1. ABSTRACT

Multimedia Objects, hereunto referred to as MMOs are digitized files in the general category of still image, video and audio formats. Portable MMO formats may be searched, viewed, played and annotated in a Database automatically and conveniently in anyone's local computer that can play the end-role as WebServer. A platform independent Multimedia Assets Management Server will use a portable schema that may run on any backend platform such as Intel_x86 PC, Sun, Mac running on Linux, Solaris, Mac OS, or Windows.

2. SIGNIFICANCE

Multimedia assets management and its Web-based delivery are among the biggest commercial and scientific activity that is currently unfolding over the Internet. The challenge lies in being able to deliver the goods without considering platform dependencies, i.e., to make the system run over a wide range of Hardware and Operating Systems such as Linux, Solaris, Mac Os or Windows.

3. OBJECTIVE

- The main goal is to allow remote web-based users view or play access to these multimedia resources without losing its identity as an intellectual property.
- To develop a platform independent system that shall efficiently & effectively manage multimedia assets kept in a portable central repository such as in a backend SQL database server.
- To develop an easy to install and use Multimedia assets manager server.
- To include the broadest scope of standard "metadata" for MMOs ideally suited to complement the needs of Decision Support Systems and for enhanced quality of presentation and delivery.
- To employ extensively the use of Open Standards and Open Source in the architecture design and development.

4. SOLUTION

Solution presented herein provides the technology and methodology used to address the above problems set in the Objective section.

4.1 Steganography.

Steganography literally means covered writing as derived from Greek. It is related to Cryptography only in purpose but is completely orthogonal in methods.

Cryptography scrambles while steganography hides information. Both can be relied upon when sending secret information. Use of invisible inks, character arrangement and microdots were the common classical ways of practicing steganography. Steganography was not meant to replace cryptography but to complement it.

In myMonet, this will be implemented using a media decoder which produces a data stream that will soon be merged with a digital signature stream and fed to a media/stego encoder that produces the watermarked media object (WMO), see figure 1.

![Figure 1. Depicts how a codec process will merge the original media object with a digital signature](image)

4.2. Java.

The system will be programmed using the Java Programming Language, in all respects possible, to ensure Operating System and Hardware independence. The Java Programming Language in its most recent version known as J2SE 1.4.x is robust and more than sufficient to handle the needs and development requirements of MAMS as an application. It will allow the consistent end-to-end development of this project using a single technology that is Java Only! In addition, it leverages the application with existing Development & Implementation standards that is strongly promoted by J2SE 1.4.

For more information why J2SE 1.4 is the best-of-breed language of choice, please refer to link provided in the reference section:

Related Java Component Packages required by myMonet

- Java Media APIs v.2.1.1
- Advanced Imaging API, Image I/O,
- Media Framework-- see link in reference section
4.2.1. Java Media Framework.³

API (JMF) enables audio, video and other time-based media to be added to Java applications and applets. Support for audio and video media formats are completely dependent on the licensing and legality support that Sun provides for such technologies. Most significant in this issue is MP3 which was made to work only in Windows for the time-being with no Real-time streaming capabilities. Sun however promised to have MP3 back in its JMF API package, once licensing issues are ironed-out. In this regard, the Academic version of myMonet supports MP3 the same way JMF is allowed to use it.

4.3. XML.⁴

Extensible Markup Language is the universal format for structured documents and data on the Web. Evidently, besides HTML, this is the only major Language that is not Java in this application. XML has proven to be versatile as it is now used in many applications such as to hold textual database record, a script, and other design-time and/or run-time information. It is used in ANT as a build-script. It can be used to store GUI object definition that could improve considerably the graphic output render performance such as the way Forte uses it. myMonet uses it to hold design-time database & MMO metadata dictionary, just to cite a few examples.

4.4. HSQL.⁵

As part of the 100% Java objective, Hypersonic SQL, which was written in Java, will be the backend Database platform of choice. At the course of using HSQL, it is believed that all of its potentials have yet to be fully tapped. At this point, only the VARCHAR and INT data types had been used and other promising data types like BLOB, CLOB and DATE had not been used, which was due to time and human-power constraints in developing this Academic version. Taking advantage of such data types may improve the system’s dynamism and processing time performance. So far, the HSQL Server works as a repository for textual metadata information on the Multimedia object in the Filesystem. The JDBC Bridge is used extensively to do SQL DDL & DML Command statements and their execution.

