The Media Art Notation System: Documenting and Preserving Digital/Media Art

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ABSTRACT

This paper proposes a new approach to conceptualizing digital and media art forms. This theoretical approach will be explored through issues raised in the process of creating a formal declarative model (alternately known as a metadata framework, notation system or ontology) for digital and media art. The approach presented and explored here is intended to inform a better understanding of media art forms and to provide a practical descriptive framework that supports their creation, re-creation, documentation and preservation.

Need for a Formal Notation System

Digital and media art forms include, but are not limited to, Internet art, software art and computer-mediated installations, as well as other non-traditional art forms such as conceptual art, installation art, performance art and video. This paper will not define the boundaries of digital and media art but will propose a descriptive framework that centers on digital and related media art forms.

The digital and media art forms listed above have confounded traditional museological approaches to documentation and preservation because of their ephemeral, documentary, technical and multi-part nature and because of the variability and rapid obsolescence of the media formats often used in such works. It is not feasible for the arts community to keep the original equipment and software in working order over the centuries, and industry has no incentive to continue producing old parts or to keep all new equipment backward-compatible indefinitely. Besides, preserving media art as the "original" physical object may be counter-productive, as discussed below. Owing to lack of documentation methods, and thus access, such artworks often are not used in research and instruction. In many cases these art forms were created to contradict and bypass the traditional art world's values and resulting practices. They have been successful to the point of becoming victims of their own volatile intent.

A new way of conceptualizing media art is needed to support documentation and preservation as well as other activities that surround media art. New projects from the artistic, academic and museum communities are being formed to address these needs. This paper is a direct outgrowth and continuation of two such projects, Archiving the Avant Garde [1] and the Variable Media Network [2]. These projects investigate many aspects of media art preservation, including migrating or updating media art works over time or using emulation to run old software on new computers, as tested in the Guggenheim exhibition Seeing Double. This paper will focus on the development of a formal notation system for media art. It is best to begin by introducing the concept of a formal notation system in the context of media art.

Media art is as much performative or behavior-centric as it is artifactual or object-centric. Media art has variable form, much like music. A single musical work can be performed using different instruments or hardware each time. As long as the essential score performed is the same, the musical work itself will be recognizable and retain its integrity. A work by Bach can be performed on a relatively modern piano as well as on a harpsichord, for which many of Bach's works were originally created (in fact these works can be performed on a computer or synthesizer). Even on the piano, we recognize the work and its creator; we consider it to be authentic. The performing arts are not exclusive in their variability; music merely provides a useful and widely understood analogy. Digital media also are inherently variable. Digital media are by definition computational media—that is, media that may be the end result of computational processes or composed of ongoing computational processes. Digital media are beholden to the separation of content from infrastructure, of logical from physical, that is required by the theory of a "universal machine." A universal machine is a machine whose in-

Fig. 1. The conceptual model of MANS outlining the structure of a score.

Corresponding DIDL XML elements are indicated in <BRACKETS>.

Score: *xml metadata about document itself*
<DIDL>
Descriptor: *descriptive data about score document*
<DESCRIPTOR>
Work: *logical media art work or project*
<CONTAINER>
Descriptor: *descriptive data about work or project*
<DESCRIPTOR>
Version: *an occurrence/state/ account of work*
<ITEM>
Part (optional): *logical sub-component*
<ITEM>
Choice (optional): *variables affecting configuration*
<CHOICE>
Resource: *physical or digital components*
<RESOURCE>

