and culture of many tribes in Indonesian Archipelago. An example of some preserved Javanese ancient manuscripts is kept in University of Indonesia’s library. People face difficulty or reluctant to read and study the manuscript due to their physical condition. Those ancient manuscripts require an advance information technology approach to preserve and then a user friendly system to introduce them to people around the world. This advance information technology system is hoped to be suitable for the 21st century generation to understand and increase their eagerness to read and study them. That will help to preserve those valuable information and culture. At the Electrical Engineering Department of the University of Indonesia we are currently preparing an implementation study of virtual environment and grid computing as tool to share
applications to enable people around the world to view and study those manuscripts on line and in real-time basis. A series of laboratory study and testing on the application have been started and being tested prior to collaboration with the similar project that is being developed in the University of Sheffield United Kingdom.

This paper reviews the grid-based distributed virtual environment. The virtual environment which will be conducted during this work is aimed at storing real-like 3D (three dimensional) digital copies of Indonesian tribal artifacts, especially manuscripts, which the existences are being harmed by aging. With those copies, human race can preserve the manuscript in digital format with the look and feel of the real manuscripts in a virtual museum. People in the future will still be able to enjoy and feel those artifacts more lively than it does today since the artifacts are now preserved with glass boxes in museums and prohibited to be touched. A similar project is being conducted by Cauchard an Romano [1] at The University of Sheffield, United Kingdom.

The work will be conducted under the collaboration to share the information virtually through grid computing environment. The virtual environments have highly developed nowadays and are found to be very useful in applications from medical usage till gaming and entertainment purposes. Using this virtual environment, our distributed museum will be constructed. The sharing of information for this distributed environment is trusted on grid computing. With this technology, the inherent benefits of the distributed computer power can be completely applied. All of these will be done well by assuming that the networks used are guaranteed to be efficient and secure.

II. VIRTUAL BOOKS AND VIRTUAL MUSEUMS

Aging had been a serious problem to artifacts from centuries where they become very vulnerable from damage caused by intensive interaction during studies and research. As the technology in computing growing extensively during last few years, virtual reality concepts were being sought to be an alternative way to preserve old manuscripts. This paper reviews such issues to be implemented in Indonesian historical artifacts focusing to Javanese manuscripts. Refers to studies about virtual museum and user experiences in virtual environment, the way in interacting with those manuscripts can be made almost exactly real with their virtual copies.

With the copies, more people can be brought closer to the manuscripts even to touch and turn pages. In collaboration with a similar project from the University of Sheffield, United Kingdom, we try to use this technology for Indonesian manuscripts while defining a system which can share virtual copies from both countries in interactive and collaborative way. Technical discussions and communications with Sheffield University of England for collaboration coordination are being actively conducted. An intensive research and collaboration meetings and work will be conducted during summer 2006 at the campus of the University of Indonesia, Depok, Indonesia.
III. GRID COMPUTING AS RESOURCE SHARING TOOLS

The sharing system is based on grid-based application technology which supports the sharing and coordinated use of diverse resources in dynamic virtual organizations from geographically and organizationally distributed components. Globus Toolkit is commonly used in the grid-based application. Globus Toolkit® is an open source program that fundamentally enables technology for the “Grid”, letting people shares computing power, database, and other tools securely online across corporate, institutional, and geographical boundaries without sacrificing local autonomy. The toolkit includes software for security, information infrastructure, resource management, data management, communication, fault detection, and portability. It is constructed as a set of components that can be used either independently or simultaneously to develop applications [1]. For 3D (three dimensional) Virtual reality programming, we use Java Language and OpenGL platform. OpenGL (Open Graphics Library) is a standard specification defining a cross-language cross-platform API for writing applications that produce 2D and 3D computer graphics. The interface consists of over 250 different function calls which can draw complex three-dimensional scenes from simple primitives. It is very popular in the video games industry where it competes with Direct3D on Microsoft Windows platforms (see Direct3D vs. OpenGL). OpenGL is widely used in CAD (Computer Added Design), virtual reality, scientific visualization, information visualization, and video game development [2].

IV. DESIGN OF THE VR

The virtual environment will be built with the generally known OpenGL platform. It is such an open source platform with a low-level graphics library specification from which the museum 3-D environment is created. OpenGL API binds a number of programming languages, and Java will be the one to be used for this project. Java programming language has been widely utilized and known as a reliable language to accommodate programmer requirement.

After defining the graphics, the works continue to prepare a system that translates user’s activity on glove to be used for controlling the graphics. The glove here is a device that can make responses due to user’s hand movements. This kind of devices used in virtual reality application is called haptics.

Figure 3 the 3-D image shown when the page of the book is turned [3].

The figure above depicts a VR condition in what a book opened and the page is being turned. This is an example of the 3-D graphics provided to users when interacting with the book.

Figure 4. The Javanese manuscript sample

Instead of only the book itself, to make this work visually collaborative with other users from the two countries; the graphics is extended to be showed in a room. The room will be the virtual museum where the virtual images of users, called avatars, can walk, interact with the artifacts, and interact with each other.

Figure 4 and figure 5 are pages from the manuscript we are going to use. It is “Serat Jaka Semangun”, a traditional story about a Javanese hero who lived in the time of Mohammad SAW and when Islamic trading spread in Indonesia especially in Java.
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Sheffield University is over a cloud, i.e. internet, so not only the two Universities can use this system, but many people can use system by means of connecting to the cloud. Now, in Indonesia for driving bigger chance to get information in the entire internet. The government has launched research network among universities in Indonesia (inherent project). The network consist one or more universities to be a mirror of the international information therefore with this network the cost for international connection can be reduced and connection among universities in Indonesia will use a backbone of 100Mbps bandwith.

\textbf{VI. Future Work}

According to the plan, a large amount of information will be shared between countries through world wide network. The problem is the way to ensure that the network is fully reliable; desired QoS (Quality of Service) must be defined. Such a configuration may also lead to security issues. The information that are shared not just “high-price” data but also related to a country’s very valuable assets – tribal artifacts. That is why; the sharing system had to be guaranteed to have high security policies.

Despite of the network services, QoE (Quality of Experience) should also become a point to be well implemented. QoE parameters include the characteristics of the sensation, perception, and opinion of people as they interact with the system. This work must produce a system that can be driven by a wide range of users even by a person who is not familiar to computer. It should also be developed to make the environment as lively as possible. In addition to this, to make this project to have bright prospect, its application had to be written in the simplest way possible.

Later on, we plan to enlarge and apply this project to public and to include more arts from more countries to be shared online.

\textbf{VII. Conclusion}

This paper has outlined a project which illustrates an alternative way to view and enjoy ancient artifacts. By making the virtual copies, the real artifacts can still be preserved in their ways, glass boxed, while people

\textbf{V. Design of the Grid Computing Platform}

Grid computing environment has been built in University of Indonesia. It consists of was built on some computer that available at the Computer Science Faculty, the Electrical Engineering Department, and the university IT infrastructure under grid.ui.edu domain. The grid is based on Globus toolkit. It is an open source programs that fundamentally enabling technology for the “Grid”. For interfacing between the application and the grid, we can use many middleware such as AccessGrid, VRML, etc.

![Figure 5 Example of Java Manuscript Handwriting](image)

![Figure 6 Network Plan](image)
enjoying the virtual copies. In addition, this way will allow sharing of the artifacts from other places, i.e., another country. Grid computing enables this feature to be used widely.

The challenges are the way to make this connection efficient, so it will gain QoS expected. It has also to be ensured and easy method of the different of infrastructure and preservation of intellectual property. Arts are not free-to-copy stuffs.

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