4.6. Netbeans Platform as Framework

Netbeans can be ordinarily an email client or even a mail server. Think of any application, may it be an accounting system, an Enterprise full-cycle ERP or a Web-Commerce site, Netbeans can be anything that you can imagine. It is an understatement to say and think that Netbeans is a multi-awarded Java-based IDE and Tool for Java, C++, etc. Checkout this CAD Coal Mining Software from Minex, w/c uses Netbeans as platform.

Strikingly enough, besides its being highly modular, its developers strictly enforced the use of Open Standards whenever they're made available. Of note, is the wide support for and implementation of XML as a pre-processing design-time and/or run-time Document. It also uses Module Manifest files w/c is based on Java Versioning Specification. CVS/VCS or the Concurrent Versioning System/Versioning Control allows the easy Source Code maintenance, where on the one hand, Developers can upload new codes and on the other, Netbeans extenders can download bleeding-edge copies of those codes. Central to Netbeans architecture uniqueness is the smart use of Nodes (from the Glasgow JavaBeans Spec) which is also an implementation of Xerox’ Model-View-Control paradigm popularized by JFC Swing Components. MVC is described in many J2SE books as well as the Netbeans book, whose link is provided below.

Since, the system will adapt and apply the Open Source and Free Software principles such as GNU General Public License and Sun's Public License, Netbeans firmly belongs to this arena. This will provide myMonet's implementation an overwhelmingly broad resource and depth in "Re-Usable" Object components that can help accelerate the project development. A Java-based OOP Domain such as that of Netbeans is a lucky-to-have priceless entity that will forever change the Development landscape in the years to come. To "Re-invent the wheel" is now likened to being "clue-less" that something else exist elsewhere in the World! What an utter waste of time, effort & resource, it would have been, if Netbeans was missed.

Current Netbeans version used to implement myMonet is Nb3.3.2.

To know more about Netbeans, there is a book⁶ you can download & read from their site.

4.5. J2EE, Tomcat, JSP, Servlet.

Netbeans itself has support for developing J2EE Web Applications thru the JSP/Servlet Module. It provides the Tomcat Application Server as container for Web components to be executed. Please refer to chapter 13 of the Using Netbeans book provided in the link above.

This facility will be used to produce dynamic Web-pages for the Internet-based client of myMonet.

Standards for MMOs.

Meta-data is data about data. As for the case of a Multimedia Information system such as myMonet, there exists representations of MMOs, which are not textually based. These representations consist of portions of images (static visual representations of objects), videos (dynamic visual representation of objects), and audios (aural representations of objects).

In this regard, meta-data is additional data linked to the MMO which provides extra information about the contents of the MMO, the creation of the MMO, or the uses of the MMO.

Example metadata:
- Artist: monet
- Date: 1840
- Location: France
- Title: fair lady
- Comment: not original

Every MMO has a unique well-defined file format. Known file formats supported by myMonet are MPEG, JPEG, GIF, PNG, AIFF, MP3, AU, WAV, & MIDI. Each MMO File Format definitely varies with the way they store media data physically. Theoretically however, all of them follow some kind of a Media Model. Take the case of an Image for instance whose model is depicted below in Figure 5 shows how information is logically structured.

![Image Model](image.png)

**Figure 5. This Image Model is also the same Model used generally by most Media Objects.**

The first part, “Header Data”, is a specific set of private metadata that consists of essential information to decode the image data, such as compression method, image size and additional information required to locate the image data and the other metadata within the file. The second part, “Image Data”, is the binary representation of the encoded raw or compressed image. The last part, “Metadata”, is the public editable metadata which provides additional information that may improve the image presentation considerably plus other vital information on its ownership. The current JPEG standard allows a mechanism to associate and attach a metadata with the image data. It does not however define a standard set of metadata.

While there is no apparent general-purpose standard metadata set that exist and every Media File format designers implements their own metadata set which cannot be directly mapped into one media to another, myMonet proposes this ad-hoc mapping solution that could demonstrate the advantages of having and maintaining Media Specific Metadata Set. Obvious advantages are improved Presentation Interpretation improved Decision Support Systems classification search hits, and information portability.