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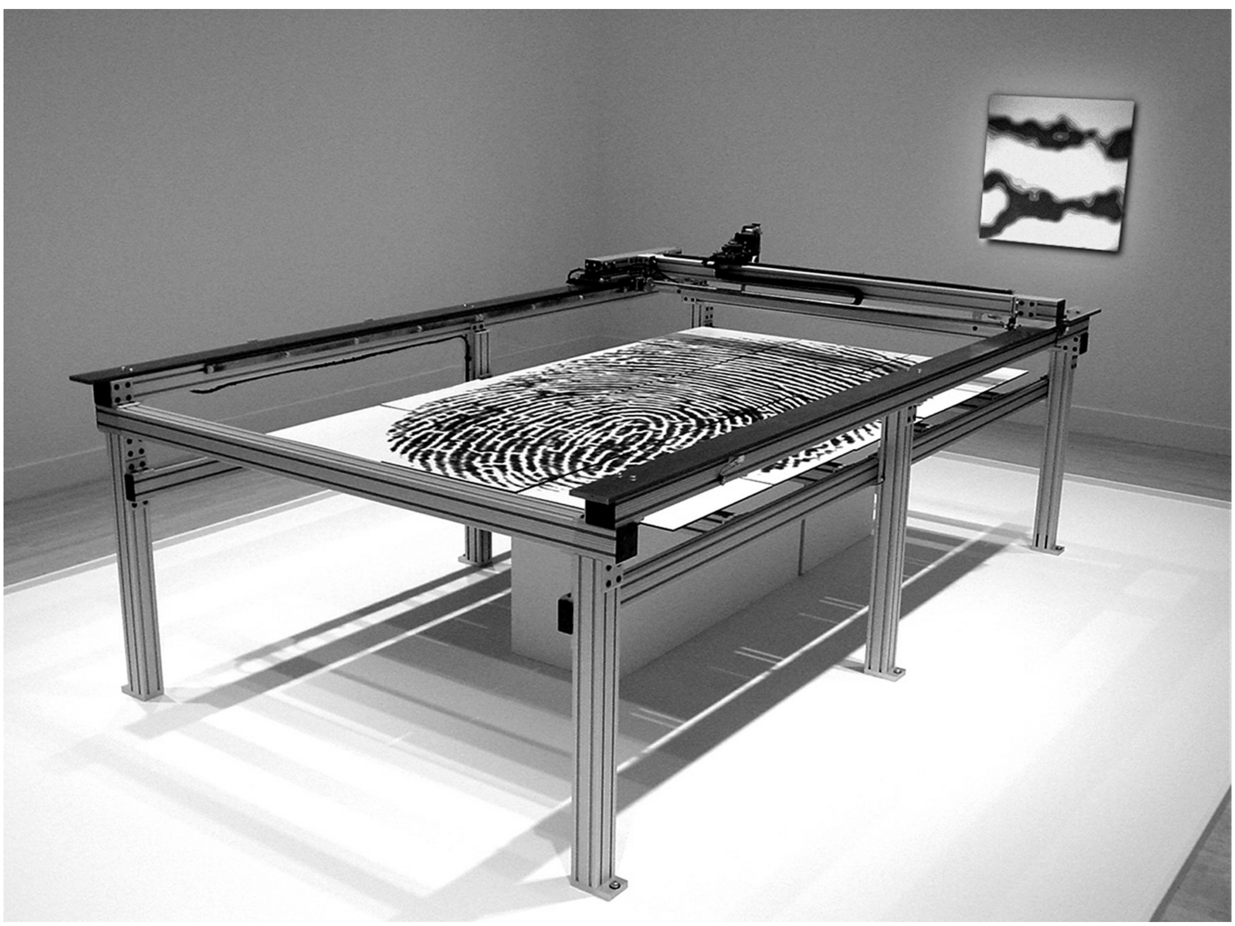
frastructure may be reprogrammed to work with and produce almost infinite varieties of content—a computer. Computation may manifest physically, but it is not tied to any specific physical instance. In practice, digital artworks may be authored on one brand of computer hardware and software platform, but presented under a different configuration. For works of Internet art, aspects such as color, scale and speed can vary significantly when viewed on different monitors over different network speeds. This variability is not considered corruptive but rather an inherent property of the medium and the work. Digital and related media art will almost certainly use different hardware for presentation a hundred years from now, but can still be considered authentic.

Given the similar variability of music and media arts, it is appropriate to consider a mechanism like a score for maintaining the integrity of media artworks, apart from specific instruments. What would a score for media art look like? For digital art, code acts as a kind of score—a set of instructions that trigger actions or events. However, this level of instruction is often too environment-specific, operating differently under variable conditions such as operating system or hardware. This would be like musical notation working for one brand of tuba but not another. A system of formal notation for media art should be abstracted from specific environmental factors. It should be robust, generic, adaptable and portable —universal content for a universal machine. A formal notation system must also accommodate media art works that are not necessarily digital, and it should be legible well into the future independent of the media it is intended to preserve. For these reasons, we cannot count on computer code to be a self-documenting notation system for artworks.

It is important to note that systems of formal notation for media art and musical scores are analogous, but not identical. Musical scores embody admittedly complex relationships to the works they transcribe and are often open to a wide range of interpretation. The reason that musical scores provide a useful model for media art notation is that they provide the clearest example of description that compiles formalized (systematic) discrete elements into documents that aid in the re-performance or re-creation of works of art. Musical scores also demonstrate how to navigate the border between prescription (maintaining the integrity of the work) and the variability that is inherent in media art. Formal notation systems necessarily embody trade-offs in their level of abstraction: if too abstract they lack capacity for integrity, if too prescriptive they lack portability and robustness. So, a media art score would share the goal of a musical score to provide not the perfect recipe, but the best possible one.

Fig. 2. Richard Rinehart and Shawn Brixey, *Chimera Obscura*, anodized aluminum telerobotic artwork, 8 × 10 ft, 2000. (© Richard Rinehart and Shawn Brixey. Photo: Shawn Brixey.) Like a musical work by Bach, this artwork may be re-created in the future using new "instruments": new mechanical parts for the installed robot, new software to activate the robot, and new software to create the Internet interface that lets visitors control the robot. However, if the work is described in detail using MANS, these re-creations will be guided by parameters established by the artists at the time the work is collected. In some instances, these parameters define the specific functionality of elements of the work; in others, they define the look and feel of the re-created element.



The development of a system of formal notation for media art first requires the development of a conceptual model. The formal notation system could be considered an expression of that model. A score is a specific instance of notation. In music, the conceptual model structures sound into pitch and rhythm, etc.; the notation system is composed of notes and other graphics used to write music; and a score is a specific combination of notes in a musical work. It is important to note that the conceptual model and expression format are distinct entities. For instance, a conceptual model for media art could be expressed using various formats such as Extensible Markup Language (XML) [3], formats built upon XML such as RDF, or in a database. In this way the conceptual model itself defines the integrity of the score while allowing for variability in its expression. The conceptual model could be considered a kind of meta-score.

Digital and media art forms have confounded traditional museological approaches

This new conceptual model and notation system could be used to aid in preservation of media art works, for their re-creation in the future; as a documentation format, as an architecture for media art management databases, as a framework for on-line public access catalogs of media art, for educational and community forums dedicated to media art, or as a framework for generative and collaborative artist networks such as the Pool at the University of Maine [4]. For the semantic web community, this conceptual model and expression format constitute an ontology. For the digital library and broader cultural informatics communities, it composes a metadata framework. For our purposes here, it is a system of formal notation for scoring works of digital and media art.

Requirements for a Formal Notation System

The first requirement of a system of formal notation for scoring works of media art is that it be appropriate to the content and purposes it is intended to serve. In this context, it must reflect the nature of media art. It must be able to describe the artwork not just as an object or collection of objects, but also as an event or activity (or any combination of these). It must accommodate not just the declaration and location of files and objects, but also the explicit declaration of behaviors, variables and contingencies. This formal notation system may not describe the artistic process per se, but should be able to describe the work as a set of parameters manifested as a product or occurrence. It should describe levels of agency and choice within the work, allowing for a continuum of assignable human or automated roles from creator to user.

A specific document instance of the notation system—a score—should constitute a guide to aid in the re-creation or re-performance of the work. A formal notation system must be capable of describing all-digital, all-physical or hybrid artworks. Many media artworks combine digital with physical components, and the descriptive needs of discrete digital and non-traditional physical works are similar enough to justify an integrated notation system. Such a system should be able not just to describe the aggregate work, but also to make explicit the structure of sub-components of the work. Details such as technical data, creator information, rights information and related choices may vary between different parts of a work.

A notation system should provide broad interoperability with other descriptive and technical standards that digital media art interacts with, including cultural informatics, library and museum standards, and media industry standards. There are many prototype standards (several based on XML/RDF) being tested in the museum and library communities for managing and providing on-line access to cultural materials such as books and artworks. A notation system for media art is distinct from these in that it needs to include the level of detail necessary not just to describe the works but to recreate them. However, interoperability with these other prototype standards is needed so that documentation for media artworks does not remain marginalized but instead can easily coexist alongside traditional art documentation within larger databases or systems. Although standardized, the notation system should be flexible enough to allow for local descriptive practices within the overall framework.