Diagrams above were taken from the DIG35.pdf whitepaper. It simply shows the proposed process flow and management of an MMO Metadata stored in an XML file.

Meta-data set used in myMonet comes from the following sources of Metadata standards:
- exif, the Japan Electronic Industry Development Association produced a whitepaper called exif-2.1.pdf
- dublin-core meta-data initiative see http://dublincore.org

5. THE SOFTWARE DESIGN

5.1 The Narrative.

The MAMS application programmed in Java can execute the following subsystem that allows to initially build the backend database using a wizard, allows the update of the database using a similar wizard, allows the manual maintenance of the database, allows the use of SQL DDL/DML to manage the database, facility to search, facility to view or play MMOs, Thumbnail presentation view, a Metadata annotation facility and the automatic generation of the default XML pages that activates the Media Web-casting Services.

A completely revolutionary way of exactly doing the above was discovered at the final stages of Research & Design at the duration of Domain-Analysis timeline. This was where and when Netbeans entered into the scene. Discovered with Netbeans are its highly modular extensible/patcheable Modules, many of which perfectly suits this Thesis' design requirements.

The initialization of the backend Database wizard optionally searches recursively a specific folder or the mounted storage devices such as the harddrives CD, DVD, ZIP, etc.
valid MMO files in the general category of image, video, and audio formats. The supported image formats are JPEG, EXIF JPEG, TIFF (amendment: JPEG, GIF, PNG). The supported audio formats are MPEG-3, WAV & MIDI. An embedded distributed SQL ORDBMS programmed in Java (using HSQLDB) shall provide for the backend Database engine. A filename and a folder must be specified for the database storage. A password is required for its first layer of security. The size and quality of the thumbnail must also be selected to determine database functional retrieval performance, quality and space requirements.

To update the database, a wizard can make life easier for providing the facility to do a recursive search of select folders or a select mounted storage device.

Using the thumbnail presentation view and the hierarchical view of folders or categories facilitates the manual maintenance of the database by providing functions such as delete or Modify Metadata annotations. Zoom views and media play can also be made by a mere click of a mouse.

A menu driven, keyword and query facility shall provide efficient location of a leaf or tree of MMOs in a forest full of these.

In the Web Service scene, the default home page in XML, details a dynamic folder of multimedia assets in the general category of image, video, and audio. A menu driven, keyword and query search facility shall be provided for a more thorough listing of Multimedia Assets from the Web Server which will be presented in a tableaux of thumbnails using an Applet. The user may zoom View image, or play the Video or audio using a JMF streaming technology.

5.2 The Actors.

![Figure 7. From the narrative, the following actors were extracted.](image)

The actors enumerated above manifest the simplicity that is the myMonet system design. The webClient refers to individuals in general who would want to view/play MMOs published over the Internet. The workgroupClient with all probability could be a teamMember or an authorized co-worker who would want to use MMO resources within the confines of the Corporate or Enterprise LAN. The owner/administrator is certainly the main end-user and the assumed owner of the MMOs in the Server. Thus the administrative role is an outright privilege which means, he/she can do as he/she pleases w/o restrictions.

5.3 The use-case.

Also from the narrative, the following use-case can easily be extracted. Once again, the apparent simplicity of the use-case list shows that this Academic Version of myMonet as a thesis does not want to appear unexpandable. Matter of fact, its Commercial Production potential is most compelling as it is very encouragingly promising. Detailed in the later of this document are its Commercial use.

5.3 The packages.

The major high-level packages or modules as described from the narrative are:

- javax.media - provides the media player manager and streaming capabilities
- org.myMonet.audio - handles audio media object
- org.myMonet.video - handles video media object
- org.myMonet.image - handles image media object
- org.myMonet.sequel - handles backend SQL server management
- org.myMonet.webies - handles Web Services
- org.myMonet.core - the main myMonet module
- org.netbeans.modules.db - handles the low-level database connectivity and management
- org.hsqldb - the backend SQL Server
5.4 The Deployment Diagram

The traditional MAM infrastructure always consist of a backend Database Server equipped with the highest end of Media hardware technology such as recorders, video adapter, sufficiently large Disk arrays and Controller adapter that can handle and store the best 3D video capture and playback render. The buck however does not end with just having all these top-of-the-line and state-of-the-art equipment, it has to have the best software that can manage efficiently and optimally the hardware and the Media Objects stored in it. Thus, the system is so designed, such that, the Owner/Manager of the system has at its disposal the Filesystem Explorer when it needs to manage the MMO at the Filesystem level or optionally use the DB Explorer module to browse thru the table of MMOs and modify their corresponding metadata, assuming the MMO is already contained in the DB. A middleware that handles Web access and services provides the Search facility and a rich presentation feature for the MMOs.