The notation system should employ an expression format that is standardized so that the development of software tools, training, documentation and support are feasible for the arts community and leverage larger community or industry efforts. To allow durable and transparent scores, the notation system should integrate both human-readable (natural language) layers that allow high-level functionality and machine-readable (artificial/encoded language) layers that allow for automated processing. A notation system should be practical, cost-effective, scaleable and tractable. It should allow varying levels of implementation, from minimal scores to complex scores that are expanded upon at various points in the life cycle of the work. Addressing these concerns results in a more useful and accurate conceptual model by addressing media artworks not as abstract and isolated entities, but rather as entities in the complicated context of the real world.

Survey of Related Work

In addition to the aforementioned projects this paper builds upon, other projects share similar goals or subject matter. This overview of related work is not comprehensive, but cites projects that have the closest parallel or influence on this paper. This survey will draw out the similarities and differences between approaches for comparison.

The PANIC Project

Jane Hunter and Sharmin Choudhury of the Distributed Systems Technology Center in Brisbane, Australia, present their research on Preservation and Archival of New Media and Interactive Collections (PANIC) in "Implementing Preservation Strategies for Complex Multimedia Objects" [5]. "The goal is to investigate alternative approaches to the archival and preservation of mixed media objects and determine the optimum approaches for ensuring their longevity and to facilitate their redisplay."

Hunter and Choudhury outline a solid strategy in many respects. They promote the use of existing standardized metadata schema that leverage previous cultural and industry efforts. These standards include Metadata Encoding and Transmission Standard (METS) for descriptive metadata [6] and the Synchronized Multimedia Integration Language (SMIL) for structural metadata [7]. They also propose a layered preservation strategy that accounts for uneven availability of documentation, metadata and original files for media objects.

It is difficult, however, to encode the structure of a work in SMIL without manually re-creating the work entirely. SMIL is not scaleable because one cannot create an outline of the work's structure to be completed at a later date. Hunter and Choudhury recommend the use of several "behaviors" (such as networked or installed) that have been defined previously in the Variable Media Network as "types" or broad genre classifications for whole media artworks. These types might be even more useful if applied to relevant sub-components of works. For instance, a telerobotic artwork might be installed, networked and encoded all at the same time. To re-create the work, it would be essential to know which parts were networked and which encoded.

PANIC points out the real need for software tools for preserving media objects. Tools are an important consideration because without tools and other mechanisms for implementing our conceptual models, we are left with far fewer options for testing these models.

Capturing Unstable Media Conceptual Model (CMCM)

The V2 organization in Rotterdam, the Netherlands, has developed CMCM. V2 "has conducted research on the documentation aspects of the preservation of electronic art activities—or *Capturing Unstable Media*—an approach between archiving and preservation. . . . Defining strategies for collecting and preserving actual works is outside the scope of this research project" [8]. CMCM is not intended for preservation per se, but as a conceptual model for documenting and describing art projects. Nonetheless, CMCM is a rich model with multiple potential applications and influences, preservation among them. CMCM has identified a goal of interoperability that goes beyond crosswalks (comparison and mapping). CMCM could potentially be used in combination with other models such as the one described in this paper.

CMCM recognizes the importance of collaboration and distributed authorship in media art. CMCM accommodates this by defining a list of creative roles such as choreographer and visual designer, meant to act like the semi-standardized set of roles described in film credits. CMCM has similarly detailed lists of technical behaviors, dependencies and relationships, project component types and more. Most of these lists embody crucial recognition of factors absent in traditional art descriptive standards, but as implementable strategies they reflect the tension between sophistication and tractability in conceptual modeling. A conceptual model for media art should allow detailed description at very granular levels, but should not necessarily require it. The level of granularity evident in CMCM points to its sophisticated grasp of the complexities of media art, but may ultimately make the model difficult to implement and test. Moreover, the defined lists of possible creator roles, user interactions and such may be too prescriptive in the context of media art, where new forms of interaction and relationships are formed at a rapid pace. CMCM would benefit from clear guidelines that define high-level simple application and low-level granular usage.

CMCM includes description of certain intents and parameters in the form of user interactions. Audience interaction with media art works can be described explicitly using CMCM, but other types of intents and parameters are included only implicitly. These other parameters include choices the artist or others might make in re-creating the work or environmental variables that presenters of the work must navigate. Ideally, these creator parameters would be explicit and thus durable as well.

Digital Music Library Data Model Specification Version 2

The Indiana University Digital Music Library project aims to establish a digital music library testbed system containing music in a variety of formats, involving research and development in the

Fig. 3. A sample portion of a MANS document describing *Chimera Obscura* (Fig. 1) [18].

```
<CONTAINER>
<!–This element represents the logical Work or project as a whole. Note that descriptive
metadata elements are repeatable as there may be several creators, versions, subjects,
applicable types, etc. –>
    <DESCRIPTOR>
        <STATEMENT TYPE="urn:mpeg:mpeg21:did/statement-types/text/xml">
            <dc:title>Chimera Obscura</dc:title>
            <dc:date>2000</dc:date>
            <dc:creator>Richard Rinehart</dc:creator>
            <dc:creator>Shawn Brixey</dc:creator>
            <dc:contributor>Jesse Rankin</dc:contributor>
            <dc:subject>Genetics</dc:subject>
            <dc:subject>Genomics</dc:subject>
            <dc:type>Installed</dc:type>
            <dc:type>Encoded</dc:type>
            <dc:type>Performed</dc:type>
            <dc:type>Duplicated</dc:type>
            <dc:type>Networked</dc:type>
            <dc:format.extent>8 by 10 feet, largest component</dc:format.extent>
            <dc:publisher>The artists</dc:publisher>
            <dc:language>English</dc:language>
            <dc:identification.location>University of Washington Library
            </dc:identification.location>
            <dc:relation.version>2000, Seattle</dc:relation.version>
            <dc:relation.version>2003, Berkeley</dc:relation.version>
            <dc:rights>All rights the artists</dc:rights>
        </STATEMENT>
    </DESCRIPTOR>
    <ITEM>
        <DESCRIPTOR>
        <!–This section includes a picture and caption that represent the Work. –>
            <COMPONENT>
                <RESOURCE REF=
                "http://www.coyoteyip.com/project_archive/chimera/
                rinehart_chimera3.jpg" TYPE="image/jpeg"/>
                <DESCRIPTOR>
                Completed robot installed Henry Art Gallery, Seattle, 2000
                </DESCRIPTOR>
             </COMPONENT>
        </DESCRIPTOR>
```

> areas of system architecture, metadata standards, component-based application architecture, network services and intellectual property rights [9].

This data model is in part based on the Functional Requirements for Bibliographic Records (FRBR). In the Digital Music model, "a single musical work can be manifested in a range of physical formats" [10]. Like FRBR, the Digital Music Library Data Model clearly separates the logical work from its various manifestations or physical expressions. Despite the domain origin of the Digital Music Library Data Model, this model may describe a score as a component of a musical work, but does not itself function as a score for re-creating the work. Thus this model holds a slightly different position in relation to the work itself than is desired for a media art score.

Expression Format for a Formal Notation System

The next question is how to express, or write out, a conceptual model for media art that is analogous to the way that musical notation is used to write out music. It is no coincidence that all of the related projects surveyed above utilize XML as the syntactical expression format for their conceptual models. In addition to being widely documented and used in numerous domains and communities, XML supports two important aforementioned requirements for a formal notation system for media art.

XML is standardized in the sense that the specification is not proprietarily owned by any private interest. An equally important aspect of XML is that, as a standard, it is not dependent on any particular hardware or software environment. Adoption of XML endows benefits of standardization, increased interoperability and durability for preservation. XML also meets the requirement of transparency. It offers support for high-level meaning to be included as natural language text that is human-readable with minimum interpretation or processing. At the same time, XML supports multimedia and machine-readable "hooks" that aid in computer-mediated processing and use of the content.

For the purposes of developing a formal notation system for media art, it is logical to pursue XML as a baseline expression format. It bears mentioning again that the overarching conceptual model for media art may also be expressed in other ways, such as a database, but that XML constitutes the default and preferred expression format.

XML is a standardized syntax, but it does not define what that syntax is used to construct. Domain-specific communities are left to define the structures (schemata) they want to build using XML. One schema may be used to describe car parts and another used to describe art objects. If an XML schema obtains consensus within a significantly large community, then it becomes a de facto standard of its own. It is preferable to adapt rather than invent an XML schema for reasons of interoperability and leveraging the efforts of entire communities. Following is a description of one such schema that warrants investigation as the potential basis for a formal notation system for media art.