5.5 The myMonet Architecture

Figure 1 depicts the hierarchical relations of hardware and software resources within myMonet. At the highest level, a computer w/ a chain of drives or disk partitions, even Zips or Jars and CD drives can potentially store hundreds to thousands or more MMOs aggregated in the available storage places. To manage these resources, all that's required is a Java JRE that can load a Java Virtual Machine and the myMonet software implemented over a Netbeans platform. With the myMonet modules pillared by javax.media, org.hsqldb, XML.apache.org, JSP/Servlets/Tomcat and WAR, results to a program that can handle and manage and deploy over the Web these MMOs effectively as designed.

Figure 11 below is a screenshot of myMonet that shows a mounted Filesystem root called mixedMedia in that contains a /video/client1.mpg file. If clicked, a player/viewer screen will be opened for it at the right, and plays the video. Notice the Properties Sheet displayed at the lower left, its been customised to show the filename, rootpath, lastModifiedDate, the Icon, filesize attributes of the Media Object. This same Icon Node can be right clicked, and a menu that provides an option to Insert the MMO into the database may be selected. If selected, a dialog UI will pop to allow the owner/administrator (see the Actors diagram above) to input Annotations and specific Metadata for the MMO.

6. TECHNOLOGIES

- Sun's J2SE, J2EE/JBOSS, Tomcat, JMF2.1, XML covering XMI, DOM, SAX, XSLT, etc.
- Hypersonic SQL Server or any back-end server
- Exif, MPEG-7 and Dublin core.
- Steganography
- Sun's Netbeans 3.3.2 as IDE
- Sun's Netbeans 3.3.2 as Platform

Java J2SE, J2EE, JMF, & Netbeans are productnames & trademarks of Sun Microsystems, Inc.

7. CONCLUSION

MAM is a system capable of acquiring, storing, retrieval, management, and view/play any type of digitized media. MAM has been around for almost a decade, but maturity has yet to be realized as no system has ever come up so close to the ideally complete MAM architecture except "Cinebase™". MAM is said and considered complete if a logger agent module that handles automated metadata authoring thru the use of a voice and face recognition system and many AI-based algorithms becomes an integrated part of the system. This implementation supports such integration but will not be realized until its Commercial Production version. Intelligent Web streaming technologies will also make this product such a compelling system for Commercialization.

To list the potential Commercial establishments that could take advantage of this system, are:

1. The broadcasting and advertising industries for their pre-process and post-production needs.
2. Corporate Websites whose contents need to be continually refreshed and managed.
3. Universities and other learning institutions that provide distance learning and managed media libraries.
4. The Film producers that demands state-of-the-art archiving facility.
5. The Print media. Time.com delivers some of their news thru subscribed video streaming methods.
6. Audio & Video stores
7. National archives
Figure 11. The hierarchy of hardware and software components that comprise the current myMonet version.

Figure 12. A sample screenshot that gives a glimpse how myMonet manages the MMOs at the Filesystem level.
8. REFERENCES

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Disclaimer:

While, myMonet is an Academic Development Version where active coding and construction activities are on-going as of this writing, some solutions described in this documentation may change without prior notice as new technologies and open standards and more efficient solutions become available.

The myMonet code name or alias to this MAMS project is never intended as a final name but rather purposely as a convenient and relaxing name to call and refer to as compared to its longer name, the Multimedia Assets Management Server. The name myMonet may also be not original; but it has a smart metaphoric ring in it, that its adoption as alias was never really hard to swallow. This is because the name actually means my (signifying ownership to MAMS) - MO (Media Objects) – net (Network-centric), and at the same time, the project in its tangible form is an artwork, which is likened to the Artist Monet’s priceless classic artwork.