Basis for a Formal Notation System

MPEG-21 is part of the MPEG family of standards that includes the familiar MPEG video format standards. Here we are concerned with MPEG-21 Digital Item Declaration, a documentation standard.

> The purpose of the Digital Item Declaration (DID) specification is to describe a set of abstract terms and concepts to form a useful model for defining Digital Items. Within this model, a Digital Item is the digital representation of "a work," and as such, it is the thing that is acted upon (managed, described, exchanged, collected, etc.) within the model. The goal of this model is to be as flexible and general as possible, while providing for the "hooks" that enable higher level functionality [11].

The DID conceptual model is expressed using an XML/RDF schema, the Digital Item Declaration Language (DIDL).

DIDL may be used to describe many types of digital items, from games to artworks. The very open conceptual model of DIDL defines abstract elements (such as "container," "item" and "component") that may be mapped to domain-specific meanings for artworks. This flexibility and descriptive extensibility is one reason the Los Alamos National Laboratory adopted DIDL as the building block for its digital library [12]. DIDL supports description of multi-component works and explicit description of complex decision-tree–like groupings of choices and conditions related to a work. In many XML schemata, description of "interactivity" assumes and supports an invisible barrier that separates creator from user and often structurally limits users to trivial navigation or selection actions. Instead of "interactivity," DIDL describes "choices" without limiting who or what makes those choices. DIDL does not structurally differentiate the choices made by creators from those made by presenters or audiences. This allows agency to assume the form of a smooth continuum that stretches between creator and user and suits the description of highly interactive works, distributed authorship and even open-ended collaborative projects and systems.

DIDL is supported by a large and diverse media and technology industry. This allows for a large enough economic base to ensure the development of cheap and plentiful tools and means of implementing DIDL. Description of physical assets or resources is required to accurately describe many hybrid media art works, and DIDL accommodates description of both digital and physical primary assets at the same level (as components of the same work).

At first glance, consideration of a media industry standard like MPEG-21/DIDL for adaptation as a media art formal notation system might seem awkward. However, the tradition of the arts (especially media arts) borrowing and adapting from applied sciences is well established. As far back as the 16th century, while developing the Western system of musical notation, scholars adopted the alchemical visual symbols for gold and silver to represent perfect and imperfect tempus [13]. The critical factor in favor of DIDL is that it is generic enough to accommodate domain-specific adaptation and extension. Among the various domain-specific XML schema, DIDL meets the most requirements for a formal media art notation system and seems the best choice to test and build upon.

Presenting the Media Art Notation System v1.0

What follows is a definition of the conceptual model and expression format that make up the Media Art Notation System (MANS). I developed MANS with the consultation and review of project collaborators. The MANS conceptual model is not the same as the MPEG-21 DID model, but is close enough that they both use the DIDL XML schema as their preferred expression format. MANS defines a set of usage guidelines, as discussed below, that creates a new "flavor" of DIDL tailored for the art world. Figure 1 shows an outline description of core concepts of the MANS conceptual model. These core concepts form a "broad-strokes" description of the work. This broad description could be formed by the artist or museum at the time the work is created or collected. Further details, alternate accounts and audience annotations could be filled in later in the life of the work.

The elements in Fig. 1 may be repeated as necessary. For instance, one Work may have several Versions, and one Version may have multiple Parts. In this model, variability necessary for preservation and re-creation (such as replacing dysfunctional files or objects with new ones) will most likely occur at the lower levels of Parts and Resources while higher levels of the model maintain the integrity of the work.

Descriptive Metadata in MANS

The cataloging, wall label or "tombstone data" that makes up the descriptive metadata in most traditional art contexts may not provide the most useful description of media art works. For instance, complex multi-component works, highly collaborative works with numerous authors over time, works that re-configure over time, or works with complex technical descriptions are not well accommodated in traditional art description systems. In "Death by Wall Label" [14], Jon Ippolito writes, "Wall labels are the pins that fix the butterflies of new media to museum walls." MANS attempts to provide more appropriate descriptive metadata and a way to map MANS descriptive practice to more traditionally oriented museum or library descriptive practices and standards. MANS adapts and extends another standard, the Dublin Core (DC) [15], as the formal expression of descriptive metadata within a MANS score. The DC was developed by cultural agencies and industry to describe digital documents but has since been adapted to describe art objects and other cultural artifacts. While the conceptual model illustrated in Fig. 1 outlines the structure of the media artwork (structural metadata), the following elements provide descriptive details (descriptive metadata) about the work. These elements could be used to describe any level of the work, from a whole project to a specific part.

Descriptive Metadata Elements of MANS

Name: Type
Definition: Genre or classification of a Work or Part of a Work, taken from the Variable Media Network list of behaviors.
XML: <dc:type>

Name: Date
Definition: Date of first creation or occurrence of a Work or Part. If multiple dates are listed, then the first should be the date of creation. Other dates could be important milestones in the life of the Work that are spelled out in the larger structure.
XML: <dc:date>

Name: Title
Definition: A name given to a Work or Part. First instance of which is the primary title. Repeats may include alternate or past titles.
XML: <dc:title>

Name: Measurements
Definition: Dimension, duration, file size, or other measurement applied to the Work or Part.
XML: <dc:format.extent>

Name: Subject
Definition: That which is depicted in the Work or Part or important concepts, places, people, or things associated with work that may serve as intellectual access points. Keywords.
XML: <dc:subject>

Name: Creator
Definition: An entity or entities primarily responsible for making the Work.
XML: <dc:creator>

Name: Contributor
Definition: An entity or entities responsible for making contributions to the content of the Work or who are secondarily responsible for making the Work.
XML: <dc:contributor>

Name: Host
Definition: Owner or steward of the Work. The permanent owner of the Work should not to be confused with temporary presenters of the Work. Being duplicable, digital art may be collected by multiple owners. Unlike traditional art descriptive schemas, MANS allows the identification of multiple owners of the work.
XML: <dc:publisher>

Name: Identification
Definition: An unambiguous reference to the Work within a given context.
XML: <dc:identification.number>

Name: Version
Definition: Identification of an instance or occurrence of the Work.
XML: <dc:relation.version>

Table 1. "Crosswalk," or mapping, of MANS core concept elements to other conceptual models for structured digital or media art objects: MPEG-21 Digital Item Declaration Language (DIDL) and Capturing Unstable Media Conceptual Model (CMCM). Note: This crosswalk includes only selected high-level conceptual elements, and does not include, for instance, descriptive metadata elements (Table 2).

MANS	MPEG-21/DIDL	CMCM
score	<didl>	
work	<container>	project
version	<item>	occurrence
part	<item><item>	component
descriptor	<descriptor>	document
choice	<choice>	interaction
condition	<condition>	
annotation	<annotation>	
resource	<resource>	component.x

Table 2. Crosswalk of MANS descriptive metadata to other descriptive metadata standards used in the library and museum communities: Dublin Core (DC) and the Getty's Categories for Descriptions of Works of Art (CDWA). Note: This crosswalk includes only descriptive metadata elements, not all the elements that compose MANS (such as core concept elements; see Table 1).

MANS	DC	CDWA
creator	creator	creation-creator
title	title	title
type	type	object/work-type
date	date	creation-date
measurements	format.extent	measurements
subject	subject	subject matter
contributor	contributor	
host	publisher	ownership-owner
identification	identification.number	repository number
language	language	
version	relation.version	state
location	identification.location	current location
authorization	rights	copyright/restrict

Name: Language
Definition: A natural language of the intellectual content of the resource.
XML: <dc:language>

Name: Location
Definition: The current physical or logical location of the Work or Part.
XML: <dc:identification.location>

Name: Authorization
Definition: Statement about authority to re-create, configure, access, verify, represent, depict, or otherwise use Work or Part.
XML: <dc:rights>

Figure 2 depicts *Chimera Obscura,* a media artwork that looks at the theme of human genomics. The work includes a telematic robot, streaming video and interactive web controls. Figure 3 illustrates a portion of a MANS score in XML describing *Chimera Obscura.* Table 1 presents a mapping between MANS and other structural models for describing art, while Table 2 presents a mapping between the descriptive model of MANS and other description standards.

Conclusion

The Media Art Notation System has three levels of implementation progressing from simple to more complex. These levels qualitatively change the nature and function of the resulting Score. The first and simplest level of implementation would be a short, simple Score that is mainly composed of high-level descriptive metadata and minimal XML markup. This would create a Score that serves as a record of the Work. The second level of implementation would include more granular description of sub-component parts expressed structurally through XML markup and more Descriptors containing text, images and other media that document the Work. This would create a machine-processible Score that functions as a representation of the Work. The third level of implementation would include technical metadata, Choices that model every behavior of the Work, very granular description and structural markup to the level of individual Resources and inline bitstreams or linked source files that comprise the Work itself. This would create a machine-processible Score that would function as a working model or manifestation of the Work (or partial manifestation for hybrid physical/digital Works).

The Media Art Notation System allows one to grow from the first and simplest implementation toward the third level of implementation over time. A realistic near-term scenario is that Scores created using MANS would serve as guides for people to re-create or re-perform a Work for an exhibition. These Scores need not initially include sophisticated functionality (inline original bitstreams activated by emulators for instance [16]), but they could easily include links from Resource descriptions to original media files and applications. In this way the MANS Score would represent a media-independent logical backbone for the Work that relies on the original files to provide detailed functionality and appearance. This feasible level of implementation would create an interoperable record of the Work, a guide to re-creation, and a way to maintain the integrity and cohesion of complex works into the future.

MANS is one of a handful of proposed conceptual models and expression formats that could be used to describe, investigate and utilize media art. It remains to artists, museums and others who make up the cultural informatics community to critique, refine, integrate and test such models on actual artworks in real-world environments. It is my hope that MANS will make a useful contribution to the field, aiding practical but urgent activities such as preservation and furthering rigorous investigation into the nature of media and art. It is clear that in these efforts there is no one silver-bullet solution. Reflecting the fragmentary, dynamic nature of media art works themselves, solutions will come in the form of interpenetrating clouds of conceptual models, multi-layered implementations, argument and collaboration [17].

References and Notes

1. Archiving the Avant Garde, <www.bampfa.berkeley.edu/ciao/avant_garde.html>.

2. Variable Media Network, <www.variablemedia.net>.

3. Extensible Markup Language, <www.w3.org/XML/>.

4. The Pool, <http://river.asap.um.maine.edu/~jon/pool/splash.html>.

5. Sharmin Choudhury and Jane Hunter, "Implementing Preservation Strategies for Complex Multimedia Objects," <http://metadata.net/newmedia/Papers/ECDL2003_paper.pdf>.

6. Metadata Encoding and Transmission Standard, <www.loc.gov/mets>.

7. Synchronized Multimedia Integration Language, <www.w3.org/AudioVideo/>.

8. Capturing Unstable Media, <www.v2.nl/Projects/capturing/>.

9. "Digital Music Library Data Model Specification V2," <www.dml.indiana.edu/pdf/DML-DataModel-V2.pdf>.

10. Functional Requirements for Bibliographic Records, <www.ifla.org/VII/s13/frbr/frbr.pdf>.

11. "MPEG-21 Digital Item Declaration WD (v2.0)," <http://xml.coverpages.org/MPEG21-WG-11-N3971-200103.pdf>.

12. Jeroen Bekaert et al., "Using MPEG-21 DIDL to Represent Complex Digital Objects in the Los Alamos National Laboratory Digital Library," <www.dlib.org/dlib/november03/bekaert/11bekaert.html>.

13. Gabriella F. Scelta, "The History and Evolution of the Musical Symbol," <www.intelligirldesign.com/literature/musicsymbol.pdf>.

14. Jon Ippolito, "Death by Wall Label," in Christiane Paul, ed., *Presenting New Media,* forthcoming (Berkeley, CA: University of California Press, 2007).

15. Dublin Core, <www.dublincore.org>.

16. Myriam Amielh and Sylvain Devillers, "Bitstream Syntax Description Language: Application of XML-Schema to Multimedia Content Adaptation," <www.unizh.ch/home/mazzo/reports/www11conf/papers/334/>.

17. Expanded notes and appendices for this paper can be found on-line at <http://bampfa.berkeley.edu/ciao/avant_garde.html>.

18. For the complete MANS document describing the work *Chimera Obscura* (Fig. 1), see <www.bampfa.berkeley.edu/about_bampfa/formalnotation_apndx.pdf>.

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